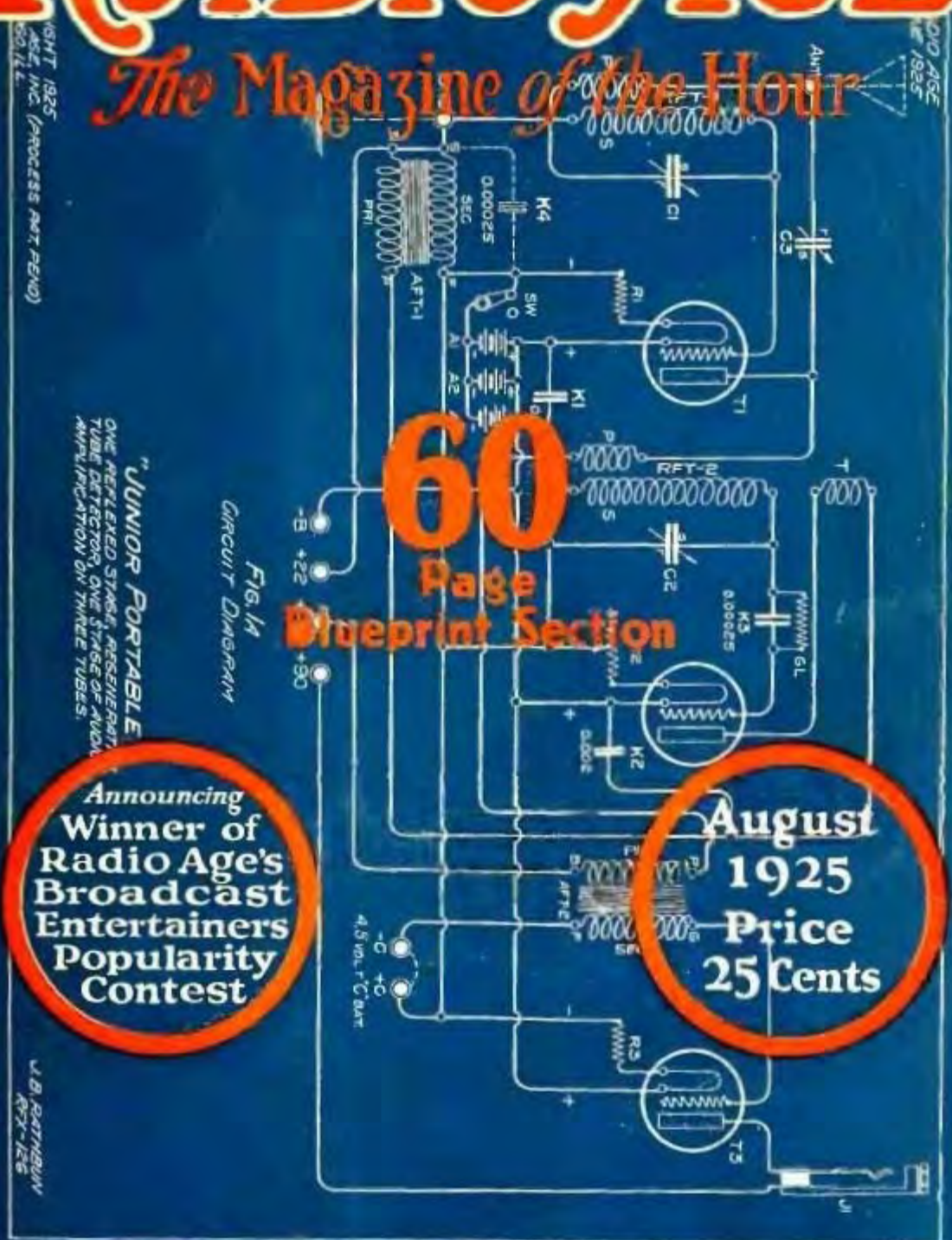
RADIO AGE

The Magazine of the Hour



60 Page Blueprint Section

Announcing
Winner of Radio Age's Broadcast Entertainers Popularity Contest

August 1925
Price 25 Cents

RADIO'S BIGGEST ROUND-UP OF HOOK-UPS

Is The "ANNUAL" on your Summer List?

IF YOU intend to take a trip this Summer, you're surely going to keep in touch with Radio, either by bringing a set along or building one during the dull afternoons, from parts you can take with you.

AND how are you going to build this set or study up on radio for the big season that is bound to come in September?

The answer is simple. All you have to do is to invest ONE DOLLAR in a RADIO AGE ANNUAL for 1925, the world's most complete and authoritative hookup book, and take it with you, whether you go to Eagle River or the River of Doubt.

Let the ANNUAL for 1925 be your Radio Companion this Summer! It will tell you whatever you want to know in the radio line—from troubleshooting of the little faults that may develop far from home—to the actual construction of simple portable sets or elaborate multi-tubers.

GET THE ANNUAL NOW—and THEN go on your vacation! It will be your radio safeguard!

A Big Blueprint Section for your Dollar!

How many blueprints could you buy for a dollar if you started out to buy them, one by one? Very few, you'll admit. Yet in the RADIO AGE ANNUAL for 1925 you'll find sixteen full pages of blueprints in actual color, explaining concisely every important simple and complicated hookup developed during the past year! The 32-page blueprint section of the ANNUAL is worth many times the purchase price of the book alone. Order the ANNUAL NOW—for the limited first edition is rapidly being bought up by eager radio enthusiasts.

$1.00 a Copy

RADIO AGE ANNUAL FOR 1925

$1.00 a Copy

Some of the Features

How to read and understand hookups.
How to understand radio phenomena.
Building your first simple set.
How to select the right receiver.
Substituting a tube for a crystal—building the first tube set.
How to amplify any kind of set.
Making a reflex set.
Building your first Reinartz set.
The renowned Baby Heterodyne No. 1.
Adding audio and radio stages to the Baby Het.
How to make a battery charger.
How to make a loud speaker.
RADIO AGE ANNUAL BLUEPRINT SECTION with such pular hookups as the aperiodic variometer, loop sets, feedback receivers, neutrodynes, reflex hookups, Baby Het No. 2, a Wonder Super-Het, and others.
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How to make an amplifying unit.
How to recognize and deal with every kind of tube trouble.
Another super-heterodyne for the super experimenters.
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Improving the ever popular Reinartz.
AND MANY OTHER UP-TO-THE-MINUTE HOOKUPS AND ARTICLES.

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RADIO AGE, INC.,
500 North Dearborn St., Chicago, Ill.

Gentlemen: I want to be one of the first to get the RADIO AGE ANNUAL FOR 1925. Enclosed find $1.00. If I am not satisfied with the ANNUAL I will return it within five days and you will refund my dollar.

Name.....

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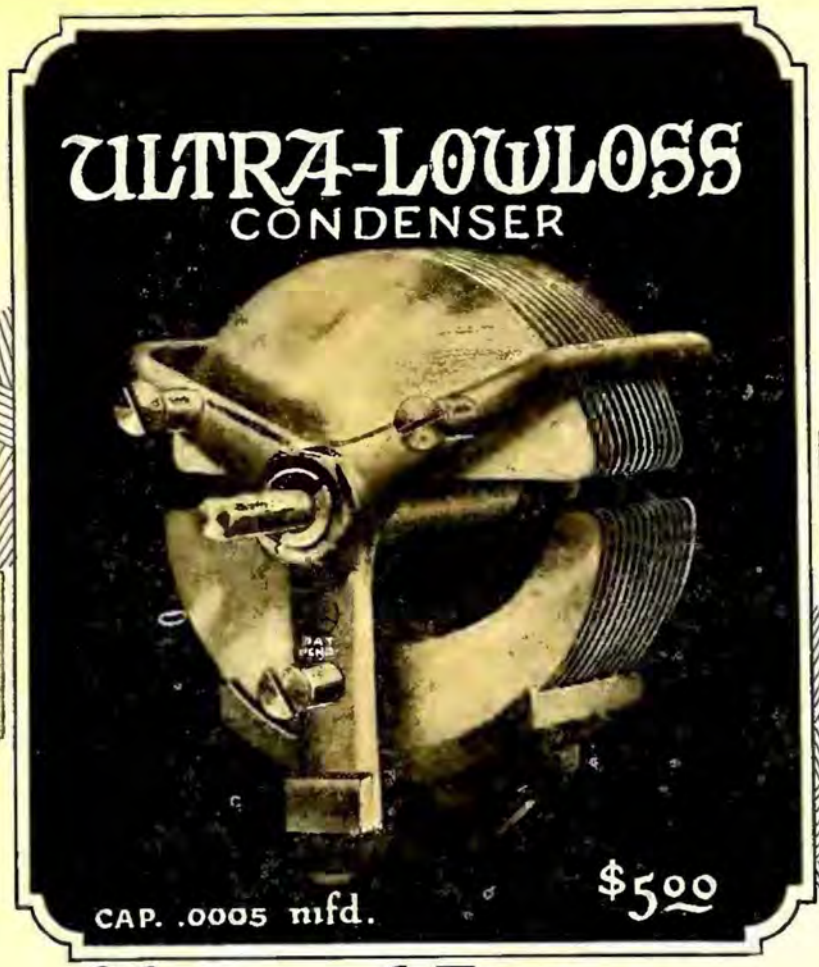
7-25



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IN less than six months the Ultra-Lowloss Condenser has proved its right to leadership by greatly simplified design, greater tuning efficiency, and radically different operating results —not only in the eyes of scientific and engineering men, but with the buying public as well.

These are the predominating Ultra-Lowloss features: (1) Single insulation strip reduces leakage losses materially, (2) Monoblock mounting with plates cast into block reduces series resistance and assures positive contact, (3) Minimum of metal of high resistance material in the field and frame reduces eddy current losses, (4) Cutlass Stator Plates produce a straight line wavelength curve—separating stations evenly over the dial. Each degree on a 100 degree scale dial represents approximately 3½ meters over the broadcast wavelength range.

This even separation applies to both high and low wavelengths! Simplifies tuning materially!

The Ultra-Lowloss Condenser is a recent development of R. E. Lacault, E.E., originator of the famous Ultradyne Receiver.

Design of Lowloss Coils furnished free with each Condenser for amateur and broadcast wavelengths showing which will function most efficiently with the Condenser.

At your Dealer's. Otherwise, send purchase price and you will be supplied postpaid.

Simplifies radio tuning. Pencil record a station on the dial—thereafter simply turn the finder to your pencil mark to get that instantly. Easy—quick to mount. Eliminates fumbling, guessing. Furnished clockwise or anti-clockwise in gold or silver finish. Gear ratio 20 to 1. Silver $2.50. In gold finish, $3.50.

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TUNING CONTROL

R. E. Lacault

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I will gladly consult with any manufacturer regarding the application of this condenser to his circuit for obtaining best possible efficiency.

ULTRA-LOWLOSS CONDENSER

Write for Descriptive Folder.

PHENIX RADIO CORP., 116-B East 25th St., N. Y.

✻ *Tested and Approved by* RADIO AGE ✻

RADIO AGE

The Magazine of the Hour
Established March, 1922
WITH WHICH IS COMBINED RADIO TOPICS

Volume 4 *August, 1925* *Number 8*

CONTENTS

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A Chat With the Editor

THIS issue of our magazine is a milepost in our progress. This is the twelfth consecutive month in which RADIO AGE has presented a group of blueprints with accompanying constructional detail. It is fitting, therefore, that we celebrate the close of our first blueprint year by offering our readers a collection of blueprints which comprise all the basic circuits known to radio. Upon the circuits described and illustrated in this group ALL hookups are developed. Other arrangements may differ from the parent circuit in many details but fundamentally all of them are only adaptations of one of the basic designs inside this cover.

It will be remembered by radio fans that RADIO AGE was the first magazine to present illustrations of radio circuits in picture form. That is, we were far ahead of all other magazines in producing drawings in which the parts of the receiver were indicated in their proper location, thus getting away from the ancient schematic diagram. Many old timers still prefer the wiring diagram but the continued success of RADIO AGE shows that there are many thousands of fans who prefer the picture diagrams. This magazine therefore gives both, and has been doing so for two years.

Other magazines have fallen into line, although tardily and the picture diagram is an essential these days. We predicted we would have imitators and we are pleased that our competitors have justified our prophetic accuracy and at the same time have flattered us by thus plainly showing their approval of our original methods of helping those who built their own.

Now several other publications have taken a deep breath and leaped into the making of blue prints. After one year of offering an exclusive blueprint feature we again are pleased to have "follow the leader" publications admit they have been behind the times for twelve months.

After all, what makes a "big" magazine? We leave the answer to you.

Frederick Smith

Editor Radio Age.

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EVERY TUESDAY AT 8 P. M.
(Eastern Standard Time)

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WFI	Philadelphia	WCCO	Minneapolis / St. Paul
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Such complete and voluntary endorsement can lead to but one conclusion—for best reception and longest life, Eveready Radio Batteries lead the field.

You can prove this for yourself by hooking Eveready Radio Batteries to your set. You will find that they deliver a steady, vigorous stream of power that lasts longer. It is Eveready economy that has created such an overwhelming preference for Evereadys. For every radio use there is a correct, long-lasting Eveready Radio Battery. There is an Eveready dealer nearby.

Manufactured and guaranteed by

NATIONAL CARBON COMPANY, INC.
New York San Francisco
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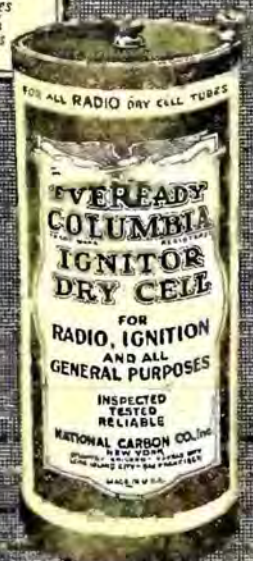

No. 772 45-volt Large Vertical Price $3.75

No. 767 45-volt Large Horizontal Price $3.75 With variable taps

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RADIO EDITORIALS

RADIO Corporation of America has quit its fight to deprive RADIO AGE of its name. It now appears that the title of this magazine will be duly registered in the United States Patent Office at Washington and that the publishers will be left in peaceful enjoyment of the snappiest and most expressive name in the radio publication field.

The immediate reason for this fortunate ending of the controversy is the decision of Radio Corporation to discontinue publishing "Wireless Age." The Corporation bought "Wireless Age" with other assets which it took over from the Marconi Wireless Telegraph Company several years ago.

When RADIO AGE applied to the Patent Office in July 1924 for registration of its title the Radio Corporation interposed formal opposition on the ground that the name RADIO AGE was causing confusion in the public mind between RADIO AGE and "Wireless Age." The publishers of RADIO AGE, having been building up the prestige of their name for several years, resisted the Radio Corporation's contention vigorously and the details of the controversy have interested many thousands of radio fans, as well as editors and publishers who are naturally interested in such litigation.

It is to be regretted that the legal points involved could not have gone to a decision. This magazine has been sincere in its conviction that it was morally and legally entitled to the name which it has endeavored to identify honorably and helpfully with the progress of radio in the United States.

We are informed that the subscription list of "Wireless Age" has been sold to another radio publication and that the Corporation's magazine will not appear after the August issue. This is, perhaps, a development which points to more compactness in the radio publication field. RADIO AGE, in the last few years, has absorbed two other radio periodicals. It is a field of free competition and only the fit will survive. It is a business so keenly competitive that the successful radio publisher must make a business of radio publishing and not attempt to make it pay him dividends as a sort of by-product of his other publishing or commercial enterprises.

As the dove of peace settles down upon our editorial desk we look about us at the discarded implements of war and we have the same sort of feeling that swept over us a few minutes after 11 a. m., Nov. 11, 1918. We were a battlefront war correspondent and while the dead were still being carried from the American field we walked up to the German barbed wire and across it exchanged questions with Fritz as to what all the shootin' was for.

The boys from the fatherland had their notions on the matter and we had ours. But we agreed on one thing—the dadblamed rukkus was over and we couldn't wait to cut across the shell-holed scenery and get back to the pursuits of peace. Peace, be it said, with honor. Away with legal briefs! Bring on the blueprints!

THE radio man who has been mixing his conscience with his business policy is stepping out on the long, straight highway which leads to permanence and prosperity. We have been watching the radio trade for several years and have been making mental bets that certain individuals in the trade would succeed and that certain others, who bore the outward appearance of success, would fail. Most of the bets were cashed.

Makers of sets and parts either kept faith with the public or they did not keep faith. They were either after a quick dollar or they were intent on establishing a sound business. They were either price-cutters or they aligned themselves with the anti-gyp forces. They were building up suspicion of radio performance by selling inferior stuff or they were fortifying the radio industry by selling merchandise that would function.

The radio men with the conscience are still in the industry and they are preparing for immense production this season. Some of them have been advertising in RADIO AGE since popular broadcasting first thrilled the country and they are still advertising. It is a pleasure to see their names in the book. They prove that honest manufacture and honest merchandising pays.

As time passes it is going to be increasingly difficult for the gyp and the maker of shoddy radio to exist. The fans are educated. If just entering the fascinating art they have friends in plenty who will warn them away from the catch-penny purveyors. We want to add our voice to the general chorus and warn the radio beginners to let the flashy stuff alone. Buy from the manufacturer or the dealer who has invested heavily of money and effort to build his business. He respects his business and will not jeopardize it by gyping customers. Deal with manufacturers who advertise in reputable radio publications. Wise publishers will not knowingly accept advertisements from sources which do not give value received.

Radio progress has been marvelous but it would have been more speedy if it had not been for the ghouls who tried to raid it before its structure was scracely begun. The radio industry is on its feet and it is a giant. The day of the gyp is numbered.

Certain editors of radio publications constantly are shouting that their editorial columns are not for sale. Yet we seem to detect evidences that some of them have been sadly tempted.

Radio is fortunate in having one of its leading figures represented in the MacMillan expedition to the arctics. The presence of E. F. MacDonald, Jr., president of the Zenith and Radio Corporation, as commander of MacMillan's second ship, the "Peary" assures the world that whether this adventurous group find the unexplored continent or not they at least will give low wave radio transmission the most effective test it has ever enjoyed.

We are receiving numerous letters from our English and Australian readers. They are eagerly testing and proving the blueprints. Brazil, Japan, Holland, Germany, France and South Africa, as well as Mexico, Cuba and Porto Rico are represented on the growing subscription list. Verily the hook-up is the same in all languages.

Introducing the Winner!

Photo posed especially for RADIO AGE

HE WINS RADIO AGE SHIELD

Karl Bonawitz, premiere organist for Radio Station WIP, the Gimbel Brothers radiocast at Philadelphia, Pa., emerged with first honors securely won after the final count in the first annual RADIO AGE Broadcast Entertainers' Popularity Contest. Karl maintained a steady lead throughout the entire competition, which started last July. A picture of the shield to be presented to him will be found on page 8, this issue, with the Contest Editor's comment on pages 7 and 8.

You may escape the collection ~ but not the need of OZARKA SERVICE

THE satisfaction you receive from your radio depends not on what it does once in a while—but night after night and month after month. Whether you grin or cuss depends on the service behind your radio.

Ozarka radio instruments are *only* sold by trained factory representatives, men who not only specialize in radio but sell and service Ozarkas only. 3,100 of these men, trained directly under Ozarka engineers constitute a service force, unequalled elsewhere in radio today.

When you buy a radio you'll compare appearance, tone, volume and selectivity by having various instruments set up in your own home but—that isn't enough—compare the service behind each one.

Any Ozarka factory representative will set up an Ozarka in your home—he will not even operate it himself, but depend for his sale on what you yourself do. If you, by your own operating, do not bring in the distance, the volume and tone, you expect a radio to give, then do not buy the Ozarka. If you do buy it, you can rest assured, no matter what happens, a competent service man is at your call at all times. No Ozarka representative can sell Ozarka Instruments without giving Ozarka service. You are entitled to such service—demand it!

The Ozarka Representative knows every part, every wire of the Ozarka. In fact he completely assembles his own instruments. His training on installations, aerials, ground connections, operation and service comes directly under our own engineers who designed and perfected the Ozarka circuit.

That is why our book, "Ozarka Instruments No. 200," describing all models of Ozarka should be of particular interest to you. This book and the name of the Ozarka representative near you, will be sent immediately at your request. Please give the name of your county.

We Have Openings for a Few More Ozarka Factory Representatives

OZARKA Incorporated, is now entering its 4th year. From a beginning with one engineer, one stenographer, one salesman — our present president, the Ozarka organization has grown to over 3100 people. There must be some good reason for this growth.

Ozarka instruments have made good — they have more than met competition. Ozarka representatives have made good not only because Ozarka instruments were right, but because they have been willing to learn what Ozarka engineers were willing and capable to teach them—Ozarka unusual salesmanship and Ozarka service.

There are still openings for the right men in this organization—men who believe in the future of radio—men who are tired of working for some one else—men who want a business of their own. Prove yourself by sales and willingness to learn and exclusive territory will be given you. The man we want has lived in his community for some time. He has the respect of his fellow men because he has never "put anything over" just to make money. He may not have much money, but he is not broke and is, at least, able to purchase one demonstrating instrument.

Check Coupon for FREE Selling Book

Radio offers a wonderful opportunity to men who are willing to start at the bottom and build. You need not know salesmanship, but will you learn what we will gladly teach you? You may not know radio, but we can and will teach you if you will do your part. With such knowledge and willingness to work, it doesn't seem possible that you cannot make good. Sign the coupon below, don't fail to give the name of your county. Better still write a letter, tell us about yourself and attach the coupon. If interested in our salesman's plan ask for "Ozarka Plan No. 100."

* OZARKA

121 Austin and La Salle Streets
Chicago, Illinois

INCORPORATED

121 Austin and La Salle Streets
Chicago, Illinois

Gentlemen: Without obligation send book "Ozarka Instruments No. 200" and name of Ozarka representative.

Name _____

Address _____ City _____

County _____ State _____

Gentlemen: I am greatly interested in the FREE book "The Ozarka Plan" whereby I can sell your radio instruments.

Name _____

Address _____ City _____

County _____ State _____

* *Tested and Approved by* RADIO AGE *

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RADIO AGE
The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication
Devoted to Practical
Radio

Frederick A. Smith
Editor

Results of Readers' Vote—
BONAWITZ WINS *Contest!*

By HARRY ALDINE

BY popular acclamation, Karl Bonawitz, organist, has been chosen winner of the RADIO AGE Broadcast Entertainers' Popularity Contest for 1924-25. By virtue of his victory he will be awarded the winner's shield.

Getting off on an early start, the name Karl Bonawitz appeared in eighth position after the first thirty days of the contest. During the next month he climbed to third place. Then with the contest only one quarter of the way through, he suddenly jumped to the head of the list where he has been continuously threatened by Bill Hay, Bert Davis and H. W. Arlin, but never at any time displaced.

K. B., as he is familiarly known to the thousands of radio fans, might justly be christened "The Monarch of the Reeds."

One year ago, in the July, 1924, issue of RADIO AGE, there appeared a full page announcement of the RADIO AGE Broadcast Entertainers' Popularity Contest.

"Who is your candidate for the Radio Hall of Fame?" is the way it was presented to our readers.

Open To All

THE candidate could he any person identified with radio, including announcers, entertainers, inventors, manufacturers, or in fact any person in any manner connected with the great radio industry. Beginning with that issue, ballots appeared in twelve successive numbers of the magazine, the last one being presented in RADIO AGE for June, 1925.

During that period thousands of radio fans were given the opportunity of naming their favorite, and as each ballot in every instance registered only one vote for the candidate, it is believed that the winner was selected strictly on his own merits. RADIO AGE maintained an attitude of strictest impartiality throughout the contest.

In receiving the votes, after the contest had ended on midnight of June 15. a number of interesting facts was disclosed.

It is quite singular to note that of all the hundreds of candidates, that the heaviest vote should have been polled in favor of an organist. For with all due respect to the strains of an organ, the performances were limited and pitted against a handicap of entertainers who performed nightly over the microphone.

Bill Hay

Bill Hay, Announcer of KFKX, the Westinghouse station at Hastings, Nebraska, in addition to taking second place in the contest, must be given credit in being named the greatest announcer in the world. For from among the great array of talent, Bill Hay succeeded in pulling more votes than any other announcer. He is the only candidate who drew the greatest number of monthly votes on three different occasions.

Hay is Consistent

HE, like Bonawitz, took off to early start and was never at any time lower than third position. Starting at the head of the list, he gave way to the organist and H. W. Arlin. And there he stayed to the end of the seventh month, when the announcer from Hastings deposed H. W. Arlin from second place. Two months later Bert Davis came along and shoved Hay off his comfortable perch. For the next sixty days it looked as if the congenial announcer were through.

Bill Hay, genial host at KFKX, Hastings, Neb., who was among the leaders when the final vote was taken in RADIO AGE's Popularity Contest. He won second place.

Then, suddenly, Bill Hay staged the most remarkable comeback in the history of the contest. Holding a poor third, with John S. Daggett and H. W. Arlin close on his heels, the scattered forces rallied round Hay, and with a deluge of votes pushed him back to the seat of honor second only to Karl Bonawitz. Twenty-one more votes would have declared him winner, which is the closest the organist has been to defeat in recent months.

Forty-one votes behind Bill Hay comes "The Clown of the Air," Bert Davis, for third honors. While Bonawitz and Hay had a thirty day start on the eccentric comedian from WQJ, Bert made an excellent showing and for a time it appeared that he would run away with first honors. The fans whose votes placed the eccentric entertainer at this point of vantage, will undoubtedly regret having deserted him during the last few days when a comparatively few ballots would have put him over the top.

By way of consolation, it must be noted that Bert Davis has been proclaimed the leader in his particular style of entertainment, as no singing comedian leads him in the final accounting. A wandering minstrel, more or less, since he first started performing over the radio, the Clown of the Air is now started on what will be the first leg of a trip around the world.

Fourth on the list, we find "Uncle John S. Daggett," the beloved announcer of KHJ, Los Angeles. Here again we must pause to recognize an exceptional achievement in Uncle John's having landed a place so close to the top. Located way out on the Pacific Coast, far from the center of population of the United States, added to the fact that the contest had been in progress for sixty days before his name was mentioned in RADIO AGE, makes his showing all the more remarkable. From among the many broadcasting stations in his section

of the country, he is the outstanding figure west of the Rockies.

H. W. Arlin, the world's pioneer announcer from Station KDKA, comes fifth. During the early stages of the contest our friend from Pittsburgh consistently held a corner on the position next to the top for six consecutive months. It was during the early part of 1925 that his support gave way to find him eventually a little lower down the scale. His record is worthy of commendation.

There then follows in the order named Coon Sanders' Night Hawks and Art Linick, both of KYW; Jack Nelson of WJJD, Harry Snodgrass, formerly WOS, and Ford and Glenn of WLS. A reference to the "Final Standing" will show how the next twenty stood.

There follows the standing of the candidates as it looks at the conclusion of the contest:

FINAL STANDING

Karl Bonawitz, Organist	WIP, Philadelphia
Bill Hay, Announcer	KFKX, Hastings
Bert Davis, Entertainer	WQJ, Chicago
John S. Daggett, Announcer	KHJ, Los Angeles
H. W. Arlin, Announcer	KDKA, Pittsburgh
Coon-Sanders' Nighthawks Orchestra	KYW, Chicago
Jack Nelson, Announcer	WJJD, Mooseheart
Art Linick, Entertainer	KYW, Chicago
Harry M. Snodgrass, Entertainer	WOS, Jefferson City
Ford & Glenn, Entertainers	WLS, Chicago
Duncan Sisters, Entertainers	KYW, Chicago
Lee Sims, Pianist	KYW, Chicago
Lambdin Kay, Announcer	WSB, Atlanta
J. Remington Welsch, Organist	KYW, Chicago
Fred Smith, Announcer	WLW, Cincinnatti
E. L. Tyson, Announcer	WWJ, Detroit
Hired Hand, Announcer	WBAP, Fort Worth
"Sen" Kaney, Announcer	KYW, Chicago
Nick B. Harris, Entertainer	KFI, Los Angeles
Jerry Sullivan, Announcer-Entertainer	WQJ, Chicago
Edward H. Smith, Director-Player	WGY, Schenectady
Charles E. Erbstein, Announcer	WTAS, Elgin
Wendell Hall, Entertainer	WDAF, Kansas City
Howard Milholland, Announcer	KGO, Oakland
Scottish Rite Orchestra	KGO, Oakland
Banks Kennedy, Entertainer	WEBH, Chicago
S. Hastings, Announcer	KFI, Los Angeles
Robert Boniel, Announcer	WEBH, Chicago
Arion Trio, Instrumental	KGO, Oakland
Gold Dust Twins, Entertainers	WEAF, New York

And now a few additional remarks about the winner of the contest. What was there about the performances of Karl Bonawitz that won for him first place in the hearts of the great radio audience?

The following is a letter typical of the many which accompanied the votes received by Harry Aldine.

123 Waverly Place,
Trenton, New Jersey,
February 4, 1925.

RADIO AGE,
500 N. Dearborn St.,
Chicago, Illinois.
Att.: Mr. Harry Aldine, Contest Editor.
Gentlemen:

Kindly enter my vote herewith for Mr. Karl Bonawitz. His informal manner of announcing makes one feel he is playing for the liseners in personal benefit. His happy manner is certainly medicine to those who cannot get out of a sick room. If this peculiar method of announcing and his clever playing can in any way make life more worth while to unfortunate shut-ins, he surely deserves to win your contest.

Very truly yours,
Thomas Prentice.

"The Clown of the Air," Bert Davis, who made a big spurt toward the end of the contest and missed winning the coveted shield by only a few votes. Bert's popularity among Middle Western fans grew amazingly during the life of the contest. He finished third.

His Life Story

Karl Bonawitz was born in Philadelphia in 1894. He studied organ, piano and musical composition in that city; also in London and in Berlin.

The thousands of radio fans who have heard and enjoyed his organ recitals were first introduced to him at the Germantown Theatre, where he went on the air for his initial performance. This was in May, 1923.

He was at once accepted by the delighted fans, who sent an avalanche of congratulatory messages to the Gimbel Brothers Station, WIP, at Philadelphia, who broadcast the strains of the Germantown organ.

A view of the shield which is to be presented to Karl Bonawitz on behalf of the readers of RADIO AGE. It measures six by eight inches over all.

In the two years that followed, Karl Bonawitz has rendered over two thousand compositions. Thousands of letters and telegrams give testimony to the reception accorded this popular entertainer.

Performing from one of the largest instruments in the country, this pioneer broadcasting organist "Could make the reeds talk," and the simple manner in which he made his announcements between numbers made the listeners realize that he was not "acting."

RADIO AGE congratulates Karl Bonawitz on his success. In behalf of the others who made such an excellent showing, we can only regret that there is but one first place.

A Word from the Winner

SINCE closing its first editorial forms, RADIO AGE has been fortunate enough to hear from the winner—Karl Bonawitz. He is now playing the organ in the Stanley Theater in Atlantic City, N. J., where the bathing beauties flock every year.

However, let's let Karl tell the story in his own way.

Here's his letter:

"Harry Aldine,
Popularity Contest Editor,
RADIO AGE:
"Dear Harry:

"I received your kind letter and I am very much pleased to hear that I have won the RADIO AGE Radio Favorite Popularity Contest, which was begun a year or so ago.

"I stopped broadcasting a month ago, although I notice I have been getting votes since then. When I saw that there might be a chance of my winning your contest, I made several announcements by radio concerning your excellent magazine and its popularity contest.

"I started broadcasting from the Germantown Theater organ on May 15, 1923, and thereafter I was on the air three and four times a week with organ recitals and Sunday night concerts. I have letters from all over the country and telegrams numbering over 1,500. I have never received a penny for broadcasting, and in two years of this work I have given approximately 336 hours of my time.

"But don't get me wrong. I did it willingly and would certainly do it all over again, as I firmly believe radio work is the greatest advertising medium in the world.

"Now, you wanted to know something of my new activities. On July 3 I will be solo organist of the new Stanley Theater in Atlantic City, N. J. We may soon be on the air again through Station WPG at Atlantic City. However, you might write in your paper that my position will be changed from the Germantown Theater in Philadelphia to the Stanley Theater at Atlantic City.

"I hope you'll pardon my hurried note, and let me know if at any time I can be of service to you.

"Sincerely,
"Karl Bonawitz."

And so ends the contest. Long live the king!

A Plea for More Smooth-Tuning Receivers

Failure to Balance the Tuning Condenser and Coil Causes Woe

BY BRAINARD FOOTE

SO OFTEN we come across a radio set whose tuning dial includes the entire broadcast band within perhaps 50 degrees on a 100 degree dial. The short-wave stations like WFKB, Chicago, and WHT, Deerfield, Ill., come in at 30 and we find KSD around 80. Sometimes, and really almost as often, the short-wave stations aren't heard at all. The blank spaces at either extremity of the dial are absolutely useless and they only serve to compress the useful tuning scale within narrow limits and to render much more difficult the exact adjustment of the dial.

What's wrong, anyway? Why don't we have sets that tune with smoothness from 200 to 550 meters over a scale of zero to 100? The fault is that the tuning condenser and the coil are not properly balanced. Perhaps the coil is too big or the condenser too big. Does the trouble lie possibly in the design of the coil? There's a little of each to be considered.

In the first place, we should recall the well-proved statement that the loudest signals are obtained with a minimum of capacity and a maximum of inductance in the circuit. This fact used to be used in support of the variometer method of tuning the secondary circuit, but the extra length of wire required by the variometer and its added resistance wasn't considered. To keep inductance high and capacity low, it is evident that the circuit is 100 per cent efficient (if there is any such thing) at some short wavelength at which the capacity is sufficient to make the circuit oscillatory and at which the inductance is predominant. This would be near the "natural wavelength" of the coil.

Distributed Capacity

THE fact that a coil has a natural wavelength without a condenser connected across it may be understood when it is shown that a coil is NOT pure inductance. It has a certain amount of inherent capacity, which is caused by the side-by-side position of the adjacent wires. When the wire is insulated with enamel or single silk, and wound closely, the turns lie very near each other and the distributed capacity is very high. This means that the coil already has a certain amount of capacity and that fewer turns of wire will be needed to place the lowest wavelength at the desired point—200 meters for broadcast reception. The effect of the tuning condenser is thus decreased; that is, a larger condenser is necessary to cover the broadcast band.

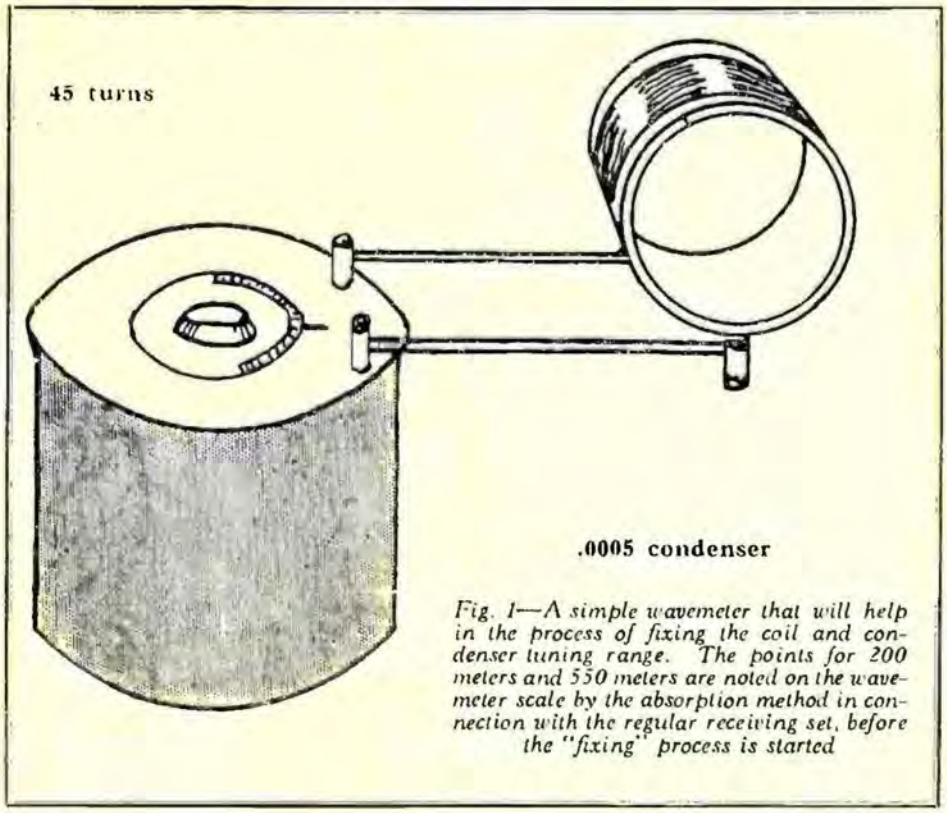

Fig. 1—A simple wavemeter that will help in the process of fixing the coil and condenser tuning range. The points for 200 meters and 550 meters are noted on the wavemeter scale by the absorption method in connection with the regular receiving set, before the "fixing" process is started

Now suppose we wind a coil to have very little distributed capacity. This may be done in various ways, the simplest of which is perhaps to employ the "basket" construction, where the turns criss-cross and come near each other only at the crossing points. This method is very desirable because of the reduction of distributed capacity, but it has a serious drawback not commonly thought about. The wire in a coil must describe a certain number of revolutions at a given diameter to attain a certain amount of inductance. If each revolution is a circle of that diameter, the length of wire needed will be a minimum, inasmuch as the circle is the geometrical shape having the largest inclosed area for its perimeter. The basket form involves a number of angles and the length of wire per turn of wire on the coil is quite a bit greater. Thus the resistance will be increased.

Hence, the ideal form of winding is one having a cylindrical shape where the turns are spaced from each other sufficiently to reduce the distributed capacity, but not with so much separation that the field is too extensive. A spacing equal to the diameter of one wire is correct and the ideal wire size is from No. 18 to No. 22. Such a coil can easily be made by using a treated cardboard form about 4 or 5 inches in diameter and about 6 inches long. The form should be heated in the oven to drive out the moisture and then paraffined to prevent moisture from penetrating. The actual number of turns must be determined by experiment, according to the capacity of the condenser, and of that we shall speak later on.

Spacing

THE simplest method of spacing is to use two wires, winding them both on at once. After the coil is complete, one wire is unwrapped and the remaining turns are correctly spaced by the diameter of one wire. A useful wire to use for such work is enamelled, without other insulation. It will "sink" into the paraffined surface sufficiently to retain its position of spacing. Hard rubber tubing is likely to shrink, so that it must be used for space wound coils only where it is threaded and the wire wound in the grooves.

Now for coordinating the condenser and coil. Take the usual combination of coil and 23 plate or .0005 mfds. variable condenser. Its effective work may start at 15 or 20 on the dial and wind up at 90. On the lower settings it doesn't amount to much. The trouble is that the coil is built to produce the longest wavelength near the highest setting of the .0005 mfds. condenser and then the short wave setting occurs wherever luck puts it—usually around 20 or so. Now it is NOT possible to design a space-wound coil for such a condenser, and the easiest and most practical method for the constructor to follow is as follows:

1. Wind the space-wound coil with too many turns, perhaps 65 or 70. Insert the coil in the set, with the tuning condenser at zero and find the wavelength,

which will be the natural wavelength of the coil plus an increase due to the minimum condenser setting and the tube capacity. This wavelength should be 200 meters, and to be absolutely certain about it some kind of a wavemeter is helpful.

A wavemeter for the purpose may easily be made by winding about 45 turns of wire on a 3 inch piece of tubing about 3 inches long, using small wires, say No. 24 single covered. Place binding posts on the coil and fasten lengths of bus bar in them and to the posts of a .0005 mfds. mounted variable condenser as in Fig. 1. Next, tune in the amateurs on 200 meters (where the whistling dots and dashes are to be found.) Or, if 200 meters cannot be heard on your regular set, tune in the shortest wavelength station you get, perhaps WFKB on 217 meters, let the set oscillate and bring the wavemeter near the coil of the set. Vary its condenser and at a certain point it will, by absorption, stop the set from oscillating. This is the corresponding point on the wavemeter. Note the dial reading and then install your space wound coil, with tuning condenser at zero and the tickler winding placed in inductive relation so that the tube is just oscillating. Bring the wavemeter near and vary the condenser. If the absorption point is less than the wavemeter setting for 217 meters by a few degrees, say four or five, the natural of the coil is O. K. But if it is higher, some turns must be removed until the lowest wavelength tuned in is about 200 meters. It is best to have the antenna off and the antenna coupling coil out of the way while doing this.

2. The shortest wave is thus put at 200 meters with the tuning condenser at zero. Now increase the tuning condenser gradually until the wavemeter absorption method shows that the condenser is set at the highest wavelength, or a little higher, say about 550 meters. This will undoubtedly occur at about 60 or 70 on its dial, showing that the condenser has too much capacity. Some of its plates are then removed by bending them back and forth a few times until they either break off at the rotor shaft or become loosened so that they can be pulled out (as with a condenser having plates held in slots.) In a typical case, I used a straight-line wavelength condenser having 25 plates and .0005 mfds. capacity with a space-wound coil that had to have 60 turns for 200 meters at zero condenser setting. It was necessary to pull out FIVE of the rotor plates before the tuning range was properly spread over the dial. Fig. 2 shows this.

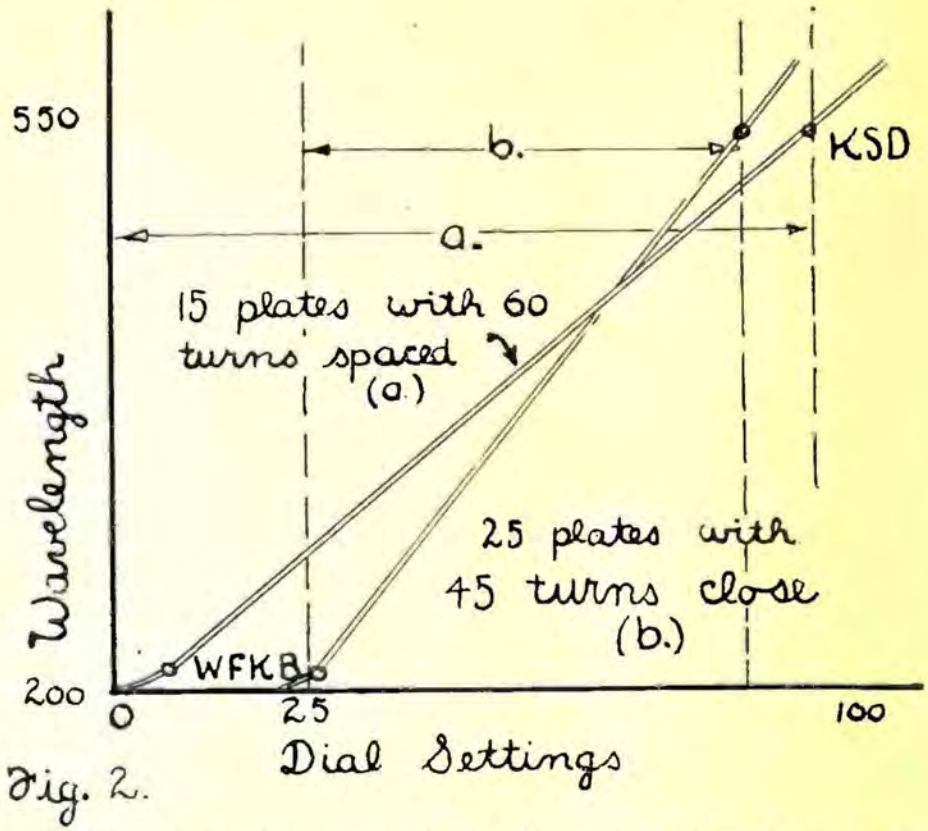

Fig. 2—Comparative tuning curves showing the advantage gained by using a space wound coil and a smaller condenser. The 15-plate condenser was made by removing five of the rotor plates from the 25 plate instrument, the corresponding 5 fixed plates thus not being used.

Ease of Tuning

THE steeper curve of Fig. 2 shows the tuning scale with the straight-line wavelength condenser and a close-wound coil of 45 turns. 200 meters occur at about 25 on the dial in this case, on account of the slight change in capacity of such a condenser on short wavelengths. No advantage was taken of the good tuning possible on short waves with a condenser of this character. But with the space wound coil, even with a great many more turns, the zero setting is brought to 200 meters, on account of the greatly reduced dis-

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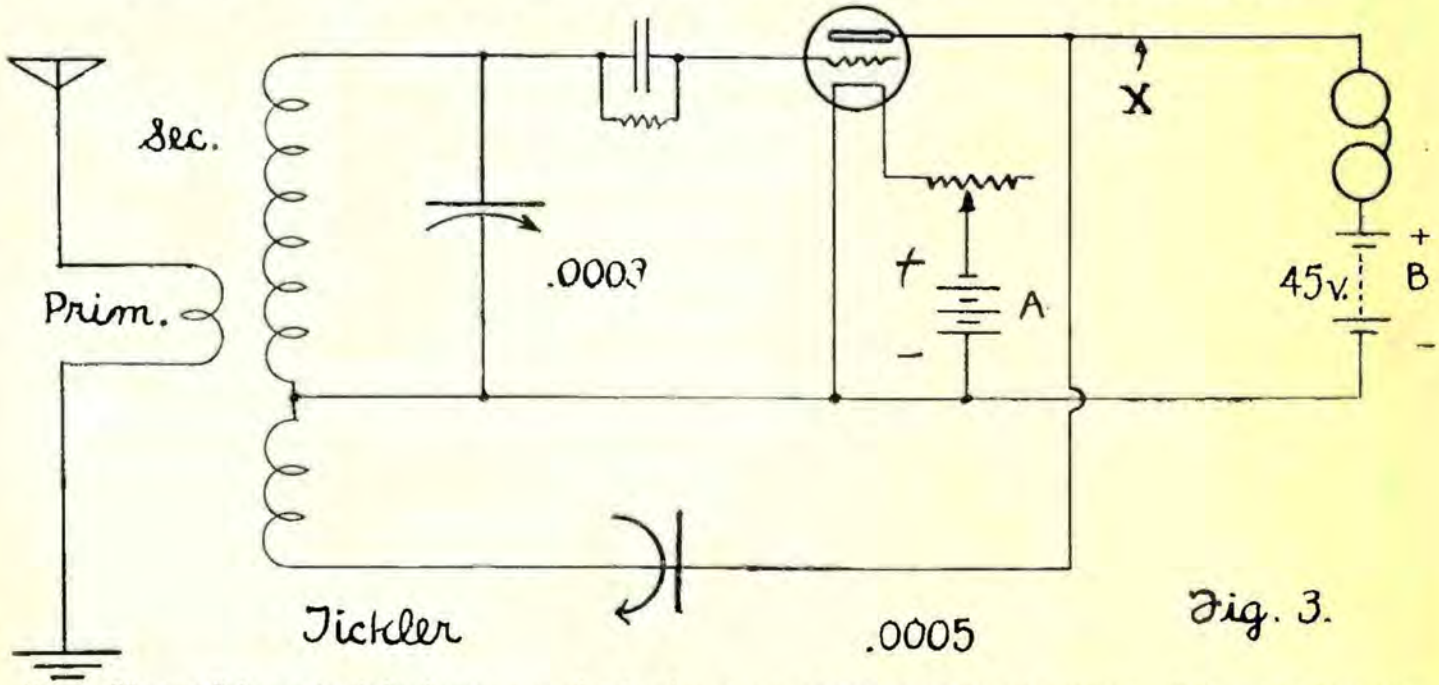

Fig. 3—Weagant-Reinartz circuit for the space wound coil and parts as used in the usual three-circuit tuner. This method of regeneration control doesn't interfere with the setting of the tuning dial. Try it.

Realizing Radio Economy with

ALTERNATING CURRENT Tubes

THE elimination of batteries from radio receivers has been the aim of engineers for a number of years. The logical place from which to draw the power to operate our radio receivers is the lamp socket. Here is power in abundance, cheaper by far than that obtainable from dry batteries or storage batteries. But the power is not in a form which can be used directly on the modern tubes.

In the majority of homes 110 volts A. C. is employed for lighting purposes, whereas we require direct current to light the filaments of our tubes and to supply them with plate voltage. How to use the alternating current for the purpose—that is the problem. Obviously there are two alternatives open to us. Either we may design a battery substitute which will operate from the alternating current lines and supply power to the types of vacuum tubes now in use, or we may design an entirely different type of tube which is capable of being operated from alternating current directly.

Without going into the matter in any detail we may state that the design of a battery substitute to supply both filament and plate current from alternating lines is a difficult matter indeed. The plate supply is a problem easy of solution; there are many successful "B" battery eliminators on the market. By proper balancing it is possible to operate the filaments of amplifier tubes from alternating current supplied by a small step down transformer. The great and heretofore insurmountable difficulty has been the operation of the detector tube. Do what you will, if the filament of the tube is operated from alternating current, there will be a terriffic hum in the output circuit.

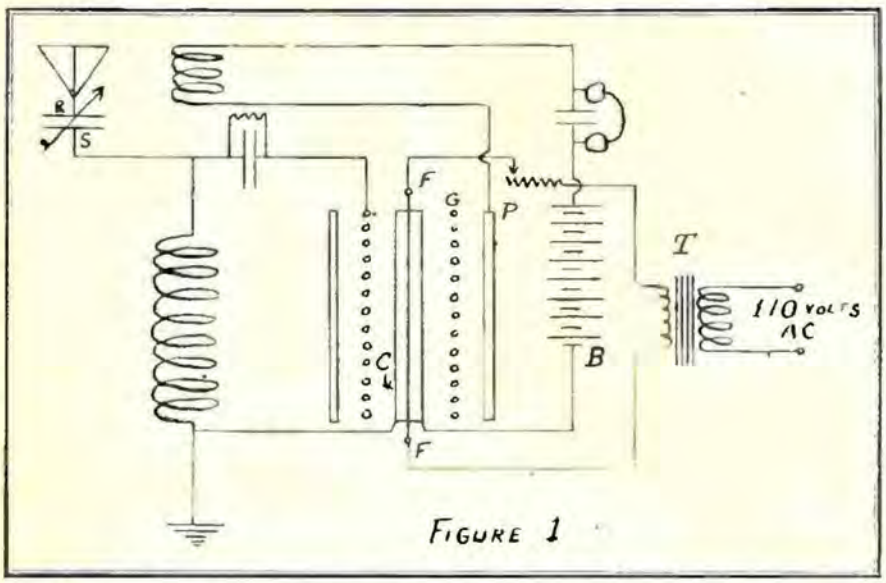

Fig. 1. Here is the schematic drawing for a typical alternating current tube supplied from the conventional 110 volt house supply. The filament F. F. is heated by the transformer voltage and in turn it passes its heat to the cylinder C which gives off an electronic emission.

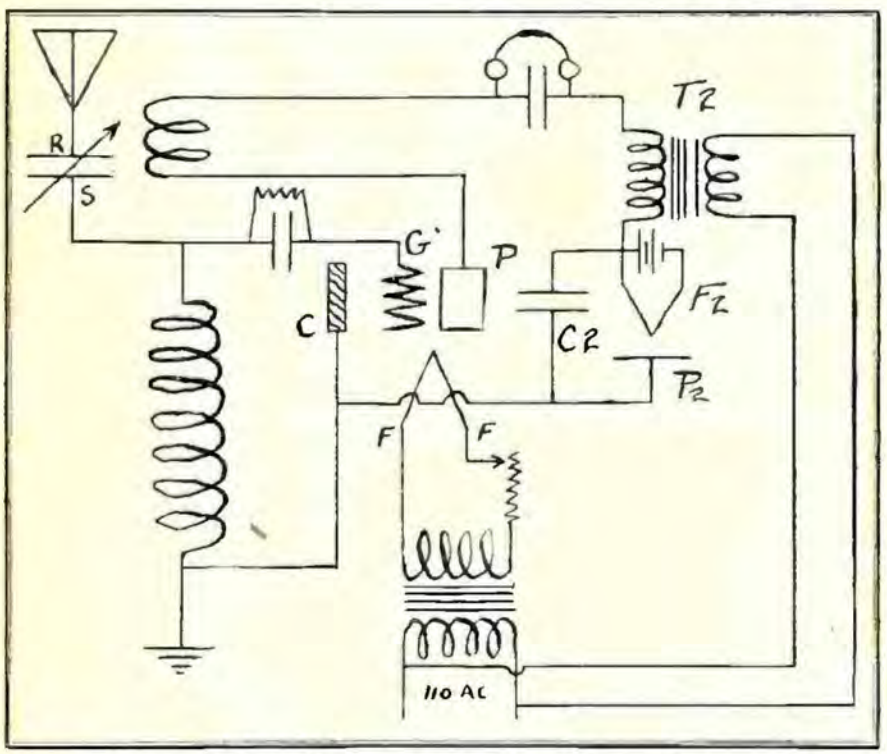

Fig. 2. Here the A. C. tube is combined with a kenetron to give us B battery supply from A. C. mains after being rectified by the kenetron.

By EDWIN E. TURNER Jr.

These difficulties led to the development of a tube which is capable of being operated from alternating current directly. Such a tube is shown in diagramatic form in Figure 1. The filament of the tube F. F. is a tungsten thread heated to incandescence by the transformer T which steps the line voltage down to the proper value of 5 volts. The tube draws a filament current of two amperes. A small nickel cylinder C, 1-8 of an inch in diameter and an inch and a half long, surrounds the filament and is heated by the white hot filament F F to slightly below red heat. The cylinder is coated on the outside with a layer of bariumoxide. Surrounding the cylinder C is the regular spiral grid G and the cylindrical plate P. The tube is shown connected in a regular single circuit set, the plate voltage being supplied by the "B" battery B. When the cylinder C is heated by the filament inside of it, it gives off electrons and acts as the source of electrons for the tube. But since it is in no way connected with the alternating current lines, no hum can appear in the output circuit of the tube. The alternating current serves merely as a heating source to raise the cylinder C to the proper temperature so that electrons will be emitted. The rest of the circuit functions in the reuglar way. The grid return and the negative side of the B battery are connected to the cylinder C because this is really the filament of the tube.

A Truly A. C. Tube

SO FAR so good. Now let us eliminate the B battery, making this a truly A. C. tube. There is no reason why we cannot use a kenetron in place of the "B" battery to supply the plate of the tube with high potential D. C. Figure 2 shows a tube of the type which we have just described, supplied with plate potential by means of a kenetron. G, P, C and F. F. have the same meaning as before. A second transformer T 2 supplies the high potential A. C. which is rectified by the two element tube F2, P2. The large condenser C2 is con-

nected in shunt to the rectifier to smooth out the voltage supplied to the plate. One fact stands out from figure 2: namely, that the anode of the kenetron P2 and the source of electrons of the tube C are connected together directly. There is no good reason, therefore, why they cannot be combined into one electrode. Also, there is no reason why the filament F2 and the filament FF cannot be combined into one, since the function of the filament FF is simply to heat the cylinder C. Also, the high potential winding S can be wound on the same transformer which supplies the filament current to FF, the primary of this transformer serving for both.

The combined circuit is shown in Figure 3. The filament, FF heated from A. C., serves not only to heat the equipotential cathode C, which in turn serves as the secondary source of electrons for the tube proper, but also acts as the cathode of the kenetron formed by the cylinder C and the filament. The cylinder C acts as the secondary source of electrons for the tube C, G, P and at

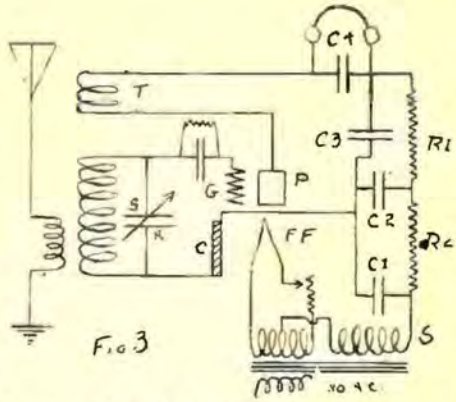

Fig. 3. This is a typical one tube regenerative circuit with the A. C. tube arranged so it also delivers B battery current in addition to the A current.

C1, C2 and C3 in parallel back to the electron source C. The winding S in the tube circuit tested had a voltage of 110 volts. The circuit operated as a regenerative detector supplying all necessary power from the lighting circuit

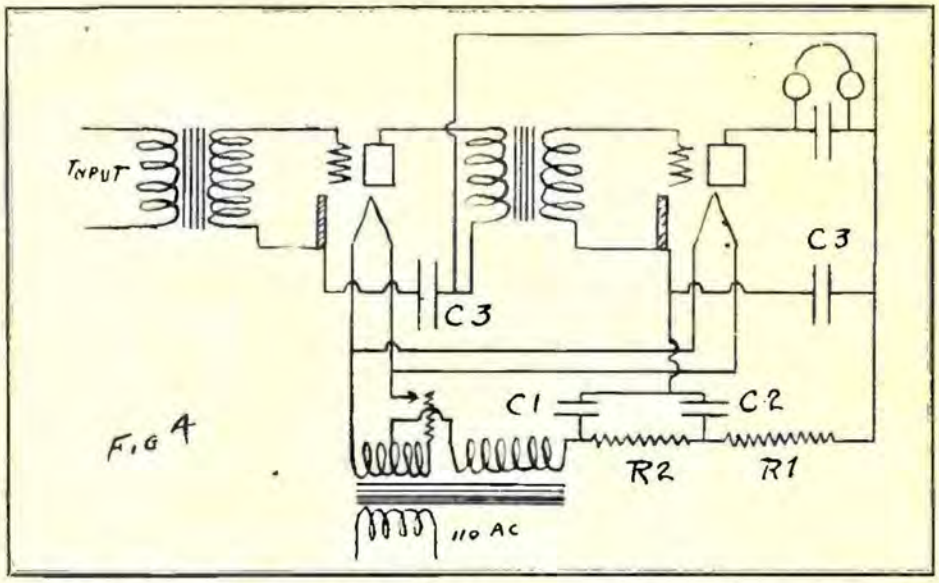

Fig. 4. The alternating current tube adapted to the two stage amplifier in which the B battery potential is also produced by the A. C. tube.

the same time acts as the anode for the kenetron FF, C. The high potential winding S is connected to the middle point of the filament lighting secondary.

By tracing the circuit carefully, it will be seen that at no point is the alternating current line connected to the filament circuits of the receiver, the B battery return being made through the electron stream from FF to C. With the tube tested by the author, condensers C1, C2 and C3 were 2 M. F. each and resistances R1 and R2 were 36,000 ohms each. This combination forms a filter which serves to smooth out the plate supply to the tube. It will be noted that these condensers in parallel are in shunt to the source of high tension supply, the positive terminal of which is the filament FF and the negative terminal the cylinder C. The load across these condensers, upon close examination, will be found to be the plate current of the tube C, G, P by way of the tickler T, through the telephones C4, through the condensers

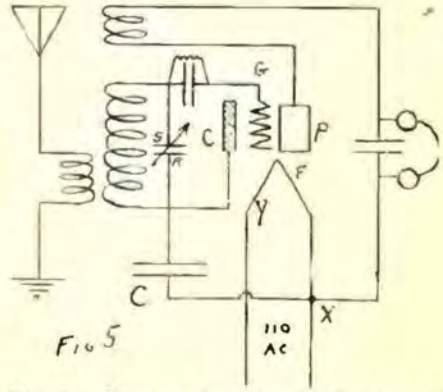

Fig. 5. Now we are using 110 volts on the filament instead of a lower voltage. Also we are supplying the plate potential through the rectifying properties of the same tube.

at 60 cycles A. C. without the least trace of hum. Figure 4 shows the hookup of a two stage audio amplifier using these tubes. Each tube supplies its own plate current, a single transformer serving both tubes. The values shown are the same as before.

A Little Experiment

THE arrangements shown up to this point operate satisfactorily on alternating current, but it will be noted that the circuits contain transformers and other accessories which may be eliminated if we take the pains to analyze the circuits. Let us see if we can operate the filament of the tube directly from alternating current at 110 volts, incorporating all the advantages which we have outlined. Figure 5 shows the circuit when the tube has a 110 volt filament. The filament F operates from 110 volts A. C. directly, operating exactly as before to heat the cathode C and to furnish the electron emission for the rectification taking place between C and F. For the high potential to operate the kenetron, C F, we employ the voltage of the line by means of the well known Edison effect. Every cycle this side of the line X becomes positive with respect to the side of the filament Y. Hence there is an electron flow and rectification between Y and C. The condenser C serves to smooth out the rectified currents, making the operation of the tube more smooth. The extreme simplicity of the receiver can be appreciated at a glance.

And as a last step in order to bring the circuit to the highest point of efficiency, let us make the change shown in Figure 6 by making the connection to the plate of the tube to the middle point of the filament F, instead of to one side of the line. At once we have done two things. We have caused the receiver to be connected to the alternating current lines at a point which is always at equal potential with respect to both sides of the line.

This alone tends toward the elimination of the hum. At the same time we have substituted for the half wave rectification furnished by the Edison effect a full-wave rectification. Electron flow and rectification takes place every half cycle instead of every cycle. The electron flow takes place first from one end of the filament and then from the other. The result is a smoother output to the receiver and less hum.

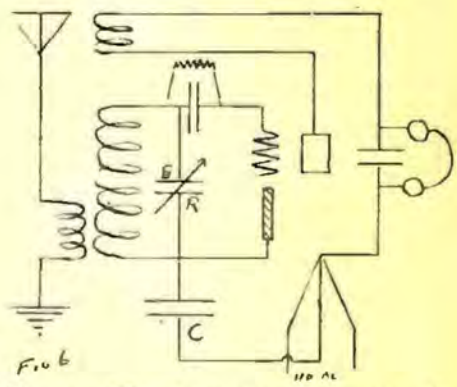

Fig. 6. The above circuit shows us the A. C. tube at its highest efficiency; it furnishes A battery current for the electronic emission and also furnishes its own B potential through the connection between the plate of the tube and the center of the 110 volt filament.

Deciding on a Portable *Super-Het*

Small Parts and Efficient Transformers are Vital for Real Portability

¶ The portable super at the left gives a good example of how a multitube set should be laid out for true portability. Note the compact arrangement of batteries and the small space consumed by them. And can't you imagine how easy such a travelling case would be to carry on your vacation?

BY RUSSELL H. HOPKINS

IT HAS long been acknowledged that the super-heterodyne receiver is the last word in radio development. For all-around, all year reception, under all conditions, and for general efficiency of operation, the "super" cannot be surpassed.

For too long a period the super was the instrument of the experimental laboratory instead of the practical receiver of the everyday fan. Too long have supers been great consumers of battery current and occupiers of unwieldy space. Some radio engineers have attempted to reduce the battery drain by introducing complicated reflexing, but that addition did not tend to bring about the desired simplicity that was essential if the super was to become universally adopted.

After testing about every known type of super-heterodyne design, from six to eight tube layouts and back again, a conclusion was arrived at that for all-around desirability, as well as sensitivity, selectivity, weight and durability, the portable super-heterodyne was the ideal receiver for the fan who wants all the latest radio improvements arranged in such a way that they will constitute a truly portable receiver, and not, as one radio pioneer so aptly put it, "so portable that one man—and six boys—can easily carry it about."

An ideal portable super-hererodyne can be built on a panel 7 inches by 18 inches by 3-16 inch and a subpanel if desired. If old-timers lift their eyebrows in amazement and question the possibilities of inter-stage coupling and excessive crowding, we will allay their fears by assuring them that inter-stage coupling can be made to disappear entirely in well constructed portable receivers.

Use Small Parts

IN designing a portable super, which we have taken as our model receiver for this discussion, it should be advisable to use instruments that have been purposely designed to permit their being placed in small space. Otherwise we are taking great liberties in calling this a "portable" set. At the same time, these parts must not be so placed that they interfere electrically with each other.

In super-heterodynes, as in any receivers, short wires insure best results, so the fact that a super was once a complicated affair need not make the prospective builder believe that connections must be elaborately though unnecessarily long. Then, again, if we mount our parts compactly, long wiring will be done away with and we will have attained our ideal from the standpoint of wiring. If our portable super is to be a welcome companion on our Summer trips, instead of a cumbersome hindrance, it must be easy to handle or we will wish we had left it at home. And the next time we go away, we will be sure to leave it at home, unless we make it as small as is possible without hampering mechanical perfection.

In our quest for compactness, however, we should not be blinded to the fine qualities that every receiver, and particularly the super, should possess. The foremost of these is tonal quality. Without it a receiver may get the stations, but it will not get *music*, clarity or sweetness of tone. Selectivity, sensitivity and distance-getting features are admirable when combined in one receiver, but *tone* is most important, for what good are distant stations if we do not enjoy their offerings?

Portable super-heterodyne receivers have been snubbed by some fans who would otherwise be loyal boosters, just because the designers, in their mad chase for extreme portability, forgot to include pleasing tone. Even after tone has been achieved, a creditable loud speaker must be used to convey that pure tone to willing ears, and not convert it into a "tinny," rasping squeal. Several small, built-in loud speakers are now available, so there should be no excuse for imperfect loud speaker reproduction in a portable set.

The Heart of the Super

THE heart of the portable super, as well as of the more elaborate models, is in its transformers, for they are the real factors to consider when we set out for results in amplification, tone quality, selectivity, economy of current consumption and wavelength range. Accordingly, we will devote part of this discussion to the proper choice of transformers for the portable super-heterodyne.

To say that the question of high frequency air-core transformers versus comparatively low frequency iron-core transformers in a super-heterodyne is a much mooted one would be to be truthful but not at all original. However, the super

fan will be interested in a few of the facts responsible for the decision to recommend iron-core transformers in portable supers.

The best gain; that is, voltage amplification, that could be obtained with standard air-core transformers varied between 8 and 16 with an average of 14 for 201A tubes and somewhat less for UV199's. The voltage gain for the transformers used in a portable super is 34 per stage between UV199's. There is no argument here between the 100 kilocycle amplifier and the 50 K. C. amplifier—though the average iron-core transformers on the market give a 14 to 18 voltage gain per stage. The two instruments for which the makers make the most extensive claims give only 24 per stage, whereas another transformer for which no extensive claims are made gives 30 per stage. These latter types are all iron-core operating from 6,000 to 10,000 meters—the low frequency of the last one being its only drawback.

It is possible to tune a 100 K. C. amplifier using air-core transformers very sharply and yet not cut side-bands. It is possible to tune a 50 K. C. amplifier sufficiently sharply so as not to cut side-bands and yet eliminate noises, but it is very difficult to do so with a 30 K. C. amplifier. Under certain conditions of perfectly matched air-core transformers an amplifier might be made so sharp as to cut the side-bands and distort speech received considerably. The danger of this is greater at long than at short waves, but since iron-core transformers are generally used on the longer waves, this difficulty disappears here and holds only for the short wave amplifiers using air-core transformers.

Assuming the air-core transformers to be all adjusted to the same wavelength, the selectivity will be good. If one is off, amplification will fall off badly and selectivity will be poor, due to the very sharp peaks of the transformers. These peaks must be sharp if any amplification at all is to be obtained from this system. Each transformer must be matched for a given set, and the transformers in an amplifier should be matched for individual positions, since variations, which to some extent can be predetermined, occur from stage to stage.

In the assembly of the amplifier the greatest care must be taken to see that the characteristics of each stage-assembly are identical or all the advantages of a well-matched set of air-core transformers will be lost. Due to the lower frequency at which iron-core transformers are operated, this trouble is practically never encountered and a set of transformers could be built for operation of 50 K. C., which will give practically no distortion and yet have a sharp cut-off either side of a sufficiently wide speech-band. This would be the ideal condition, since amplification would remain constant even though the transformers varied slightly, due to manufacturing difficulties. These difficulties, however, are very much smaller at 50 K. C. than at 100 K. C. In the case of air-core transformers, which are non-adjustable, the selectivity is dependent upon each stage speaking at substantially the same wavelength, the in-put transformer used with them being used principally for other purposes than to sharpen up the amplifier tuning. This is very nice where each stage can be tuned individually but not so nice otherwise.

In an iron-core amplifier the selectivity is almost entirely determined by the filter, which means that the selectivity of the amplifier is under easy and accessible control in one circuit—not distributed over several non-adjustable circuits. The primary complaint of lack of selectivity in iron-core transformers is due to the use of poor filters, as up to the present time practically no really sharp filters have been marketed—the writer is familiar with only two which are not makeshifts, improperly designed.

Attaining Stability

THE lower the frequency, the greater the stability of an RF amplifier—the very principle of the super being based on this law in a measure. The feed-back effects are less the lower the frequency, and are slight in a 50 K. C. intermediate amplifier and very easily overcome. Where an iron core is used in a transformer, the field is limited and shielding may be employed efficiently if desired, although since the field is limited, it is generally necessary to no greater extent than individual transformer shields, which are provided on practically all standard makes of iron-core transformers. An air-core amplifier cannot be shielded without increasing its bulk very noticeably, and unshielded require greater spacing than an iron-core amplifier. operating at even the same wave length, in order to maintain stability.

With a given set of air-core transformers designed for operation at 140 K. C. with 201A tubes, the substitution of UV 199's would throw the operating frequency up to 190 K. C.

This means that the wavelength would shift from 2,150 to, roughly, 1,600 meters for this particular set of transformers. This indicated how very slightly dependable the manufacturer's rating of the operating efficiency of air-core transformers really is. At these low wavelengths changes like this are of considerable importance, whereas the changes which occur in iron-core amplifiers at higher waves are very slight, principally due to the comparatively high distributed capacity of the windings.

Since a 50 K. C. amplifier is more stable than a 100 K. C. one, less loss in the form of positive grid bias need be introduced to stabilize it. In actual practice the former amplifier may be tuned with the grids from one to four volts negative with respect to the minus end of the filament for UV199's The average positive bias for air-core transformers at 100 K. C. with UV199 tubes is one-half to two volts positive. It is an axiom that a tube is inefficient when its grid is operating positive and where a strong signal is to be handled distortion is bound to result from a positive amplifier grid. Besides being far more efficient in operation, a tube with a negative grid bias consumes very much less current than a tube with a positive bias. The writer has noticed in an amplifier using air-core transformers a current consumption, 50 per cent greater than the consumption of an iron core 50 K. C. amplifier.

The potentiometer controlling regeneration on an air-core amplifier will generally, if retarded over thirty degrees of its arc, throw out a comparatively strong station entirely. This indicates that the nature of the gain in the amplifier is mostly regenerative, since for good sensitivity the amplifier must always be operated just below the oscillating point. This is not a good condition, since regeneration such as is necessary for sensitivity will distort the signal in addition to rendering the control of the set extremely critical. With an iron-core K. C. amplifier this is not the case—the grids are run negative by a "C" battery and if a potentiometer is used it is merely for volume control. The amplifier need not be operated just under the oscillating point to secure good selectivity, and the potentiometer may be retarded over its entire scale in the case of a well designed amplifier without throwing a signal out. Unless the signal is weak, it will be a gradual decrease, which means that is more nearly a true volume control than in the previous case. Yet the 50 K. C. amplifier will give better amplification with a non-critical adjustment than a 100 K.C. operated at its limit—just before the oscillating point.

Back view of a truly portable super-heterodyne, for Summer as well as all-year use. Use of small parts enables the builder of a set like this to mount his transformers under the tube sockets and out of the way, thus conserving valuable space.

Few Stages Best

THE fewer stages we can use in an amplifier the more efficient each stage

(Turn to page 93)

Where to Look for Faults in Reception

The *Causes of* VARIATION *in* DX *Results*

By ERNEST PFAFF
Assoc., I. R. E.

IN VIEW of the fact that the more or less experienced radio amateur, as well as the novice, is confronted with such a variety of confusing and conflicting information regarding the range of various receiving sets, a non-technical discussion of the factors limiting long distance reception will undoubtedly be appreciated by many enthusiasts.

It is the purpose of this article to point out the limitations of radio reception in general, since the varied conditions under which an instrument may be operated makes it practically impossible to estimate the range of a receiver with any degree of accuracy. This is due to forces entirely beyond our control, such as atmospheric conditions involving the amount of moisture in the air, electrical charges which accumulate upon particles of dust and moisture causing various forms of static, man-made electrical interference, interference between direct waves and waves which have been reflected from the upper strata of the earth's atmosphere, which manifests itself in a fading of signal strength and deflection of radio waves by large metallic masses. These factors will be dealt with in somewhat greater detail in the following paragraphs.

Theoretically, increasing the sensitivity of a radio receiver will increase its range, because the energy necessary to operate it will be reduced. The value of signal strength necessary to operate any receiving system is generally called the threshold value. The accompanying curve will show the approximate threshold value for the most common types of receivers. Abnormal conditions sometimes cause results which may vary considerably, but these results are termed "freaks" and are not worthy of lengthy discussion.

The curve in sketch 1 gives an approximate idea of the relative sensitivity of several very general types of receiving equipment. The line sloping down across the chart from left to right indicates the gradual decrease of signal intensity of a transmitting station of a given power, at various distances from the source. It will be seen from the curve that it will take approximately nine units of energy to operate a crystal receiver.

The threshold value of a regenerative receiver is lower, therefore, decreasing the amount of energy necessary to operate it to about eight units; similarly the regenerative and the neutrodyne receivers require even less energy. Lastly the super-heterodyne requires but one unit of energy to operate it and we are consequently at the point where a further increase of sensitivity will be of no avail, since at this point the noise becomes louder than the signal. In other words, if we decrease the threshold value of the super-heterodyne which is shown on the curve, there will be no increase in the range of the set because it is already capable of picking up any signal that is audible above the most favorable winter noise level.

The summer noise level is so high that the lightning discharges are made audible in the most unsensitive receiver. It should be noted that the noise apparently increases as the sensitivity of the receiving instrument is increased. In order to make the received signal audible, it is obvious that it must be of greater amplitude than the noise level. The neutrodyne is capable of reaching the summer noise level and during the summer months would have a range equal to that of any set. The super-heterodyne, however, has the distinct advantage of obtaining the maximum range which is possible under the very best conditions of noise level and interference. *(Turn the page)*

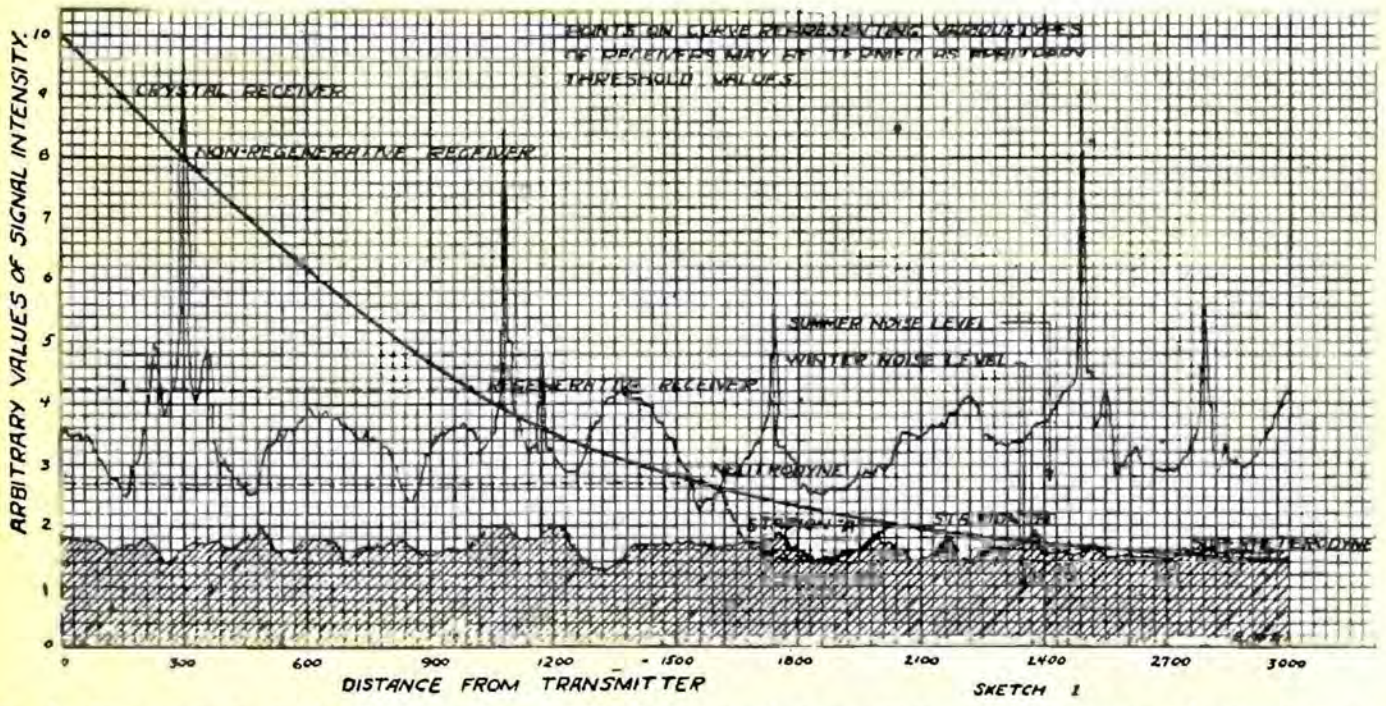

Fig. 1. The curve in the sketch above gives an approximate idea of the relative sensitivity of several very general types of receivers. The line sloping from left to right indicates the gradual decrease of signal intensity of a transmitting station of a given power at various distances from the source.

IN VIEW of the above mentioned facts, it would be useless to build a receiver of greater sensitivity than the one which was last mentioned. Adding additional intermediate frequency amplification or preceding a good super-heterodyne with a radio frequency amplifier would only serve to complicate matters. Future development in radio receivers will probably be along the lines of increasing selectivity so that one may pick out any station desired from others which may be operating at approximately the same wavelength. There will also be an endeavor to simplify this type of receiver so that the same degree of sensitivity and selectivity may be had with less equipment and consequently less cause for trouble.

By referring to the above mentioned curve, it may be of interest to note that the signal intensity decreases as the first power for distances up to 200 miles; for distances greater than this the signals will decrease according to an exponential and inverse first power law. These laws are more nearly accurate when the transmission is over water because water is better conductor than the earth.

We are often startled when we are able to receive a station at some considerable distance with comparative ease, but experience difficulty in receiving a more powerful station which is not so distant. The cause of this dead spot or semi-dead spot is usually found to be some absorbing or deflecting medium between the transmitting and receiving station. The most common causes of these dead spots are ore deposits, mountain ranges, heavily wooded tracts of land, or groups of steel buildings. Any very large substance which is a conductor of electricity may cause this effect. By referring to the chart, it is evident that station "B" which is 2100 miles from the receiver, is to be received with much greater ease than station "A" which is only 1700 miles from the receiver, because the line of signal intensity has been caused to follow the dotted line of the curve by some conducting object which is responsible for this attenuation.

With the advent of the more sentitive receivers, many other limiting factors have been realized. The most common hindrance to good reception is "lack of selectivity." It is evident that the number of stations within the range of a receiving set is increased as the square of the sensitivity; therefore, selectivity becomes increasingly important as the threshold value is lowered. This fact is illustrated graphically in sketch 2. However, this factor has been greatly diminished, if not entirely overcome, by the super-heterodyne type of receiver which permits a very marked degree of selectivity.

The Super and the Loop

THE super-heterodyne receiver has another advantage: that of being highly efficient when used with a loop antenna, whereas most of the other types of receivers require an outdoor antenna to realize any great degree of sensitivity. The greatest advantage

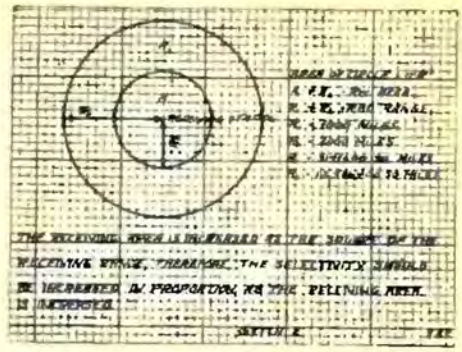

Fig. 2. It is evident that the number of stations within the range of a receiving set is increased as the square of the sensitivity, so selectivity becomes increasingly important as the threshold value is lowered. The sketch above illustrates this point.

of the loop receiver is not its portability or ease of erection, but rather in the directional qualities which enable one to entirely separate two stations operating on the same wavelength if they are located at right angles to each other with respect to the location of the receiver.

Since there is no reasonable limit to the possible degree of sensitivity of a well designed super-heterodyne, one would naturally come to the conclusion that there is no limit to the range of a receiving system of this nature. However natural this supposition may be, it is erroneous, since the principal limiting factor of radio reception is the amount of noise which is always prevalent in the atmosphere, regardless of whether it is made by natural sources, power lines or electrical devices. The causes contributing to this phenomenon of noise level are numerous, but may be divided into two general classes, namely, "man-made interference" and "atmospheric disturbance."

If one is located in the city, the factor of man-made interference becomes very serious. This disturbance may be due to any arc or spark such as would be produced by a faulty connection in an

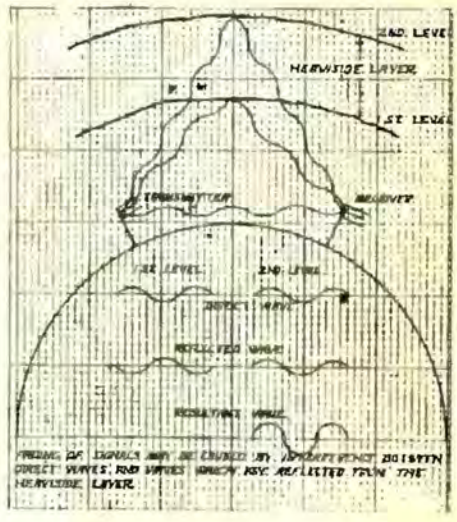

Fig 3. This sketch shows how both direct and reflected waves travel from the transmitter to the receiver. The reflected wave travels much farther than the direct wave and is therefore subject to being out of phase with the latter wave.

electric light socket, vibrating battery charger, electric furnace, tree branches rubbing against a power line or induction from any motor driven apparatus such as a washing machine or electric dish washer, etc. Violet ray machines and "X"-ray devices also are a common source of interference.

The factor of atmospheric disturbance is a universal one, but varies during certain parts of the day and is more prevalent in summer than in winter. It is commonly known that reception over great distances is made difficult, if not entirely impossible during the summer months because of atmospheric disturbances. It has also been demonstrated that reception is greatly enhanced on a clear, cold night. A brief consideration of the electrical constitution of the atmosphere is necessary in order to clearly understand the phenomenon known as static.

The atmosphere contains a distributed positive charge, which, as a whole, approximately equals the permanent negative of the earth. Franklin proved that there was a difference of potential between the earth and the atmosphere when he succeeded in drawing a spark from the cord which was holding his kite. The regular increase in voltage between the earth and the air at various heights is called the potential gradient. The vertical potential gradient varies between thirty volts per foot at the earth's surface and one volt per foot at the height of six miles. This condition of the air is generally conceded to be due to ionisation of the gases which compose the earth's atmosphere, by cathode rays or other corpuscles from the sun and radio-active constituents of the earth's crust. The process of ionization consists of breaking up the atoms which constitute these atmospheric gases. When an atom is broken up into its constituents, the result is a positive charge of electricity and a number of negative charges or electrons.

How Ions Recombine

AS THE relative position between the earth and the sun changes, it is evident that the extent of ionisation will vary to a considerable extent. In other words, the ions recombine rapidly as soon as the force which caused this condition has ceased. This de-ionisation or recombining of the ions to form gas atoms will change the amount of electrical charge in the air. It is the change in amount of electrical charge, or change of potential gradient, which causes the electrical disturbance or noises in the radio receiving set which are commonly known among radio operators as "grinders." These grinders travel over great distances and are more noticeable at night just after sunset, because it is then that the process of de-ionisation is at its height. The potential gradient may also be varied by vertical air currents, which are caused by the sun's rays heating and expanding the upper layers of the atmosphere. During the summer months, when the sun is relatively close to the earth, the extreme heat will cause the air to shift vertically as already explained, thereby

(Turn to page 95)

Some Radio *Luminaries* —and *Why*

Drake Studio Photo, Chicago

WHO hasn't heard the McCormack-like voice of Sandy Meek trilling from the antennae of prominent Middle-Western radio stations? Very few, we'll wager, for Sandy has covered a lot of ground lately, specializing in Scottish and popular ditties from WBBM, WHT and WQJ, Chicago, also having appeared on RADIO AGE programs at KYW. The demure miss at the right, in case you aren't a movie fan, is Miss Carol Dempster, leading lady of the D. W. Griffith stock company. She told of some of her harrowing experiences lately when she appeared before the "mike" at WBCQ, the Grebe station at Richmond Hill, L. I.

Intl. Photo

WALTER WILSON, "Uncle Bob," the kiddies' bedtime idol at KYW, is shown spending a good part of his time in the admirable occupation of teaching school children the doctrine of "The Curb is the Limit, so stay off the streets." He has signed up more than 50,000 children in his campaign. His goal is 100,000. More power to you, Walter!

Radio Age Announces

A PRIZE CONTEST

For the Readers of This Magazine and Particularly the Followers of the Pickups and Hookups Department; Awards to be Made Monthly to Lucky Winners!

WHEN all the radio set builders are busily engaged in making up the world beater for the Winter session of DX chasing, or substituting quality for quantity for the benefit of the family, it behooves this department to get busy with a matter that is of interest both to us and the readers. This matter is the subscription list of the magazine.

Idly gazing over our subscription list the other day, we observed some very strange things. For instance, we have least subscribers in Mississippi and New Mexico. There might be a reason for a paucity of subscribers in Mississippi, for we can well remember as far back as 1912 when that state always was a hard one for radio, for what reason we do not know, but assume on account of the "delta static" which many of the old timers will remember.

Whether this same reason could be ascribed for the poor showing in New Mexico is not known. We do not believe these conditions should be allowed to govern, and with this and other figures in mind, we are starting a subscription contest for the benefit of the Pickups and Hookups readers (and of course all RADIO AGE readers.)

Monthly Prizes

THE contest will take the form of monthly prizes given for the RADIO AGE reader who sends in the greatest number of subscriptions for a given month. The contest is to be started during the month of August. The reader gets this RADIO AGE by the 15th of July and will be in position to compete for the August prizes.

First prize for the RADIO AGE reader sending in the greatest number of paid up subscriptions to the magazine during the month of August will be a .0005 mfd ultra-low loss variable condenser. You have probably seen it pictured on many occasions in the advertising pages of RADIO AGE.

The second prize will be a year's subscription to RADIO AGE for the reader sending in the second largest number of subscriptions, and for the third prize a six months' subscription to RADIO AGE will be awarded. If you are already a subscriber your subscription will be extended for the period of the prize you win.

A Fertile Field

MANY of you have countless friends who are readers and yet not subscribers of RADIO AGE. This is a very fertile territory for you to work. Another is the occasional reader of the magazine upon whom you can exert your wiles. The ladies are not exempt from the attraction of RADIO AGE, as you have observed from the many letters they have sent in.

Despite the fact RADIO AGE has a very flattering news-stand sale, nevertheless it seems to us that we would become much more like a family circle if the number of annual subscribers were increased. So many times, through one reason or another, you will fail to get your copy of the paper at a news-stand, whereas by being a subscriber you can always count on having the postman deliver your favorite radio magazine to your home or office once a month.

A Family Affair

WHILE the contest is intended for all readers of RADIO AGE, at the same time it is believed that our Pickups and Hookups readers are the ones most interested in the award of prizes, since they belong to that indefatigable band of experimenters who are never content to let radio stagnate, but who by their innate curiosity are forever led into trying this and that combination of circuits; of tinkering to see what makes the thing tick. All of this labor, some mental and some physical, is contributing toward the advancement of the art; for after all, it is truly an art. And, incidentally, if you will stop to consider, it is the only art in existence in which there are so many devotees scattered over the four corners of the globe, all intent upon making some discovery or improvement that will not only reflect credit upon the worker, but simplify the game for the benefit of the millions now interested in it.

A Worthy Project

FOR that reason we believe the Pickups and Hookups readers will be interested not only in making a fight to win the monthly prizes, but will as well be glad to increase the number of subscribers to the magazine and thus increase the family circle. More subscribers mean more readers of this department; more readers mean more contributions; more contributions mean more data and information for you, and more information for you means your quicker advancement in the game. So it is something worth while for you to strive for both from the remuneration involved and the mental satisfaction in learning more and more of the most interesting study in the world.

And the holders of the D. T. buttons who have striven for distance and succeeded should now have an added incentive in doing what they can to spread out the scope of their favorite journal, which is even now read on the two continents and many of the island countries of the world.

On your toes, readers of this department, and let's see what you can do! First prize, the .0005 mfd ultra-low loss variable; second prize, a year's subscription to your magazine; third prize, a six months' subscription. These prizes are for the men and women who send in the greatest number of paid up subscribers to RADIO AGE during the month of August. Returns must be in by the last day of August so we can make prompt award of the prizes.

Pick-ups and Hook-ups by our Readers

THE material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE, is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

MANY ITEMS of interest will be found in this department for August, on account of the industry of our contributors. The Summer months are unquestionably the ones when all the revamping of sets should be accomplished and any new ideas tried out, so the final set will be in excellent condition for the Winter months.

Several of our readers have written in asking for a method of drilling glass panels. While it is a ticklish job, it can be done. The safest way is to have a wooden template to fit over the glass panel, with holes bored in the wood for the positions you want them to occupy on the glass. Then take a rat-tail file and on an emery wheel grind one end down to a chisel edge. Then insert it in a hand brace (not the egg beater type of hand drill, but the brace and bit type). Put a little three-in-one oil or turpentine on the place to be drilled, and start drilling. It is somewhat of a laborious process, but if you must have glass panels, you must pay the price in manual labor. The wooden template serves to keep the drill from slipping sideways.

Toroid Coils

Our request for data from those who have tried to build the toroid coils has not been in vain, for we hardly had uttered the request when George B. Hostetter, Box 225, Freewater, Oregon, came to the rescue of our readers with two pictures and a descriptive article of how he made his toroid coils, which article we are including in this month's department.

One of our traveling readers has sent in pictures of his portable set. R. E. Cox's contribution will also be found in this section.

Naturally enough, many of the potential DT button aspirants will not be quite as active during this month unless they confine their activities to the stations heard on a portable while on their vacation. It would not be surprising if we had just a few of the button seekers this month, but we know they will be back with full force within the next month or so when the weather begins getting back to normal as far as radio is concerned.

From Francis Dickie, Heriot Bay, British Columbia, Canada, we have a picture of a radio-tester; a little device well known to the craft for use in testing for "opens" in coils and other purposes. A picture and a short description of the outfit is given for the benefit of our readers.

Real DX Work

Recently we spoke of the long distance achievement of E. H. Scott, who heard all manner of American signals from Tasman, Nelson, New Zealand. In connection with this matter we note that KFRU, owned by the Etherical Radio Co., at Bristow, Okla., considers this reception the longest distance from which "The Voice of Oklahome" has been reported, according to a letter received in our office from Roy C. Griffins, the director of that station.

RADIO AGE is always glad to receive letters like the following from Rhea Pearce, 69 Vedoda Way, Atlanta, Ga., for we are then sure we are on the right track as regards things that interest and satisfy our readers. After sending in his remittance for another year's subscription to the magazine, Mr. Pearce says:

"I think RADIO AGE is the best on radio I've seen. Your hookups are good and I've built sets by a lot of them and they always work." The last three words are most appreciated because we have always tried to adhere to a policy of not giving space to sets which have only been constructed in the mind. We could tell you a lot of things about receivers built in the mind which were given space in radio periodicals. However, such a practice has only served to make us more firm in our determination not to publish anything that has not been built, tested and found effective for the purpose for which it is intended.

Dial Twister P. E. Chapman, 805 North Preston St., West Philadelphia, Pa., who is greatly interested in the application of portables to a canoe, has written us telling of his scheme of combining pleasure on the water with radio. He uses a standard variometer hooked up after the fashion of the ultra-audion with two stages of amplification. Using "199" tubes, he finds this set weighs little and occupies a very small space in the canoe. With a six foot piece of copper wire (bare) dangling in the water and without an antenna, Mr. Chapman finds this set will give loud speaker volume on local stations in Philadelphia so the music can be enjoyed on the lake. His set was assembled at a cost of $16.83 and a diagram of the circuit is shown elsewhere in this department. The assembly is left to the individual needs of the builder.

Charles Hrdlicka, Kimball, South Dakota, has epitomized the experience

CONTRIBUTORS

Name	Address	City
R. A. Ganatt	17 Lorne Road, London	N. 4, England.
George B. Hostetter	Box 325	Freewater, Ore.
Francis Dickie	Heriot Bay	B. C. Canada
P. E. Chapman	805 N. Preston St	West Philadelphia, Pa.
R. E. Cox	Douglas Shoe Co	Brockton, Mass.
A. E. Hodson	139 Rawson St., Farnsworth,	S. E. Lancashire, England

DIAL TWISTERS

Leland Steele	122 South White St	Grand Island, Neb.
Harold Adams		Evans, Colo.
B. R. Cadman	3096 Bacon Road	Berkeley, Mich.
Shirley L. Travis	50 West Genesee St	Hornell, N. Y.
Charles Hrdlicka		Kimball, South Dakota
Rhea Pearce	69 Vedado Way	Atlanta, Ga.
W. J. Sergent, Jr.	25 Spellow Lane, Walton	Liverpool, England
Charles A. Wilson	2674 Burling St	Chicago, Ill.
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Harold Beaman	95 Sherwood St	Ottawa, Ont., Canada
W. M. Patterson	1003 Indiana Ave	Monaca, Pa.
Hans G. Hirsch	P. O. Box 993	Havana, Cuba
William Motyle	1320 N. 14th St	East St. Louis, Ill.

of all radio fans in the words with which he describes his receiver. He says, "I attribute the success of the receiver to the fact that high class material is employed throughout."

There is no question that the best is none too good for our modern receivers when we strain to make each tube and its associated parts do its full duty. Mr. Hrdlicka is using a five tube Weagant-Reinartz described in the May RADIO AGE, with the last two tubes arranged push-pull for quality. His list of stations automatically gives him the coveted button.

Shirley L. Travis, 50 West Genesee St., Hornell, N. Y., sends in an interesting list of stations picked on a receiver of the factory built type, which list also entitles him to entrance into the family of Dial Twisters.

B. R. Cadman, 3096 Bacon Road, Berkeley, Mich., informs us of the success he has had with the set he constructed from an article in RADIO AGE, in May, 1924. He says he has made a number of sets since that time, but always goes back to his first love for distance work, which is a converted single circuit with two stages of audio. We are glad to see that Mr. Cadman believes in converting the single circuit, for we know of thousands who are often of the same opinion, especially on the nights when lean signals and fat regenerative whistles do not mix well. His efforts in tuning also merit DT recognition, so Mr. Cadman gets the little button.

Harold Adams, who lives at Evans, Col., sends in a list of Eastern and Western stations that permits him to become a member of the dial twisting fraternity. He does not state his type of receiver, but he has the stations to show for it, so it must be all right.

Another ultra-audion fiend who lives at 122 S. White St., Grand Island, Neb., is Leland Steele, who sends in a dandy list of stations. He is another of the RADIO AGE addicts who tells us that every set he has made from blueprints in our magazine works, and works fine. Another DT added to the ever increasing family of distance hounds.

From across the pond our English cousins have furnished us a bit of news, which is very interesting. The writer is R. A. Ganatt, 17 Lorne Road, London N. 4, who tells us of the great British DX movement. Knowing that our readers are keenly alive to the quickening of the radio pulse abroad, we are printing Mr. Ganatt's communication in full. It follows:

"There is a great DX movement amongst the British fans for the Summer months, and already many ambitious plans have been made. At last the British radio fan is feeling how much he is missing by not putting more enthusiasm into radio. Up to the present it has been a half-hearted attempt, but now things are beginning to move.

"Capt. Eckersley has aroused all self-respecting fans in talks given from London, and he gives the impression that only about five people in every hundred who listen want to get DX. This is absurd. Britain wants to listen in more than she ever did to American and foreign broadcasting, and she is now putting her shoulder to the wheel and before long she will get what she wants.

"The spirit of enthusiasm is getting hold of the British bug properly, and he feels himself endowed with greater strength toward this effort. This transformation has been in force only for a week or two, and already its effects are being felt. Heretofore the British fan did not go in for anything like DX and was content to listen to the only programs available, and these local ones at that.

"Manufacturers and dealers agree that an unprecedented rush for radio sets and parts has occurred during the past few weeks. This seems unusual, in view of the Summer months, but it is a fact, nevertheless. Multi-tube sets, super-hets, neutrodynes and the like are commanding the attention of the British amateurs. The fans are feeling ashamed of themselves, and on the quiet are saying, 'I'm not going to let my American cousins put it over me.'"

And finally Mr. Ganatt gives us warning that the movement is bound to succeed, and for us to be on our guard, for the British say they refuse to be a bunch of "radio boobs" any more.

There is no question but the continental attitude in high places towards radio has resulted in keeping down the enthusiasm of the radio public, but once feeling their oats, there is no reason why the millions of listeners in the British Isles should not take matters into their own hands and bring about conditions parallel to those in existence in the United States, provided they desire that kind of conditions. More power to our British experimenters and DX seekers.

Speaking of conditions in England, we have a letter from A. E. Hodson, 139 Rawson St., Farnsworth, S. E. Lancashire, England, reporting his reception of KDKA, WGY, WBZ and CKAC, together with a number of continental stations. He sends in a hookup very popular with the British fans, which is printed at the bottom of this page.

Some of our radio friends are terrified at the prospect of the combine using some sort of a hashing machine to make broadcast music unreadable except to those owning a receiver put out by the radio trust. This subject has had some attention from contemporary radio magazines, but so far the matter does not seem to be as terrifying as it sounds. Within thirty days after the first hashing machine goes to work, its circuit and constants would be known and within

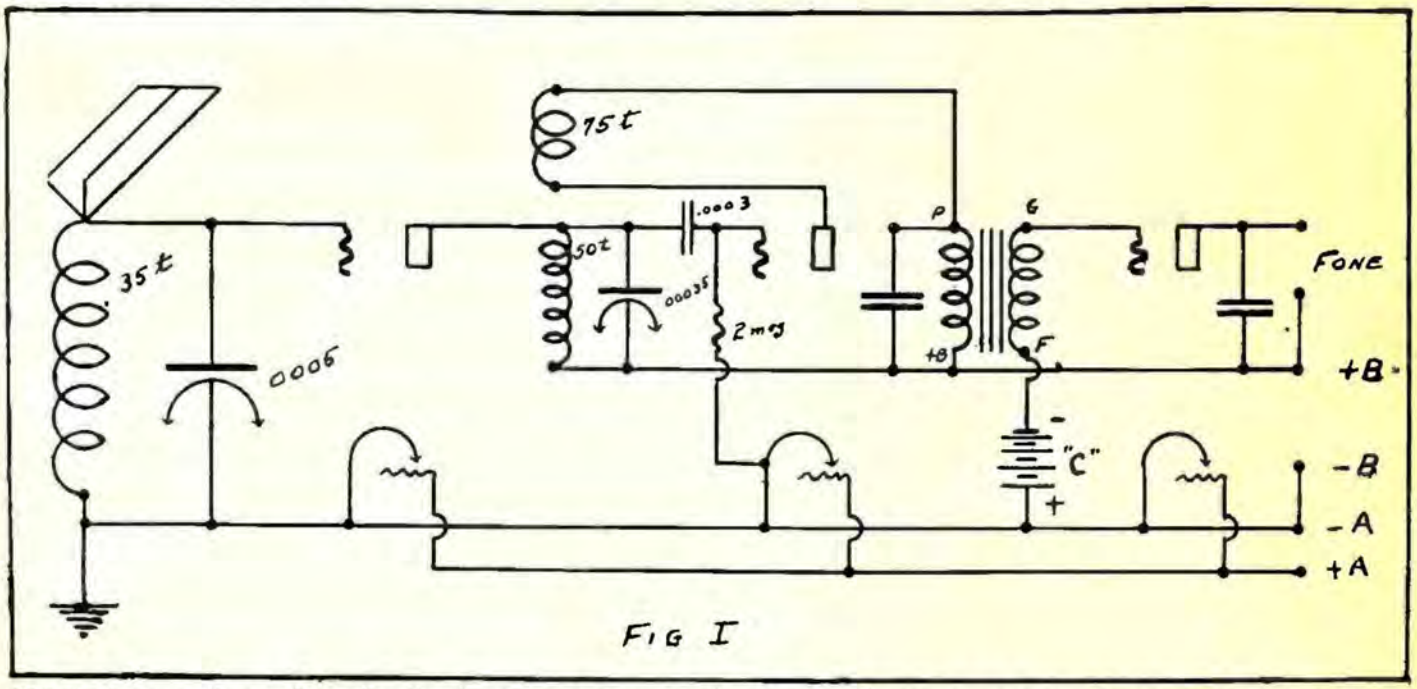


FIG I

This is the general type of tuned radio, detector and one stage of audio amplification in use in the British Isles. It is sent in by A. E. Hodson, 139 Rawson St., Farnsworth, S. E. Lancashire, England.

another thirty days a goodly number of experimenters would have receivers of their own rigged up. From that point it is easy to see that such a scheme of broadcasting only for the benefit of the privileged few will hardly ever come to pass.

There is hardly a thing that has been invented that has not had something come along later to either improve it or nullify its usefulness. And the prospect of piping music into the home, which was done as early as 1912, might seem rosy at first blush, but a little sober reflection will produce the thought that the one tie that binds in radio is the ability of the set owner to pick programs at will, and not have them thrust upon him willy-nilly. So it does not seem there will be much of a change in the status of broadcasting. Those who derive an advertising benefit from the transmitters can hardly expect the public to contribute, when, after all, the amount of money tied up in receivers and allied apparatus probably overshadows by a great deal the total involved in the ownership and operation of broadcast transmitters.

The circuit shown in Fig. 1 can be made up with honeycombs for covering a wider span of wavelengths than the broadcast band. Otherwise it can be made up in the low loss type of winding. The detector is regenerative. This type of circuit is in use in the British Isles on account of regulations preventing a regenerative set coupled to an antenna. Some of our English friends tell us in letters that despite the ban against regenerative sets there are a multitude of squeals to be heard over there. This is the set with which Mr. Hodson heard KDKA, WGY, WBZ and CKAC, together with a bunch of broadcasting stations on the Continent.

William J. Sergent, Jr., 25 Spellow Lane, Walton, Liverpool, England, sends in a DX list that certainly gives him the button. He also heard KDKA, WGY and WBZ using a four tube set, one radio, detector and two audio, built along the lines as Mr. Hodson's shown in Fig. 1. He also uses a one tube receiver with two stages of audio and on it does most of his DX work. He is particularly desirous of getting an extremely selective set using four tubes. Maybe some of our Pickups readers can give him a circuit that will do hair-breadth tuning.

The device shown in Fig. 2 is a radio-tester, manufactured by the British Industries Association, 317 High Holborn, London, W. C. I. It consists of a dry cell, a small lamp and a series connection arranged so that continuity of wiring may be tested in inductances, transformers, phones, rheostats, potentiometers; it can also be arranged to test condensers. A similar device in the workshop of the experimenter will save a lot of trouble in testing. The illustration is sent in by Francis Dickie, Heriot Bay, British Columbia, Canada.

Previous mention has been made of the contribution of George B. Hostetter,

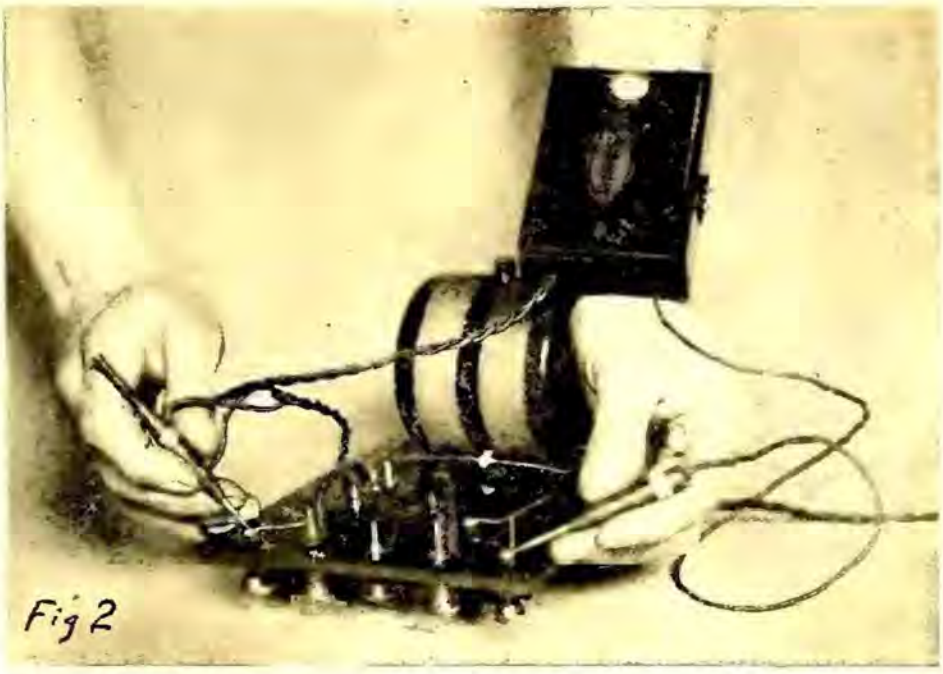


Fig. 2. A neat and efficient means of testing for breaks in wiring of sets, which can be applied to almost any use in determining the continuity of wiring in coils, transformers, phones, and other apparatus.

Box 325, Freewater, Oregon, who tells readers of this department how to make the toroid coils for use in radio frequency sets. The process is as follows:

Procure a cardboard tube one and a quarter inches in diameter and about nine or ten inches long. This is shown at G in the photograph, Fig. 3. On this wind a layer of ordinary twine string (B in photograph) fastening the end with a tiny piece of adhesive tape, A. Over this fasten a thickness of writing paper. Get a roll of half inch adhesive tape and cut off a piece about 21 inches long. Split each end of this piece for a distance of about seven or eight inches. Lay the tape length-wise on the tube, sticky side out, pushing the split edges into the ends of the tube out of the way. Now wind on 225 turns of No. 24 SCC wire, D and D1 in the picture, securing the ends by punching a hole in the tape.

Lay one of the quarter-inch pieces of tape back over the coil and the opposite quarter-inch piece on the other end of the coil, so as to form a strip a half inch wide over the top of the coil.

About a quarter of an inch from the end of this winding, start the primary, winding four turns of the same wire (E1). Do not break the wire, but run it along the tape for two and a half inches, then wind four turns more (E2), run along the tape again for two and a half inches, and wind four more turns (E3). This makes twelve turns in all for the primary. Each coil of four turns should be held temporarily in place with a small piece of adhesive tape.

Now take the two other pieces of quarter inch tape and stick them tightly in place over the primary as at (F).

Pull the tape (A) loose and unwind the string, pulling it out the end. This will allow the coil to slip off the tube very easily. Then the layer of writing paper may be removed.

Cut a piece of light-weight cardboard an inch wide and bend it into a ring whose outside diameter is exactly equal to the length of the secondary coil measured on the tape. Cut two circles of heavy cardboard two and a half inches in diameter. Glue the ring to these disks, forming a spool as shown in the upper part of Fig. 3.

With a piece of adhesive tape fasten one end of the coil to the spool, bring the other end of the coil around until the ends fasten together with another piece of tape, working between the turns of the coil, which may be straightened back into place after the ends have been secured. You will now have a coil as shown in Fig. 4. The leads may be brought out through holes punched in the disks as shown. These coils may be used in any tuned radio frequency circuit. They eliminate special placement of coils or the use of stabilizing devices.

Another traveling man, this time R. E. Cox, who travels for the W. L. Douglas Shoe Co., Brockton, Mass., and who writes from Coldwater, Mich., shows us how it is possible to always be in touch with the world by means of a portable which he carries with him on all his trips.

In Figure 5 is shown the receiver, which uses the circuit around which Browning-Drake have developed a receiver, while Figure 6 shows the self contained set being carried by Mr. Cox, whose northern extremities were not shown, since he was more desirous of showing us the set than himself. Mr. Cox tells us the set has four tubes, the fifth being in parallel with the fourth. He gets excellent results and is strong for RADIO AGE.

For essentially local work in a canoe, where weight is a consideration, the set shown in Fig. 7, contributed by Mr. Chapman, might be of interest to readers with aquatic proclivities in the Summer-

time. A six foot piece of bare wire serves as the ground. Locals come in well on a loud speaker and help considerably while out on the lake.

Charles A. Wilson, 2674 Burling St., Chicago, Ill., went DX hunting on the night of March 29, and came forth with a very interesting radio scalp, that of 4YA, the broadcasting station of the British Electric and Engineering Co., 219 Moray Place, Dunedin, New Zealand. To make sure there would be no mistake, Mr. Wilson communicated with the company and received due verification of the reception. While it has become rather commonplace for the New Zealanders to hear our American stations, it is nevertheless somewhat of a fete for the reception to be in the opposite direction. Both Mr. Wilson and the broadcasting station in New Zealand have reason to feel proud of their achievement.

Robert A. Fulton, of Viroqua, Wis., who, incidentally, is only eleven years old, has qualified for a D. T. button with the list of stations he sends in, all of which have been heard on a home-made typically regenerative set.

Using a two tube ultra-audion described in the March RADIO AGE, Harold Beaman, 95 Sherwood St., Ottawa, Ont., Canada, brought in a total of 79 stations from the Atlantic to the Pacific and earned for himself an emblem of the dial twisting fraternity.

W. M. Patterson, 1003 Indiana Ave., Monaca, Pa., who seems to be a member of the A. R. R. L., sends us a list of his DX results on a single tuber which allows him to bring home the bacon in the form of the button. His list of 83 stations includes a number of amateur phone stations.

The conductor of this column has been accused of many things in his career but never yet has he qualified as a mind reader. The reason for the foregoing is the receipt of a letter from a radio enthusiast whose address is Route C, Box 141, Frederick, Oklahoma. The correspondent neglected to sign his name to the letter, and as a consequence we have a Dial Twister's button issued to an address instead of an individual. If the resident of the address given above will communicate with us, we shall be glad to send him the button which he has merited through the DX list sent in.

Making up a "Baby Het" from specifications in RADIO AGE and adding a stage of audio for increased volume, Hans G. Hirsch, P. O. Box 993, Havana, Cuba, is having the time of his life logging them from coast to coast. His list is a fine one, especially when many of our readers imagine that residents of the Gulf section are continually fighting static. We will give him the button as an indication that static does not mean much in the existence of a real distance seeker.

Patting our Editor on the back for his resolute stand against the insidious

Fig. 4. Here is shown the toroid as it looks when completed. A careful study of the accompanying description will show you how to do it nicely.

tactics of the Octopus, William Motyl, 1320 North 14th St., East St. Louis, Ill., furnishes us with a DX list of stations heard on the regenerative reflex described in the March blueprint section. Mr. Motyl used a variometer with an aperiodic primary instead of the r. f. transformer and a variable to tune the r. f. transfomer proper, these two additions helping out to a considerable extent on DX. Another member added to the dial twisting family.

Those interested in insulating materials may find data of interest in the technological paper No. 284, "A Study of the seasonal variation of the r. f. phase difference of laminated phenolic insulating materials" by J. L. Preston and E. L. Hall, which has been issued by the U. S. Bureau of Standards. Copies of this paper may be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 5 cents.

The conductor of this column is taking no chances of your failing to read about the subscription contest, which has been started by Radio Age and accordingly calls your attention to the full details on page 18 of this number. Dial Twisters are especially invited to take part in the contest because of the nature of the prizes and because of the fact that readers of this department are the ones most interested in the creation of a larger Radio Age family which will naturally be followed by much more interesting data in these columns.

The a. c. tubes, which are being given consideration in this issue in an article by Turner, should command the attention of our fans. Probably more research is still necessary with these tubes, but nevertheless they seem to point the way to the battery-less set of the future. See what you can do with them and let us have the dope.

Dial Twisters may be interested in knowing that WGY may now be found on four wave channels, according to a recent announcement. These follow: WGY 379.5 meters; 2XAF 38 meters; 2XK 109 meters and 2XAH 1660 meters. The last three groups of call letters are special experimental licenses of the General Electric. The purpose of the four channels is for research work by the company's engineers on transmission problems under all conditions; day and night, summer and winter.

Radio fans who are equipped to receive on the four wavelengths are invited to report to the engineers the quality,

(Turn to page 86)

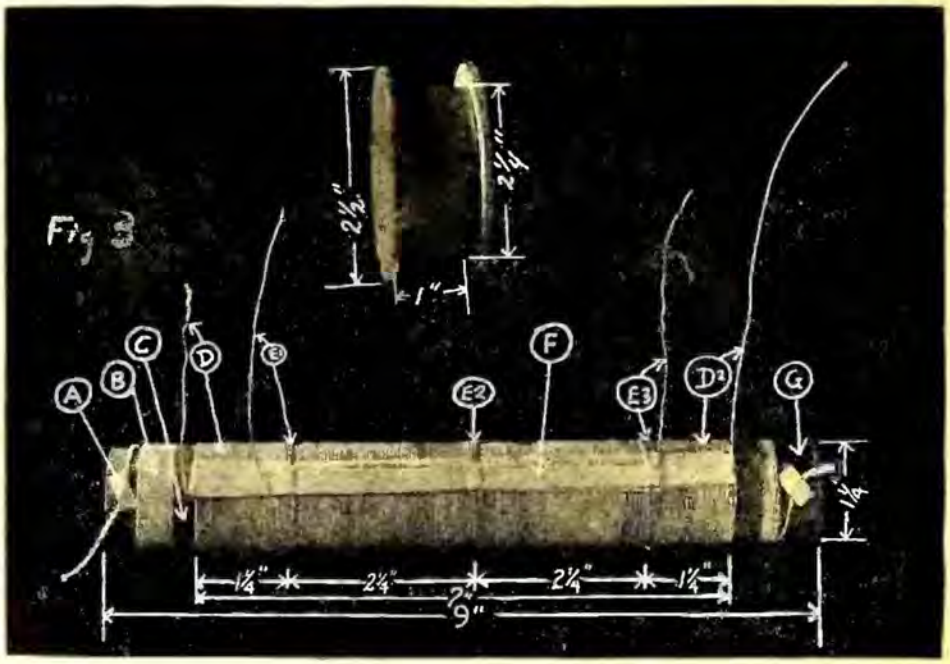
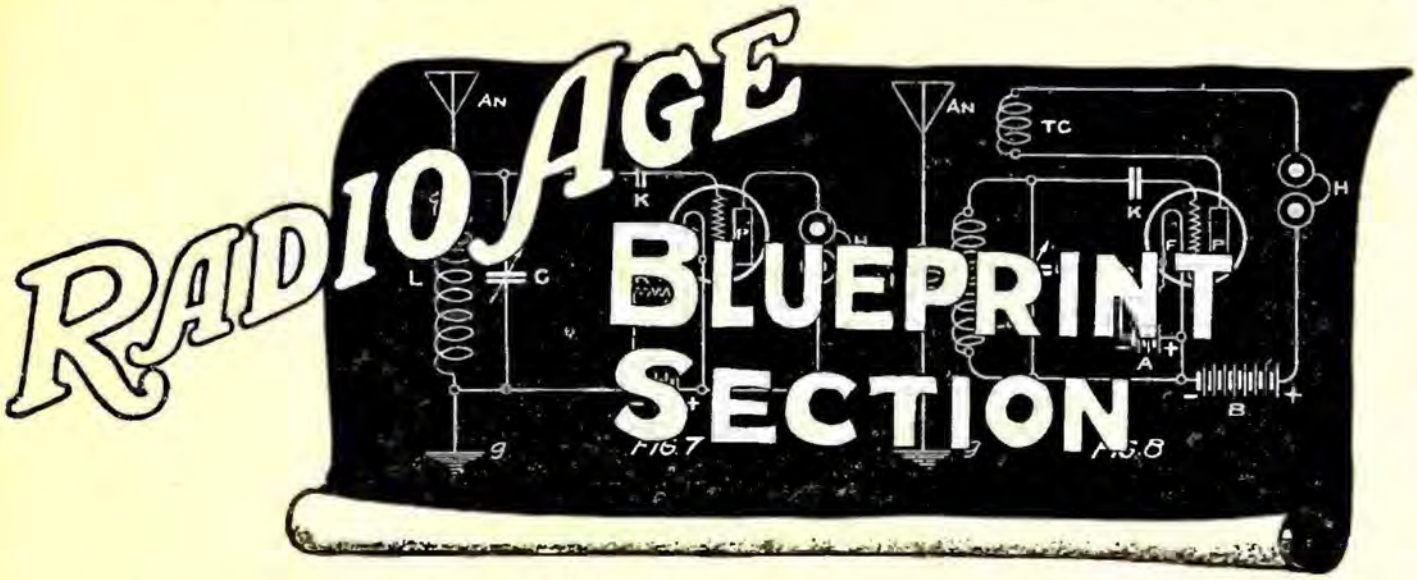


Fig. 3. The picture above shows the toroid coil wound on a straight form, preparatory to its being bent in the form of a doughnut. The form shown at the top is that used in the final assembly of the coil.



Radio Age Offers the First Real Presentation of Basic Hookups in "De Luxe Edition"

Conducted by F. A. Hill

IN putting forth the August number of RADIO AGE, its publishers have simply acceded to the demand on the part of radio fans for the basic hookups from which the various radio circuits have been developed, without a plethora of misleading terms attached to an old circuit and put out under a fancy sounding name. The radio fan has come to the stage in this interesting science where he courts and welcomes frankness, and it is the purpose of RADIO AGE to give the reader such frankness in its columns.

In looking over the crystal circuits shown by Mr. Rathbun on page 30 of this section, you will find all the possible means of hooking up a crystal set. These forms have been tried out by the Bureau of Standards and measurements made to enable the radio fan to determine which type he desires. The relative audibilities shown will soon show the interested fan which type of hookup he wishes to use.

Yet many of the forms shown here have found their way into the market under "high-faluting" names, some of the individuals even going so far as to claim the invention of this or that particular crystal circuit. Such practices as outlined are not countenanced either by the readers or the publishers of a good radio magazine. This is only one of the many reasons for our publication of this wonderful DeLuxe Edition.

Another of the reasons for its appearance is the fact that many experimenters have been stumped to find a basic circuit when they have been assailed on all sides with developments, improvements, additions and deletions to the standard circuits. Insofar as it is possible in the blueprints shown herein, we are giving the basic circuit and a brief comment as to its history and its adaptability for experimentation. Perhaps later experimentation with some of the circuits has shown improvements can be made by slight deviations from the plans. Where such is the case, due mention will be made of the changes and the reason for such changes.

With the August number of RADIO AGE in his possession, the radio fan is in a position to start work on the simplest to the most complex radio set, since nearly every form of set is shown basically; the experimenter only has to use his ingenuity in making up sets embodying elaborations or amplifications of the basic data given.

The popularity of the blueprint section of the Radio Age each month can best be understood by the flood of letters from fans desiring to build the sets described, and also from the satisfied set builders who report their success with the receivers.

The correspondence seems to be pretty well divided over the entire country, including Canada. Foreign countries also furnish a pretty good volume of letters, all testifying to the popularity of the blueprint instructions as contrasted to the conventional black and white drawings.

In following the blue prints experimenters should always remember that for electrical connections the schematic diagram should be followed, since the other drawings are either isometric or plan views of the set and are not intended as electrical hookups. Always follow the schematic when wiring your set and you will not make mistakes.

In the blueprint section this month readers will find a number of the conventional symbols which have been drawn up by Mr. Rathbun and which should prove of interest to the fans who are beginning to learn the intricacies of the game.

Readers following this section closely will see all of the basic, hookups from which the many forms of circuits are developed. Any one of the circuits can be twisted around in different ways as far as the material is concerned, but the electrical characteristics will not change. The substitution of variometers for tuning the plate circuit of a tube instead of an inductance and a condenser does not change the set from a regenerative set into something else. And so on down through the list.

In thinking over the various items which the experimenter will require in the assembly of the various circuits, very careful consideration should be given to the use of good material. There has never been any question of the fact that good material will make a set where poor material will ruin it. See that your condensers and inductances are made by reliable manufacturers. Look over the socket market and pick out one of the type that will give you positive contact on all the prongs.

The grid leaks should especially be scrutinized for in the grid leak lies a great deal of the trouble of the set builders. It might pay to buy two or three leaks of different values just to be sure you have a good one. The little grid condensers should also be good ones, preferably with mica insulation and copper plates that will not alter their characteristics.

A good deal of attention can also be paid to transformers and to loud speakers.

A Timely Discourse on

Conventional Radio Symbols and Crystal Detector Sets

By JOHN B. RATHBUN

How to Understand All Radio Symbols; Giving the Crystal Its Merited Attention

CONVENTIONAL radio circuit diagrams, the short-hand of radio, have always proved a sticker to the tyro in this science, and it is certain that many a prospective builder has contracted a bad case of cold feet and quit the game when he was brought face to face with the curley-cues and zig-zag lines of the technical diagram. Not being very familiar with the apparatus itself, it is no wonder that the prospect of learning still more of the technique filled him with dismay.

However, when these symbols are once understood, they are more easily read and understood than the picture diagrams for they show the functioning and general principles of the circuits far more clearly to the experienced eye than pictures of the apparatus. You can see the course taken by the current in the different branches of the circuit at a glance, and can immediately classify the circuit with little chance of error; something that I have never yet been able to do with the picture type. However, the picture diagram has its place in the scheme of things where the reader is not interested in theory, but simply in building something that will bring in the voice and music with the least delay and study.

For the benefit of those who have not yet become familiar with the standard conventional symbols used in radio circuit diagrams, I have prepared the accompanying two pages of blueprints in which the more common symbols and abbreviations have been defined. In addition to the listing of the symbols, I have taken up a short description of the various parts used in the receiving circuits so that the subject will be more easily followed.

Circuit Symbols (Sheet No. 1)

1. INDUCTANCE (Air Core Type). The hollow coil of wire or other inductance coil with an air core is shown by a continuous scroll or helix as in Item No. 1. Its purpose is to choke back or impede the flow of radio frequency current or for tuning radio circuits to the wavelength of the transmitting station. The abbreviation is the letter (L) and its magnitude is generally expressed in millihenries, or by the number of turns of wire.

2. IRON CORE CHOKE. This consists of a great many turns of wire wound around a core of soft steel wire or thin steel sheets called "laminations." It is used when a greater retardation must be had than is convenient with an air core choke, and can choke back audio as well as radio frequency currents. Values in henries or millihenries.

3. TRANSFORMER-COUPLER (Air Core Type). This transformer for radio frequency currents consists of two coils of wire called respectively the PRIMARY (PRI.), and the SECONDARY (SEC.) coils. Radio frequency currents passing through the primary induce similar currents in the secondary coil, thus affording a means of "coupling" two circuits together magnetically. In our diagrams the primary coil (PRI) is shown with fewer turns than the secondary and is shown on the end opposite to the grid connection (G). The other connections are the filament (F), the plate connection (P), the positive "B" battery connection (B) and the neutral tap (N) used for certain neutralized circuits. The abbreviation is (RFT), and it may be tuned or untuned, the former by a variable condenser.

4. VARIOMETER. This is a form of variable inductance used in place of the air core choke, and consists of a movable member (The Rotor) which turns inside of a stationary coil called the "Stator." The abbreviation is (VAR). By this means the inductive or choke effect can be varied through a wide range without condensers and the device is frequently used for tuning a circuit inductively. It may be tapped at the mid-point as shown at (Q).

5. ANTENNA-GROUND-ARRESTOR. At the right is shown the symbol for the antenna or aerial, abbreviation (ANT). In the center is the symbol for a ground connection (GND), and at the right is the convention for a lightning arrestor (LA).

6. OUTPUT - PHONES - SPEAKER. The symbol for the headset or phones is shown at the left, which may indicate the output of any radio receiving circuit. Abbreviation (PH). The polarity may be marked by (+) or minus as shown, or this may be omitted at will. The positive connection of the phone cords is colored red and this red strand should be connected to the (+) connection of the circuit. At the right is the symbol for the horn or loud speaker which can also be marked with the polarity.

7. CONDENSERS. A "fixed" condenser consists of alternate sheets of tinfoil and paper or mica compressed into a compact pile, and adds "capacity" to the circuit, an effect opposite to that of an inductance coil. The symbol for a fixed condenser is at the left where the abbreviation is shown as (K) and where the capacity in microfarads is also added where advisable. A VARIABLE CONDENSER used for tuning inductances is shown at the right, where the rotor plates are indicated by the curved line and the stationary or stator plates are shown by the short straight line. The Stator (Straight line) should go to the grid of a tube, while the rotor is connected to the ground side or (—A) side of the circuit. This condenser is also rated in microfarads (m. f.).

8. RESISTANCES—RHEOSTATS. A fixed or unvarying resistance is shown by the zig-zag line which distinguishes it from an inductance. For low resistances used for controlling the filaments of the tubes, its magnitude is given in terms of ohms. For very high resistances, as used for grid leaks, the resistance is given in terms of MEGOHMS, abbreviated (MEG).

A RHEOSTAT or variable resistance is shown at the right and is usually employed for controlling the filament current of tubes. The letter (R) is used for a rheostat, or resistance.

9. BATTERIES. An "A" or filament battery or a "C" battery is shown by the symbol at the left which consists of alternate short heavy lines and longer light lines. The short heavy lines indicate the negative (—) plates while the long lines are the positive plates (+). Each pair of these lines represents one cell, and it is the best practice to mark the voltage below it as at (6v.) and the letter (A), (B) or (C) above it to designate the type of battery. A "B" battery is at the right where the dotted line indicates a number of omitted cells, there being too many cells in a "B" battery to draw them complete. When the battery is tapped at some low voltage, as at (+22), the voltage of the tap is marked in this way.

10. PONTIOMETETER. This is a device which looks much like a rheostat used for the accurate control of voltages, generally the biasing voltages applied to the grid of a vacuum tube. It consists of a fixed resistance of from 200 to 400 ohms connected across the battery and a sliding contact which taps off the drop of potential at any point of the resistance. The polarity of the slider also

Blueprints of Conventional Radio Symbols and Typical Crystal Receivers on pages 28, 29, 30 and 31

UP AND AT 'EM!

Perhaps some of the Dial Twisters and readers of the Pickups and Hookups Section have strayed over into these blueprint pastures in search of choice morsels of radio information.

Here's one morsel all of our readers should seek:

On the page facing the Pickup and Hookup Section, you will see notice of a monthly subscription contest. For the month of August prizes are to be awarded for the reader who sends in the largest number of paid-up subscriptions to your favorite journal, RADIO AGE.

We could tell you a lot more, but space is limited. Read page 18 and then go after new radio recruits.

varies with its position, becoming negative at one end and positive at the other.

11. THREE ELEMENT VACUUM TUBES. The three elements of a vacuum tube are the filament (F), the grid (G) and the plate (P), although these parts need not be marked as shown. A "hard" amplifying tube is indicated by a single heavy circle drawn around the elements and as a hard tube is much used at present for a detector as well as for an amplifier. When a soft detector tube must be used, two circles are used, as at the right. The word amplifier is abbreviated (AMPL) and detector by (DET).

12. TWO AND FOUR ELEMENT TUBES. A two element tube or Fleming valve is indicated at the right and has the filament and plate but no grid. This is most generally used as a rectifier for charging storage batteries from alternating current, but is also used as a detector. The four element tube at the right has two grids.

13. GRID CONDENSER AND LEAK. This symbol used with detector tubes is simply a combination of the symbol of a condenser and that of a resistance (The leak). The leak abbreviation is (GL) and the grid condenser is (GC). If either of these items is variable, then this fact is indicated by drawing a slanting arrow across it as at the right.

14. CRYSTAL DETECTOR. A crystal detector is indicated by an arrow head for the cat whisker and a small block for the crystal. Abbreviation is (CD).

15. AUDIO (IRON CORE) TRANSFORMER. An iron core transformer, commonly known as an audio frequency transformer, is used for increasing the voltages of currents approximating voice frequencies or audible frequencies. It consists of a primary winding (PRI) and a secondary winding (SEC) with a few parallel lines drawn between the coils to indicate the iron core. The four connections are marked as follows: (G) for grid, (P) for plate, (F) for filament and (B) for "B" battery connections. These apply to vacuum tube connections with which the transformer is most commonly used. Iron core transformers of a special type are also sometimes used on radio frequencies, but when this is the case the fact will be particularly noted on the drawing. Abbr. is (AFT).

16. WIRING AND CONNECTIONS. In general, wiring is indicated by very heavy lines, and curved by an arc where a turn is made. Where two wires connect, a small OPEN circle is used to mark the connection as at (a). Where one wire crosses over another, the crows-over is shown as at (b). Connection posts or terminals for batteries, etc., are shown by a circle with a heavy black dot inside, as shown in a horizontal row. The letters indicating the "A", "B", and "C" batteries are marked at the terminals, together with their polarities. In the case of the "B" battery connections the various taps are marked by the voltages as at (+22), (+45) and (+90), but the letter "B" is not used.

17. TAP SWITCHES. Tap switches used for cutting out active turns in a coil should be connected so that the contact points go to the grid or aerial side of the circuit with the hinge connected to ground or on the far side from the grid connection to prevent body capacity effect.

18. INSTRUMENTS. Measuring instruments such as the voltmeter (VM), the ammeter (AM) or the hot wire ammeter (HWA) are shown in circles. The polarity should be marked, and also the range of volts or amperes at at (0—10) and (0—5).

19. JACKS. Jacks are specially arranged contacts used for making temporary connections by means of plugs and may be of many types. At the left is shown the single circuit jack (J2) generally used for the last stage connection and at the left is a two circuit jack (J1) used for plugging in between stages. These are by far the most common types.

20. SWITCHES. Different types of battery switches are shown, the left symbol being for symbolic diagrams while the second from the left is used frequently on picture diagrams. The switch at the right is a double pole knife switch used for heavy currents.

Sample Symbolic Drawings

ON SHEET No. 2 we show four representative circuit drawings which include most of the symbols tabulated. Each symbol is lettered with the standard abbreviation so that it will not be difficult to trace out the relation between the parts in the table and the corresponding parts in the diagram.

A simple crystal detector set, tuned by the variometer (VAR) is shown in Fig. 21. Here we have the symbols for the variometer, crystal, aerial, ground, phones and two fixed condensers. Note that when two condensors are shown that they are numbered as at (K1) and (K2). In Fig 22 we have another single circuit crystal set tuned by a simple tapped inductance (L), the tap switch (SW) being used to vary the number of turns in circuit.

In Fig. 23 is a regenerative circuit with one stage of audio frequency amplification, a type of circuit, very commonly met with. The detector tube (T1) is a soft tube, while the amplifier tube (T2) is a hard tube, as will be seen from the circles. A coupler is used for tuning, having the primary coil (L1) and the secondary coil (L2), this being used sometimes instead of the abbreviations "PRI" and "SEC." The secondary is tuned by the variable condensor (K1). For regeneration we have the tickler coil (TIC) placed directly above the secondary coil (L2) and connected with it by means of an arrow. The arrow in this case indicates that the two coils are inductively coupled by a variable relation; that is, that the position of (TIC) can be varied in respect to (L2). The grid condensor (GC) and the grid leak (GL) are shown connected to the grid of the tube.

Current for lighting the tube filaments is supplied by the six volt "A" battery which is connected so that the negative pole goes to the detector rheostat (R1). The negative pole of the "A" battery connects with the negative pole of the "B" battery, and the latter is tapped at the (+22) volt point for the detector current. The total voltage of the "B" battery at (+90) goes to the last stage jack (J2). A two circuit jack (J1) permits us to plug in on the detector tube alone without amplification, or without lighting the amplifier tube (T2). Plugged in on (J2) we get the amplified or intensified current for the operation of a loud speaker.

An iron core audio frequency transformer (AFT) transfers the plate energy of the detector tube (T1) to the amplifier tube (T2), and it will be noted that the terminals of the transformer are marked in accordance with the points that they connect. Thus (G) goes to the grid of (T2), connection (P) goes to the plate of tube (T1), connection (B) goes to the (+22) volt tap of the "B" battery, and connection (F) goes to the (—A) through the "C" battery. A fixed condenser (K) is shunted across the secondary. A 4.5 volt "C" battery is used for biasing the grid of the tube (T2) and the negative pole (—) is connected to (F) of the transformer so that the current gets to the grid of the tube through the windings. Tube (T2) is controlled by rheostat (R2).

Fig. 24 is a typical reflex circuit with the radio frequency transformer (RFT) and the audio frequency transformer (AFT), the former being tuned by the variable condenser (K2). A coupler is provided with the primary (L1) and secondary (L2) by which the set is tuned to wavelength. The grid bias on the tube is varied by the potentiometer (PO). The rest of the parts have been explained before.

Crystal Detector Sets

TO ME, the crystal set has always seemed the most wonderful of all radio receivers, for with this device we employ the feeble energy of the radio waves alone to vibrate the diaphragms of the phones without aid or reinforcement from local sources of energy. After traveling fifty miles or so, there is still sufficient energy left in the waves to move a relatively stiff piece of metal and to produce the audible air vibrations known as sound. Further, it is an exhibition of the remarkable sensitivity of the modern headset which produces understandable signals on so small an amount of current that it can be estimated in millionths of an ampere; and yet, with all of this delicacy, the apparatus is perfectly simple and so rugged that it can withstand a considerable amount of abuse at the hands of the listener.

To most of our readers who have had experience only with the cheap and simple single-slide, single-circuit crystal detector sets sold on the open market, the crystal detector is considered only in the light of a toy having only a very limited use in reception. This, however, is not the case, for with proper attention to the details of construction and with as much care taken with the tuning units as we pay to the construction of a tube set, the performance can be greatly improved in regard to distance range and signal strength. If we constructed our tube sets with the same lack of care and with the same primitive tuning systems that are used on commercial crystal sets, we would not get very much better performance. Single-slider, single-circuit tuners are not conducive of good results with either the crystal or tube detector, for they cannot be tuned accurately in resonance with the incoming waves, and there is always a considerable loss taking place that limits the distance and volume.

The Crystal Detector Circuit

OUR primitive crystal detector circuit consists of three principal units: (1) The tuning unit, by which it is brought into resonance with the incoming waves, (2) The crystal detector employed for rectifying the radio frequency impulses for the development of the audio waves, and (3) The audio output mechanism which converts the audio frequency electrical waves into mechanical sound vibrations (Phones). All three elements must be as perfect as possible if we are to extract the maximum output in the form of sound, for the incoming energy is exceedingly feeble and must be carefully utilized with the least possible loss. This means sharp tuning, a crystal having excellent rectifying qualities and an exceedingly sensitive pair of phones, none of which are in evidence in the usual $2.00 crystal detector set. In reviewing the requirements, we must also remember to include an efficient antenna into the assembly, which should have greater length and capacity than the antenna commonly used with tube sets. The latter item is generally neglected in the installation of a crystal set, with the result that very little volume or distance is had. Conservation of energy is a prime requisite.

It is here that the low-loss coil and the low-loss condenser hold forth with particular advantage; spiderweb, honeycomb or barrel-wound coils being of great advantage in the construction of such a set. The phones should preferably be of the mica diaphragm class or with very thin flexible metal diaphragms so that the slightest current in the coils will give a maximum vibration. When we look at the cheap phones ordinarily supplied with crystal sets, with their thick cast-iron diaphragms and their weak magnets, it is no wonder that reception is limited to 10 or 15 miles. This would be almost the case with a tube set if it were supplied with the same sort of phones. The feeble impulses received demand the most sensitive and efficient equipment that we can supply if the crystal set is to be more than a mere toy for children's use.

Please don't infer that I am recom-

mending the crystal set as a substitute for the tube set, for I am not. I am simply bringing to your attention the fact that the crystal set performance can be wonderfully improved by a little care in the construction and that it is a most desirable proposition for local reception where we do not wish to go to the trouble of installing batteries and similar complications. The crystal set has a field all its own and is almost indispensable for certain purposes, and for this reason I believe that more attention should be paid to the development of its performance rather than to cutting down on the expense of construction, as has been done heretofore. You cannot get long distance consistently, nor can you get full loud speaker volume of the crystal alone, but you can get locals with good volume, clear and sweet, without the fuss attending the operation of a tube receiver.

When loud speaker volume is required on local, with particular attention to quality, we can add one or more stages of audio frequency amplification to the detector. Of course, we are now getting back to vacuum tube complications and batteries, but with very simple layouts we can obtain wonderful tone values on the loud speaker and a somewhat increased distance. Just as an experiment, it is very interesting to add resistance coupled stages to a crystal detector to discover what real tone purity is like. The natural tone and life-like quality will be a revelation to you, and if you live within 25 miles or so of a broadcasting station, I am sure that you will keep this circuit hooked up permanently.

Future of the Crystal Set

CONSIDERING the many 5,000 watt broadcasting stations now under construction, and the increasing practice of re-broadcasting, it is certain that the crystal detector receiver will find a more extended use than has been the case in the past. Increased power at the stations and the relaying of these stations at close intervals over the country will mean that the crystal will take on a new life. At least ten telephone companies have adopted local re-broadcasting systems as an additional service to their subscribers, and I do not believe that the telephone companies will be the only people to engage in this work. If the network of re-broadcasting stations is fully developed the use of the crystal set will be practical in almost any part of the United States.

One re-broadcast station equipped with a good receiving set and a transmitter of moderate power will easily cover a radius of 25 miles and will efficiently serve crystal detectors in this 50-mile circle. The expense of maintaining such a station is comparatively small and can be borne by the local Granges or community associations with a great saving to their members. The station receives the voice and music from distant stations and then broadcasts these signals through simple apparatus to local listeners, thus avoiding the expense and trouble of arranging programs. So far, this arrangement has increased the total number of listeners tremendously without appreciably affecting the sale of tube sets. On the contrary, one re-broadcasting station states that the interest aroused in radio via crystal sets has greatly increased the sale of tube sets in its territory, and that a great proportion of the listeners now have both crystal and tube sets in their homes. Tiring of the local re-broadcasts, and desiring different programs, they turn to their tube sets and tune in the distant stations for themselves.

While the complete theory of contact rectification is not yet well understood, I will explain the functioning and purpose of the crystal in a general way so that the beginner can at least get a working knowledge of its properties when installed in the receiving set. Mechanically it is very simple, consisting of a small piece of mineral called the crystal, and a thin wire making light contact with the crystal at a sensitive spot. In some cases, contact is had between two crystals instead of between the wire and crystal, but in any event the radio frequency current must pass through a high resistance contact of some sort before passing through the phones, so that the audio or "hearable" portion of the incoming waves can be developed.

Owing to the rapidity with which the radio wave oscillates back and forth, the diagrams of the phones cannot follow the radio frequency currents in the receiver directly and nothing will be heard in the phones if some sort of rectifier or "detector" is not inserted into the circuit. These waves are "alternating," that is, they flow first in one direction and then in the other, and before we hear the signals these waves must be made "unidirectional" so that they will flow in one direction through the phones but with an intensity that varies according to the sounds sent out by the broadcasting station. The crystal detector with its contacting "catwhisker" wire acts as such a rectifier and permits the passage of only one set of waves that are flowing in the same direction.

A ROUND-UP OF HOOK-UPS

Will Rogers would probably call this August number a "Radio Rodeo" but we have named it the De Luxe Edition.

Having seen and burrowed in its alternate reading and blueprint pages, you will no doubt want to send a copy to one of your friends who so far has resisted the lure of radio.

A very simple matter! Get an extra copy from your newsdealer and pass it on to your friend. Then watch the fun.

OR

If you must, take his $2.50 for a year's subscription to the Magazine of the Hour.

With the radio frequency current rectified, the "audio frequency" waves are developed so that the diaphragms of the phones follow the slower voice frequency pulsations, thus producing sound. Our station waves therefore consist of two components, the high radio frequency carrier waves oscillating at the rate of about 1,000,000 vibrations per second, and the audio frequency waves impressed on them that will range from a few hundred to an upper limit of about 15,000 vibrations per second. These latter waves are produced by varying the intensity of the radio waves by "modulation," and are not actually an independent series.

There are a great number of minerals that will act as detectors to some extent, but only a few that are effective enough to be used in the practical crystal set. Galena, silicon, carborundum, cerusite, pyrites, perikon, radiocite, and hecite are among the most commonly used simple minerals, and in addition to these are the numerous synthetic crystals that bear a multitude of trade names. A good galena crystal is probably one of the most sensitive crystals, but it is not stable and must be readjusted frequently. Silicon and carborundum do not require so frequent adjustment and are quite sensitive if carefully selected and mounted. The synthetic crystals are in most cases stable and sensitive, and have the advantage of having a greater effective area or more "hot spots" than the natural crystals, so that it is not so difficult to adjust them.

For the catswhisker wire, we require a metal that will not corrode under ordinary atmospheric conditions and one that will maintain a bright metallic contact area at the point where it rests on the crystal. A copper wire will work well with most crystals, but a silver or gold wire is better, as it does not corrode or get dull as rapidly. With the exception of the carborundum crystal, the catwhisker wire should make very light contact with the crystal, working best when only just barely touching the surface. With the carborundum detector a very heavy pressure is required, which in itself is one reason for the stability of the carborundum, as the heavy pressure prevents the displacement of the contact when subjected to vibration.

There has been a great deal of argument for and against the fixed crystal detector with the immovable catwhisker, but I believe that the fixed detector will prove best in the long run for the beginner, at least, as it avoids the necessity of constant readjustment and the detuning effect when these adjustments are made. It will perhaps be of interest to know that the crystal has a great deal of effect in the tuning of the circuit and very often we can tune a station in and out by means of the crystal adjustment alone. For the experienced crystal set operator, the adjustable crystal is therefore often an advantage, as it is an aid to selectivity and tuning, particularly where there are many strong local stations and other interferences.

It is a good plan to get a number of crystals and then select the best crystal by actual test. There is a great deal of variation among crystals even of the same make, and the only way that you can be assured of the maximum results is to select the best crystal from a number of samples.

The Hook-Up or Circuit

THERE are about a thousand different crystal detector hook-ups from which to make a choice, and all of them have their adherents, who believe that they have the only circuit worth using. Some employ variometers for tuning inductances, others use spiderweb coils, variocouplers, honeycomb coils and straight solenoid coils in all sort of combinations, but as a matter of fact, a close examination will show that most of these circuits can be boiled down to six distinct classes. The type of inductance does not change the characteristics of a circuit as a circuit; it simply adds or detracts from its efficiency by the sharpness of its tuning properties and the losses occuring within the coil. A variometer may show better results than a simple tuning coil, simply for the reason that it can be more closely adjusted to wavelength than the coil—not because it is a variometer. An inductance is an inductance no matter what form it may be used.

Fig. 1 shows the six basic circuits with their relative audibility value, as determined by the U. S. Bureau of Standards. The relative signal strengths are given in terms of percentages, and it will be seen that the hook-up has a great deal to do with the reception, varying as it does from 10 per cent to 85 per cent. These diagrams refer only to the detector circuit itself and do not consider the various methods of coupling or connecting the circuit to the aerial and ground. A variable condenser is used for tuning a fixed inductance in all cases.

Diagram A

Diagram (A) shows a simple form of circuit often used, which contains the inductance (L), the variable condenser (C), the crystal detector (CD) and the phones (Ph) all connected in series. For ordinary broadcasting wavelengths there will be about 55 turns of wire in (L) when wound on a three inch tube, and the capacity of the variable condenser (C) will be from 0.00035 m.f. to 0.0005 m.f. The audibility is 55 per cent.

Diagram B

In Diagram (B) we have the same circuit with the addition of the small fixed condenser (K) connected across the crystal detector. This fixed condenser acts as a storage capacity for the waves and adds considerably to the volume, as it supplies an additional current to the crystal. This addition has increased the audibility from 55 per cent to 85 per cent, the maximum value determined by the Bureau.

The capacity of (K) depends upon the nature of the crystal detector, but in any event the capacity must be small to prevent by-passing much of the current across the dectector. With some detectors 0.00025 m. f. is about right, while with other types this may be as low as 0.0001 m.f. or even less. A small three-plate variable condenser will often prove of value in getting the adjustment correctly.

Diagram C

In Diagram (C) we have the same circuit as in Diagram (A), but a fixed condenser (K) is used to bypass radio frequency current around the phones. The average audibility under all conditions is reduced to 45 per cent; hence, this is not always an advisable addition. In many makes of phones there is a considerable amount of distributed capacity in the windings of the magnets and this frequently is sufficient to properly by-pass the radio frequency current around the inductance without the addition of external capacity. However, in case the phones have a high inductive value with little distributed capacity, a by-pass (K) may be necessary.

Diagram D

Diagram (D) is a type of crystal detector circuit often used on wave-meters and similar instruments where very sharp tuning is necessary. The audibility is so low (10 per cent) that it is impracticable for a receiver and therefore need not be discussed further. Its only virtue is its extreme selectivity.

Diagram E

Diagram (E) a second variable condenser (C2) is employed in addition to the original variable condenser (C1). This sharpens the tuning considerably and has a much greater audibility than the circuit in Diagram (D). The audibility is four times as great as with (D) and is almost equal to that of the first diagram.

Diagram F

Our last diagram (F) is the ultimate in selectivity but has a very low audibility factor. The circuit is split by means of the coupler coils (L2) and (L3) so that almost any degree of selectivity can be attained but at the expense of a great loss in signal strength. We can obtain a good degree of selectivity by other means and without so much loss in signal strength; hence, this type or circuit can be neglected for the time being.

Circuit With Coupler

FOR the sake of selectivity we will connect our aerial and ground to the detector circuit by means of an aperiodic or semi-aperiodic coupler of the type so commonly use in tube sets. For the detector circuit we will adopt the circuit shown in Diagram (B) to obtain the greatest signal strength and will depend entirely upon the coupler construction for our selectivity and tuning. This combination will probably give us the best all-round combination for signal strength and selectivity and at the same time is simple to build and tune.

In Fig. 2 we have the schematic diagram of the complete circuit. The coupler consists of the primary coil (L1) connected at one end to the aerial and to the ground at the other end. The radio impulses from (L1) are communicated to the secondary coil (L2) which is identical with the coil (L) in Diagram (B). A variable condenser (C1) is connected across the secondary coil so that it can be tuned to wavelength. The fixed condenser (K) connected across the crystal detector (CD) serves the purpose already described. The phones (Ph) are in series with the crystal detector.

By means of the inductively coupled coils (L1) and (L2) we can obtain much better selectivity than with the aerial and ground connected directly to the detector circuit. The selectivity depends largely upon the distance between these two coils. The greater the distance the greater will be the tuning qualities where there are many strong local stations. Properly adjusted, it is possible to tune in and out on a difference of five meters wavelength, but with comparatively little loss in signal strength. With the aerial and ground connected directly to the detector circuit, it is probable that a nearby station will come in all around the dial, no matter how it may be turned.

Holds on Grimly

In regard to a crystal detector, it may be said that it is much more difficult to get selectivity with a crystal than with a tube receiver and that greater care will be required in the adjustment. The crystal has the peculiar property of hanging on to a station even against powerful controls, and while it has not much distance or ability on weak signals, it will hold on like grim death to fairly strong signals.

Under some conditions it may be advisable to connect the lower part of the circuit to the ground connection (GND) by means of the short dotted wire (g). The rotary plates should also go to this side of the circuit (ground) as indicated by the curved line at (C1) and the stationary plates are connected directly to the crystal detector (CD).

With some phones, which have very little distributed capacity, it may help matters to connect the fixed condenser (K1) across the phones (Ph) as indicated by the dotted lines. This is best determined by actual test, after the set has been built and connected up to the aerial This may be a 0.001 m.f. fixed condenser.

Picture Diagram of Set

A complete drawing of the circuit with all of the parts in place is shown by Fig. 3, the letters in this drawing corresponding with similar letters in the schematic diagram of Fig. 2. A detail view of the coupler coil is shown which is connected to the variable tuning condenser (C1), the latter being connected directly across the secondary coil (L2) of the tuning inductance. The crystal detector (CD) is best placed as shown and should not be mounted on the front panel where it is likely to be thrown out of adjustment by the jar of the hand every time we move the tuning dial.

The tuning inductance (L1-L2) is wound on a cardboard tube three inches in diameter and about 4 1-2 incles long. The primary winding consists of 12 turns of No. 24 D.C.C. wire, and a space of about 1-2 inch is left between this coil and the secondary coil (L2). Starting coil (L2), we wind on 55 turns of the same size wire, and fasten the ends of the coil securely by passing them through holes punched in the cardboard tube. For strong local stations, it may be necessary to increase the distance between coils to 5-8 inch or 3-4 inch to obtain the required selectivity, but this space should be no greater than actually required for the complete tuning out of the strongest station. If the gap is much greater than this, the signal strength will be reduced. The tentative wire (g) and the experimental fixed condenser (K1) are shown in dotted lines as they may not be needed with the combination of parts used in your set.

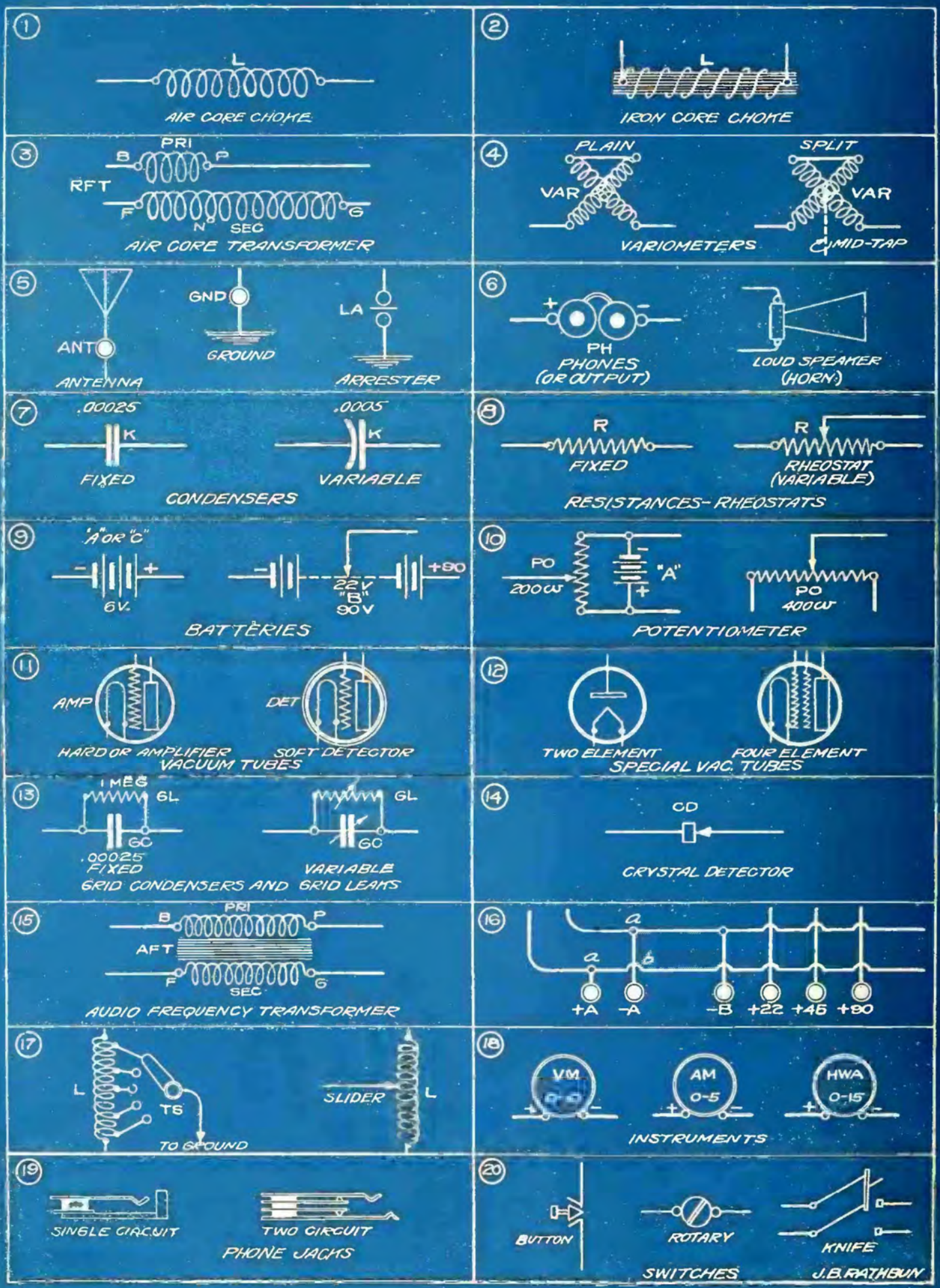
The condenser (C1) can be either a 17 plate or 23 plate variable condenser having a capacity of 0.00035 m.m. to 0.0005 m.m., but the latter is preferable. If you do not wish to wind the coil yourself, you can use a neutrodyne transformer which can be purchased complete and mounted on the back of the variable condenser. Such combinations cover a wavelength band of from 200 to 600 meters, the range of the average broadcasting stations.

It is most convenient to mount the apparatus on a 6 in. x 7 in. x 3-16 in. panel as shown by Fig. 4 with the tuning dial (D) appearing on the front of the panel as shown. The aerial binding post is at ANT, the ground connecting post at GND, and the phone posts at PH. The method of connecting to the aerial and ground is also shown in this view, the ground being a connection to a water or steam pipe.

The aerial should not be less than 60 feet in length, and more than this is desirable where the necessary room can be obtained. With a crystal detector set, the more aerial wire that we hang up, the better will be our reception, and any length (L) can be used up to 150 feet.

With two wires placed side by side, 150 feet long and with the set located in the open country, quite long distances can be covered. However, with a 60 foot aerial in a good locality, we can get good reception with fair distance, providing that the aerial is not screened by steel structures such as steel factory and office buildings, bridges, etc.

John B. Rathbun
has a surprise
in the August Radio Age


1
L
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GROUND
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ARRESTER
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(OR OUTPUT)
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(HORN)
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RHEOSTAT
(VARIABLE)
RESISTANCES-RHEOSTATS
9
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6V.
22 V
"B"
90 V
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"A"
PO
400 ω
POTENTIOMETER
11
AMP
HARD OR AMPLIFIER
DET
SOFT DETECTOR
VACUUM TUBES
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TWO ELEMENT
FOUR ELEMENT
SPECIAL VAC. TUBES
13
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GRID CONDENSERS AND GRID LEAKS
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CRYSTAL DETECTOR
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SEC
AUDIO FREQUENCY TRANSFORMER
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-A
-B
+22
+45
+90
17
L
TS
TO GROUND
SLIDER
L
18
VM
AM
0-5
HWA
0-15
INSTRUMENTS
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SINGLE CIRCUIT
TWO CIRCUIT
PHONE JACKS
20
BUTTON
ROTARY
KNIFE
SWITCHES
J.B. RATHBUN

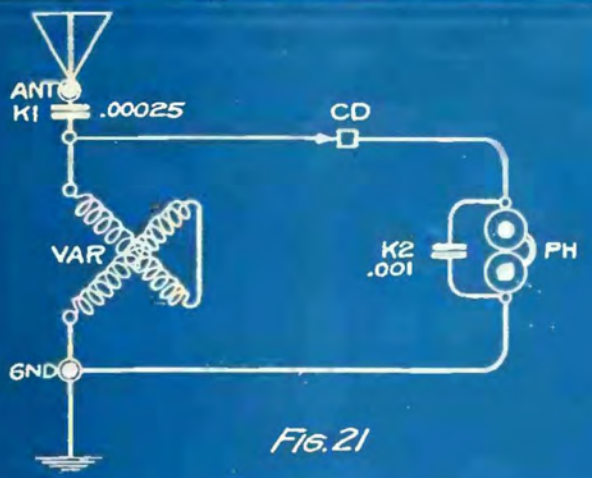

FIG. 21

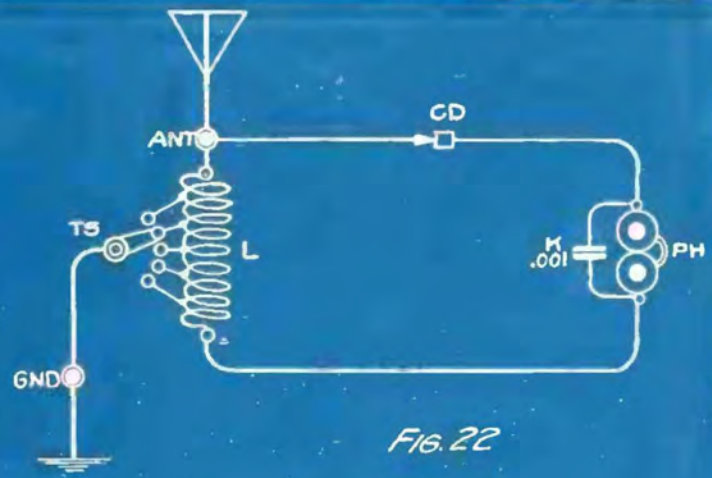

FIG. 22

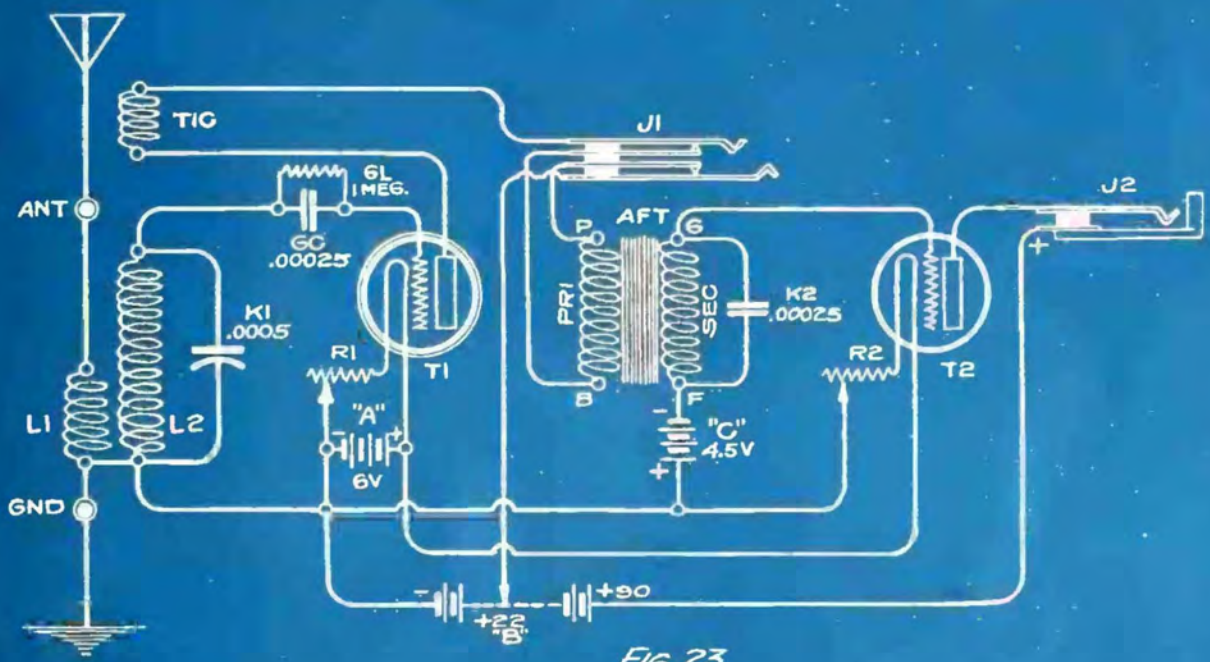

FIG. 23

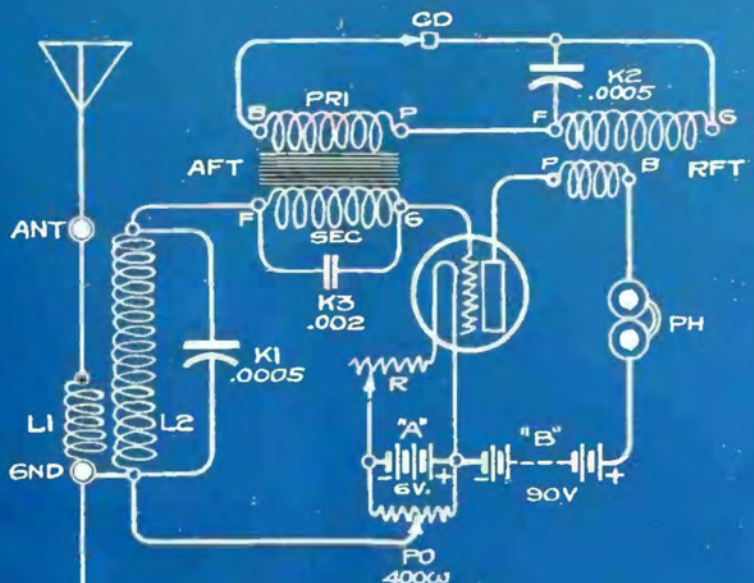

FIG. 24.

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FIG. 1. BELOW

(A)

RELATIVE AUDIBILITY = 55

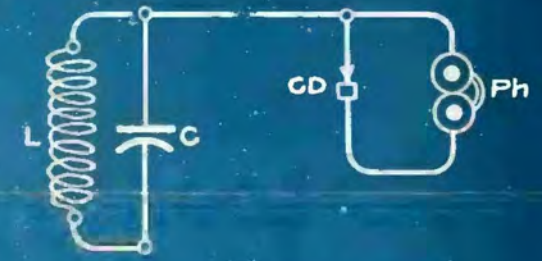
(B)

RELATIVE AUDIBILITY = 85

(C)

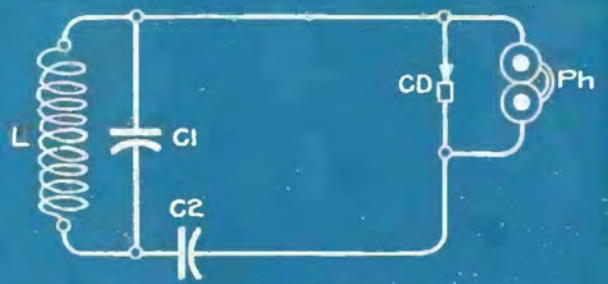
RELATIVE AUDIBILITY = 45

(D)



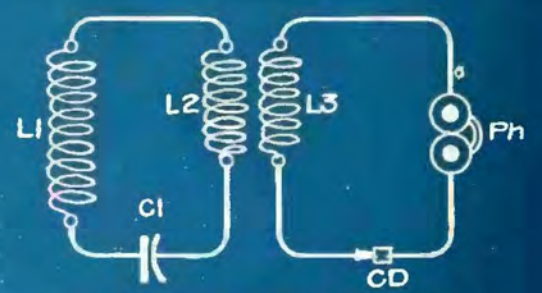
RELATIVE AUDIBILITY = 10

(E)



RELATIVE AUDIBILITY = 40

(F)



RELATIVE AUDIBILITY = 15

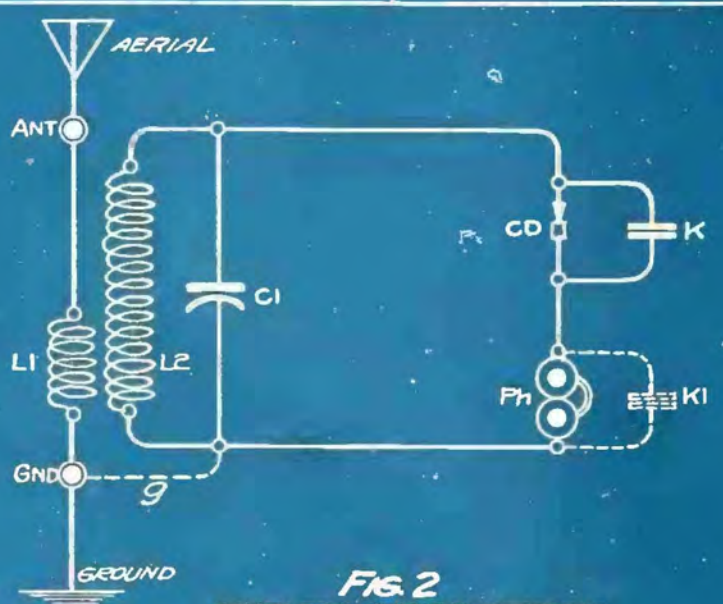


FIG. 2
COMPLETE CRYSTAL DETECTOR CIRCUIT WITH ANT. COUPLER.

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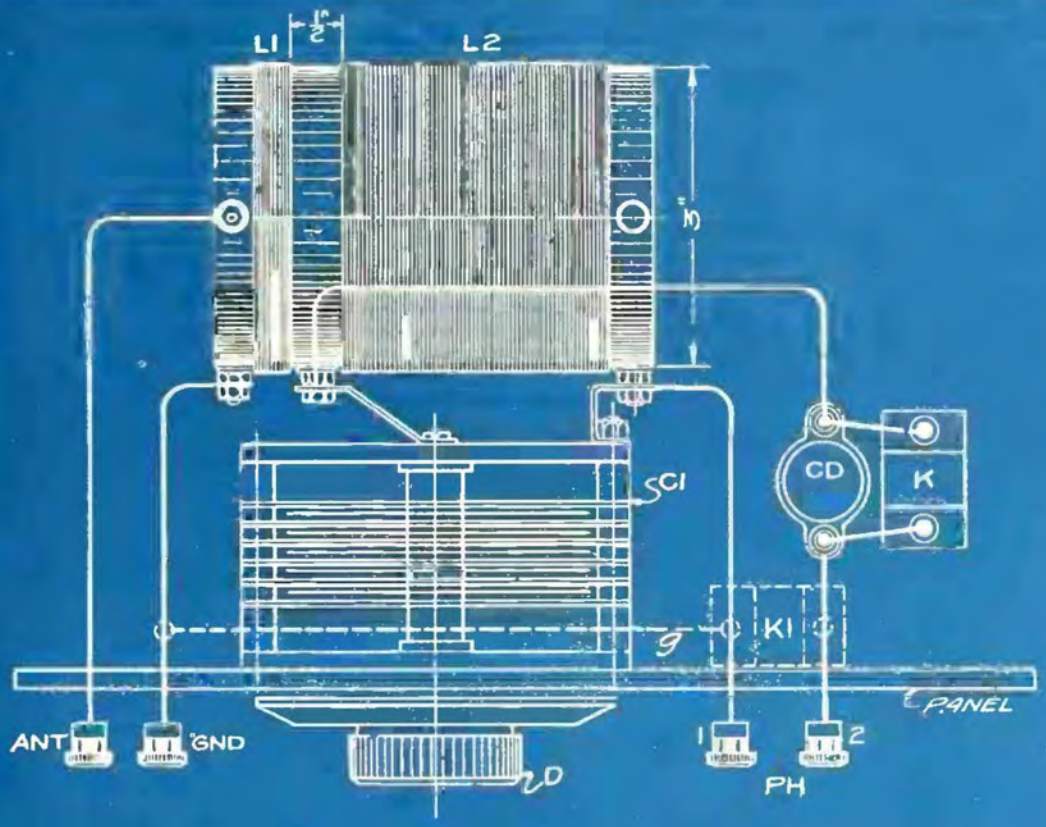


FIG. 3
PLAN VIEW OF CRYSTAL SET

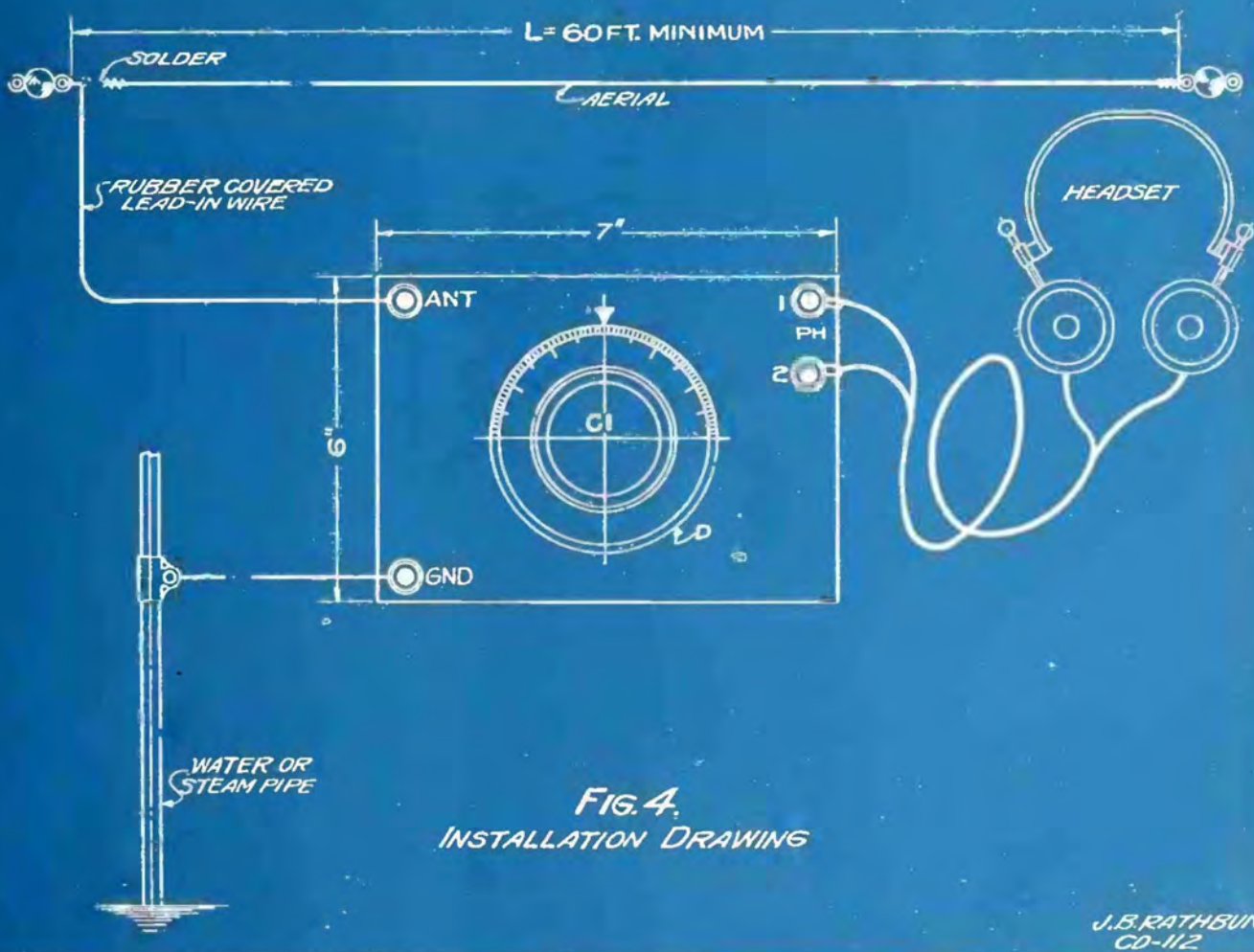


FIG. 4.
INSTALLATION DRAWING

J.B. RATHBUN
CO-112

A Capacity Feed-back Receiver

By JOHN B. RATHBUN

A Sensitive Circuit with Greater Volume; Variable Condenser Controls Reaction

NEARLY all of our readers are familiar with the inductive feedback types of regenerative circuits in which the plate energy is returned to the grid circuit through the inductive effect of a tickler coil, or by means of tuning the plate and grid into a mutual resonance by means of plate and grid variometers. He is also familiar with the direct feedback type in which the plate circuit is connected directly with the aerial as in the single circuit Ultra-audions and other circuits.

However, there is a third means of feedback which is highly effective, known as the "capacitative feedback" by which the plate energy is returned to the primary and controlled through a variable condenser between the primary inductance and the plate.

As with the inductive feedbacks, there are a great number of circuit combinations possible with the capacity feedback system and one has only to consult an English radio magazine to discover this fact. Its popularity in England is undoubtedly due to the fact that a capacitative feedback circuit has a lesser tendency toward breaking down into free oscillations when the circuit is being forced, and as we all know, radiation from the aerial is the Englishman's private pet peeve. Another factor which stands in favor of the capacitative system is the fact that much closer control of regeneration is possible by means of a vernier variable condenser than by the standard tickler coil arrangements, and that the tube can be brought closer to the spilling point without actually causing trouble.

A Sensitive Hookup

I CLAIM no originality for the general type of circuit which is demonstrated in this article except in points of minor refinements. It has been variously known as the "Super-Reinartz," as the "Inverted Weagant," and the "Capacitative Ultra-Audion" at various times. However, no matter what its origin may have been, it is an exceedingly sensitive circuit and gives great signal strength on local. The circuit is tuned to wavelength by means of a variometer while the feedback is controlled by means of a vernier variable condenser. The principal improvement introduced in this article is the use of a spiderweb type of variometer.

In Fig. 1 of the accompanying blueprints we show a wiring diagram and plan view (Looking down on top of the set) which is for the use of our readers who are not familiar with conventional or symbolical diagrams. In Fig. 2 is the symbolical diagram of the set for the information of the advanced readers who may wish to learn how the circuit functions. An isometric view in Fig. 3 shows the general arrangement on the rear of the panel and the run of the wiring, but we advise the reader to make the actual wiring connections with the aid of either Fig. 1 or Fig. 2 as in these views the wiring is clearer and easier to follow. Keep these blueprint diagrams for reference and you will have no trouble with this set.

Looking at Figs. 1-2 we see the tuning variometer (VA) which is really a specially connected vario coupler of the spiderweb type. In the particular coupler shown a movable coil or "rotor" marked (r) is connected in series with the stator (s), the latter being the tapped coil. The tapped portion (L) of the coupler stator is simply the tapped portion of this member but is drawn out separately in Fig. 2 for emphasis in showing the application of the tap switch (TS). The tap switch gives closer control of the tuning and it will be noted that no variable condenser is included in the grid circuit.

Regeneration Control

AT (C1) we have the vernier variable condenser in the plate circuit which controls the regeneration or feed back into the aerial or primary circuit. On tracing out the hookup we will see that the condenser (C1) is effectively in series with the variometer (VA) and therefore that the variometer acts as an auto-transformer for the plate circuit, increasing the potential applied to the grid of the tube. This is identical in action to the Weagant circuit except that an auto-transformer (Single circuit inductance) is applied instead of the two circuit transformer used in the Weagant. Maximum potential is developed between (C1) and (VA) at the point where the grid circuit is connected through the grid condenser (GC) and the grid leak (GL). The detector tube is at (T1) with its controlling rheostat (R1).

The use of a spiderweb inductance in this circuit eliminates a great deal of the wasteful distributed capacity which commonly grounds a large percentage of the aerial current in single circuit receivers of this class. This is a marked advantage over the layer wound type of coupler and shows up well in practice. The tap points on the section (L) are connected to the tap switch (TS) in the conventional manner, and the blade of the switch is then connected to ground.

Variable condenser (C1) should have ample capacity, hence should be a .43 plate or 0.001 mf type. The grid condenser (GC) is a mica dielectric type with a capacity of 0.00025 mf while the grid leak (GL) should be either a variable leak or else a fixed type with a resistance of about 1.0 to 1.5 megohms. The tube (T1) can be any standard tube of the amplifier type such as the UV-201A or UV-199 type. It will be noted that both the detector tube (T1) and the audio amplifier tube (T2) are connected to the positive terminal of the same "B" battery and therefore that both tubes carry the same high plate voltage. The "B" battery voltage will range from 45 to 90 volts, but the best results are obtained at 67.5 volts with the majority of tubes.

At the output of the detector circuit we have the primary coil (+B-P) of the audio frequency transformer (T) connected in the plate circuit. A fixed condenser (K1) is connected across the primary which has a capacity of 0.001 mf. The secondary coil (—F) and (G) is connected to the audio amplifying tube (T2) through the 4.5 volt "C" battery (C). The transformer (AT) should have a ratio of from 5-1 to 6-1 for the best combination of amplification and clear tone. Lower rations give less distortion but also less volume. It should be particularly noted that the (—) negative pole of the "C" battery should go to the grid post (G) of the amplifying tube socket (T2).

Simple Output Arrangement

SIMPLE single circuit jacks (J1-J2) are used in both stages, and while this leads to slightly diminished volume in the detector stage, yet this is no practical disadvantage as the detector is used only for receiving local stations in the majority of cases. The advantage lies in the simplicity of the jack connections and in the fact that the circuit is not broken at any time in switching from one stage to the other. There can be no open circuits due to poor jack contact nor microphonic noises set up as this point. In the hands of the novice a two circuit jack in the detector stage very frequently leads to trouble. Jack (J2) in the audio stage is of the usual type and requires no further explanation.

The only special instructions that seem necessary for this circuit are those which relate to the conversion of a vario-coupler into a tapped variometer. One lead from the rotor or movable coil shown by (r) in Fig. 2 is connected to the outermost lead from the stator coil (s). In this way the rotor and

stator are connected in series and the device now becomes a variometer. Do not make the connection with the tapped end of the stator coil. Leave the tapped end open for the inductance switch connection.

Good Distance Work

With this set, the writer has pulled them in for very considerable distances and with surprising volume. It has all the signal strength of a single circuit receiver combined with a great percentage of the selectivity of the three circuit type. It is not quite so selective as a three circuit tuner, especially when two or three local stations are going at one time, but it is much better than the average single circuit arrangement in this respect. One stage of audio frequency amplification is always desirable with any regenerative and is quite economical. It is the addition of the second stage that leads to complication and expense.

One stage of audio permits of excellent loud speaker volume on stations up to 100 miles or so and makes headphone signals audible that would often be passed by with the detector tube alone. With UV-199 tubes, both stages can be worked off of three No. 6 dry cells for a long time and with excellent results. By biasing the audio tube (T2) the total demand on the "B" batteries is very light and the smallest size of cells can be used for long periods.

"B" Battery Current

WHILE the amplification is slightly better with 90 volts of "B" battery on the plate yet 67.5 volts gives nearly the same volume with a much smaller consumption of "B" battery current and with less tendency toward whistling. With 45 volts on the plate the tone is probably purer but the amplification is very much reduced. If only 45 volts are used, then the "C" battery should be reduced to a two cell, three volt type in place of the three cell 4.5 volt battery used for 67.5 to 90 volts.

From 40 to 60 feet of outdoor flat top aerial will give very good results. If the aerial is made longer than this there will be trouble in maintaining the required selectivity although a longer aerial may give a slightly greater range. The great trouble with the majority of listeners lies in the fact that they try to hang up too much wire in their aerial circuit and in so doing increase the interference and disturbing noises that may originate in the neighborhood. A single wire is better than two wires in parallel.

A 7″x14″ panel can be made to accommodate this apparatus as laid out in the drawings without much squeezing. If it is likely that a second stage of audio will be added in the future then a panel 7″x18″ should be used. Bakelite or hard rubber are the best materials for the panel, and while the baseboard is usually made of wood this can also be made of hard rubber or bakelite.

In the old days when Armstrong was publishing his original means of producing regeneration and oscillation by means of an inductance in series with the B battery and phones, which was inductively coupled to the grid circuit, Weagant came along with another means of securing the same object.

His scheme was merely the use of an inductance in series with a condenser arranged in parallel to the plate and filament of the vacuum tube. The inductance used in the plate paralleling scheme could be placed either in inductive relation to the grid or secondary coil, or it could be placed away from that circuit. Better control was found by putting the plate or tickler coil in inductive relation secondary. Several years later Reinartz to the took up the Weagant and did a good deal of intensive work with it, working it over into a single circuit instead of the loose coupled original.

He added the choke coil in the plate circuit to assist in easy control of the tube.

New Circuits?

Reinartz' work with the circuit was the signal for a horde of eager-eyed experimenters to start turning out circuits at the rate of one each day or so, few of which had any particular merit. We have seen many instances where individuals would take the basic Armstrong circuit, transpose the position of the B battery and the phones, or else the B battery and the plate inductance, and then label it an original circuit. It used to be so bad that conductors of technical departments in newspapers were putting on the market wonderful receivers with a fancy name, but having nothing but the basic Armstrong or the Weagant substitute. And readers used to deluge the editor's desk with new and novel circuits, all of which when analyzed turned out to be the basic stuff.

Public Enlightened

But fortunately this condition could not persist. The public became more and more enlightened; the trimmers and riff-raff of the game were gradually eliminated or else their wings clipped, and today the radio game is getting to be pretty much of a standardized science in which the public cannot for long be mis-informed and mis-led without disastrous consequences.

If you don't believe it, get up before a gathering of radio hounds and announce in stentorian tones that you have just developed an original circuit.

Seriously, the Weagant-Reinartz-et-al-system has proved very popular principally on account of the simplicity of regeneration control, by means of a variable condenser which can make capacity changes in the circuit with greater finesse than the rotation of a plate coil inside of the secondary. Granting the plate coil in the Weagant combination is fixed, it is possible to log the set. If the plate coil is put at the filament end of the secondary, the wavelength is not thrown out when copying c. w. signals.

Radio Trade Association Meets

Unquestionably the biggest and most enthusiastic meeting of the Radio Trade Association ever held since the organization came into being was held in the afternoon of May 28 at Pontiac, Michigan, the members of the Association being the guests of the Jewett Radio & Phonograph Company of Detroit and Pontiac. The usual attendance of the bi-weekly meeting of the Association was more than doubled.

The meeting began with a luncheon served in the Board of Commerce of Pontiac, as a compliment from the Jewett Company. During the luncheon, short talks were made by E. H. Jewett, President of the Company, S. W. Edwards, Secretary of the Radio Trade Association, and Howard E. Campbell, Chief Radio Engineer and Director of the Broadcasting Division.

In his short talk, Mr. Jewett expressed his pleasure for having such a large attendance at the meeting and spoke briefly of the trend of radio manufacturing and merchandising, calling attention to the fact that this Company was in the radio business to stay, to produce products of quality and to stand back of these products even after they reached the homes of the consumers. He decried the many instances in which "fly-upon-night" manufacturers and dealers have put into the hands of the consumers merchandise of a questionable character, which in the long run has tended to lower the confidence of the general public in almost everything pertaining to radio. This, he said, was on the mend, and before long the dawn of a staple industry which has as its aim—to serve every American home—is in sight.

In replying to the brief remarks of the President of the Company, Mr. Edwards, representing the Radio Trade Association of Michigan, graciously accepted the courtesies that had been shown the members of the Association, and expressed a desire for closer and better affiliations among the representatives of the various divisions of the radio industry.

Some of the intricacies of broadcasting and a few of the humorous incidents that are always occurring in the studio of the broadcasting station, but are never brought to light so far as the radio audience is concerned, were enumerated by Mr. Campbell.

Following the meeting in the Board of Commerce, the officials of the Company and the members of the Association went to the Jewett factory, one of the most modern radio factories in the country, located on the outskirts of the city of Pontiac. Here they were taken through the factory proper, two units of which are completed and then shown through the broadcasting station of the Company, which will come on the air early in July. This station will be of the latest type Western Electric equipment, having an antenna input of five thousand watts.

Between the towers, which have now reached one-third of their two hundred foot height, the operators of the station and workmen were laying some of the six thousand feet of ground wire required for the station. There they watched a specially designed instrument sinking the wire a foot into the ground as fast as the tractor could pull it.

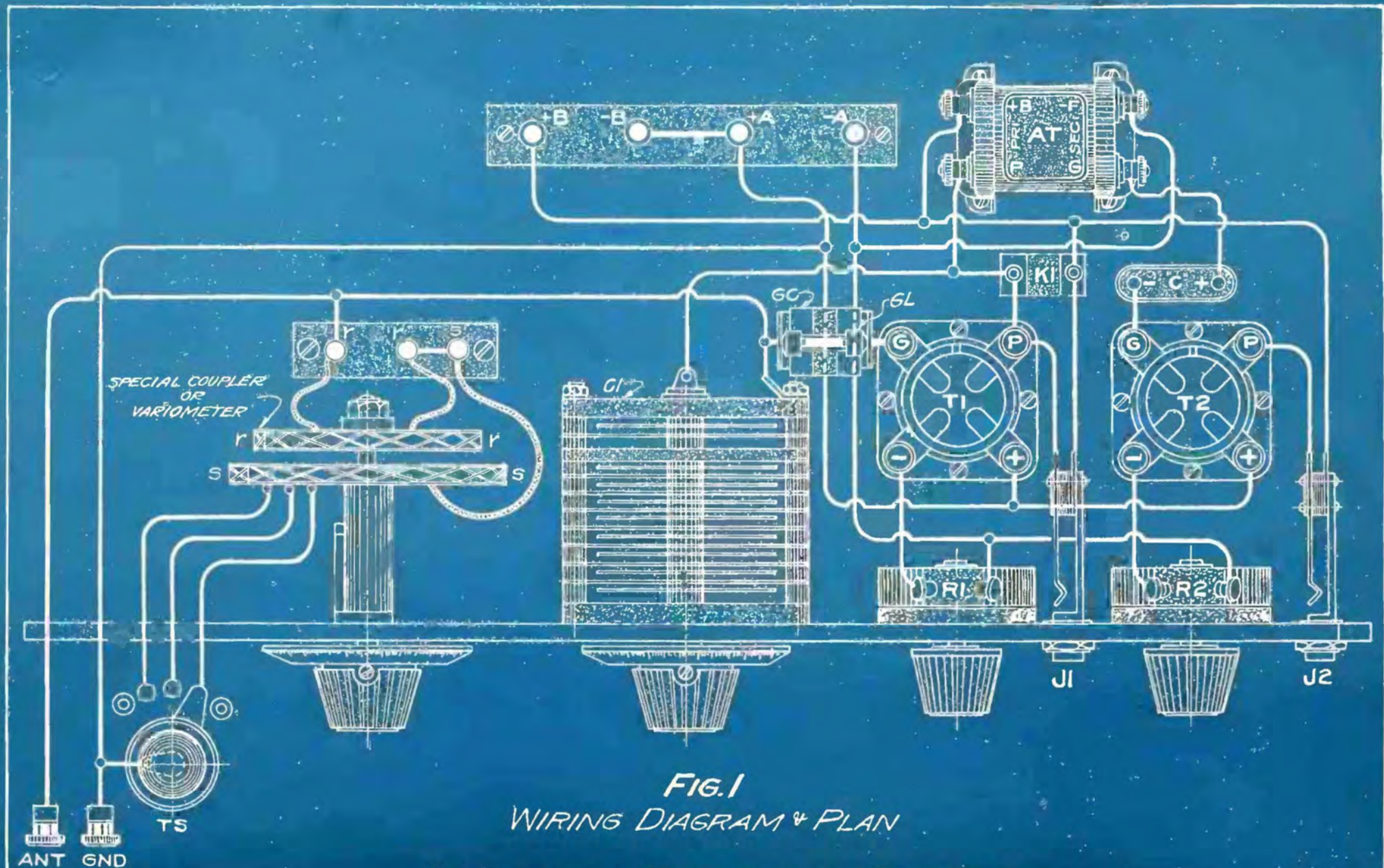


FIG. 1

WIRING DIAGRAM & PLAN

CAPACITY FEEDBACK RECEIVER

(WITH ONE STAGE OF AUDIO FREQUENCY)

J.B. RATHBUN
FB-236

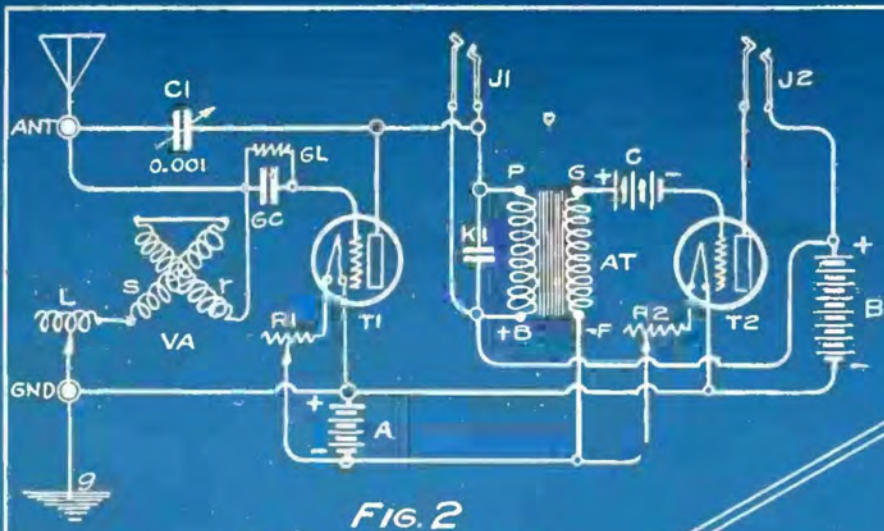


FIG. 2
CIRCUIT DIAGRAM

FIG. 3
REAR ELEVATION OF PANEL

CAPACITY FEEDBACK CIRC

J. B. RATHBUN
FB-236

A Two-Tube Ultra Audion

By JOHN B. RATHBUN

A New Version of an Old Reliable Hookup

OF the twenty-eight radio receiving circuits known as ultra-audions, there is one simple circuit that is most commonly known to the radio novice. This is the ultra-audion, alias the "Little Wonder Circuit," alias the "Radio Demon," alias the "Ultraphone," alias the "Gibbon's Oscillator." It has also paraded under the peculiar cognomen of the "Carpet of Bagdad," which however, has nothing to do with the photoplay of that name. In fact, every time that any dealer wishes to bring out a simple, cheap and efficient distance getter, he drags out the ultra-audion and labels it with his pet name. Results are about as certain with this little outfit as is possible with any simple combination of variable condenser and single inductance coil; hence it is ideal in its own sphere of usefulness.

One thing that appeals particularly to the poor hook-up editor is the fact that you have twenty-eight chances of avoiding a mistake in connecting it up; in fact, it is almost impossible to get it hooked up so that it will not percolate to some extent unless you should get the "B" battery across the filament of the tube. Confidentially, it can also be used as a transmitter over a short range by connecting a microphone in the ground circuit. This statement will probably bring down the united curses of entire neighborhoods on my head for bringing it to our readers' attention, but I thought you ought to know it. Radiate? I'll say she does. When the village pest starts twisting the dials of this outfit you will see your neighbors climbing up to the house tops taking down their aerials.

But It Works!

IT may be noisy and it may radiate, but it certainly gets the DX. Like every other circuit having distance getting qualities, it is noisy, unstable, and not particularly selective where there is much strong local, but it will reward you by pulling in stuff that you would otherwise only read about. Dollar for dollar, and tube for tube, you can cover more mileage with the ultra-audion than any other set I know of, and it is on this basis alone that I recommend it. For a single circuit receiver it tunes quite sharply, and is selective enough when fifty miles or more away from a broadcasting station, but in congested local traffic it is not much good, and in Chicago it is practically useless except on silent nights.

In Chicago, the complete set of parts have been sold retail for $6.75 for the single tube ultra, and from $10.00 to $12.00 for the two tube set. This, of course, does not include headset, tubes or battery. This is not so much greater than the cost of building a crystal set, except for the tubes and battery, and you get real tube results with a few dollars invested.

I do not recommend the single tube ultra-audion for two reasons. (1) Because the phone impedance forms part of the inductive balance in the circuit which is upset when two or more pair of phones are inserted into the detector circuit, and (2) because there is a considerable body capacity effect in the phone cords when the headset is connected directly to the detector tube. By using an audio transformer as the inductance for the first tube, we do away with both difficulties and the receiver is therefore much more flexible in regard to the output connections. A single tube ultra will not carry two sets of phones satisfactorily, either in series or in parallel, for this varies the feed-back potential and therefore the degree of regeneration. When working full blast on distance, the phone cord capacity may be so great that the station will be tuned in or out every time that you move your head or touch the headset with your fingers, but the introduction of an audio transformer and second tube will prevent this trouble.

Wide Wave Range

IN Fig. 1 is a picture diagram of the two tube ultra-audion using a spiderweb coil or "pure inductance" for the tuning unit. This type of coil is far superior

A COMPLETE BLUEPRINT SECTION IN THE ANNUAL

A thirty-two page blueprint section, replete with tried hookups and sixteen pages of blueprints in actual color, is the outstanding feature of the RADIO AGE ANNUAL for 1925, now available at $1.00 a copy. You can use these blueprints as real working drawings, for they are clear and easy to follow. Sixteen pages of blueprints are worth many times the purchase price of the ANNUAL.

In addition to the blueprint section, there are hundreds of new hookups for beginner and expert in the ANNUAL for 1925. Every class of radio fan will find his wants fulfilled.

The first edition consists of a limited number of copies, which are being exhausted quickly. Send your dollar NOW if you want to be assured of getting your copy of the RADIO AGE ANNUAL.

Blueprints of the Two-Tube Ultra Audion on Pages Following

Here is another of the forms by which it was originally attempted to get around the basic Armstrong. It is known as the ultra-audion and is nearly as old as the Armstrong itself. But it has changed its name oftener than a bootlegger. It also obtrudes its presence upon the neighborhood in about the same degree as the neighborhood cat. It is fine for the wide open spaces where men are men and single circuits are welcome, but not much for the crowded city sections when it is expected, on account of superior intelligence and enlightenment, the cliff-dweller will observe the golden rule of radio—"Don't be a tweeter."

Mr. Rathbun has efficiently described the circuit in the article above, so this leaves only the opportunity of calling your attention to the subscription contest on page 18. Read it and go out after the recruits; the RADIO AGE family sholud be expanded and the readers are the most logical ones to do it, especially since they have a chance at some of the monthly prizes.

A New Version of the Ultra Audion

to the common homemade coil wound on a tube. With a 23 plate or 0.0005 mf variable condenser (C), the range will be from 200 meters to well over 700 meters with the specified coils. It will be well to use a vernier type of condenser so that the maximum signal strength can be more easily developed by closer tuning.

When a spiderweb coil is used, such as supplied by our advertisers, a total of eighty-five turns should be specified, tapped at such points as will properly cover the range of wavelengths. The tap switch (TS) makes closer tuning possible over a greater wavelength range than an untapped coil, but a plain coil can also be used with a total of 75 to 100 turns. A 75 turn or a 100 turn honeycomb coil will be right, but the 100 turn is probably the better for the broadcast listener with wavelengths averaging about 360 meters. This is one of the advantages of the ultra-audion; it can be used over a very broad band of wavelengths by simply substituting coils of various numbers of turns. Special tapped honeycombs can be used as well as the plain, untapped variety. Tapping is not a necessity but simply a convenience.

Wound on Cardboard

When the coil is wound on a cardboard tube, a diameter of from 2.5 inches to 3 inches can be used, and we should have about 120 turns tapped at about ten-turn intervals after the fiftieth turn. Thus, we will tap at 60 turns, 70 turns, 80 turns, 90 turns, 100 turns, 110 turns and at the finish. This will give us seven tapping points, including one end. To conserve space use No. 26 D. S. C. wire, but if desired, No. 24 or No. 22 can also be used. The low loss idea can be introduced by giving the coil a good coating of celluloid varnish (not shellac), and then slipping the coil off of the tube when dried. The varnish can be made by dissolving bits of celluloid in amyl acetate, which produces a fairly good non-capacitative coating. If shellac is used, you will get no results at all. The paper tube can be slit lengthwise before winding, and when the coil is dry, we can easily separate it from the tube by breaking down the latter at the slit.

Now comes an important precaution against body capacity. The stator or stationary plates (s) of the variable condenser (C) should be connected to the grid line (5) while the rotor or moving plates should be connected to ground or to line (23). If this is not done, you will be annoyed with "body capacity" so that when you put your hand anywhere near the dial it will detune or give a shrill "Whee-ee-ee" and break into violent oscillations.

For the best results the grid condenser (K) should be a variable condenser or one of the semi-variable grid condensers now placed on the market for this purpose. When the capacity is once adjusted to the requirements of the particular tube in the socket it does not frequently need readjustment except on wide variations of wavelengths, and the latter type of condenser is perfectly correct. However, a fixed condenser of 0.00025 mf capacity will do very nicely and is used in most of the ultra-audions. A variable grid leak at (GL) must be used under all conditions as the tube is very critical to the resistance of the leak.

The Plate Voltage

NOW just a word in regard to the voltage of the "B" or plate battery (B). If we are to avoid excessive radiation from our aerial, and reduce interference to a minimum, we must nor use over 22.5 volts on the detector tube (T1). This result is attained by taking an intermediate "B" battery tap at the point (+22) at the 22-volt section of the battery, as shown. If maximum amplification is required without regard to radiation, then we can put the full "B" voltage on both tubes by connecting (+B) of the transformer with the (+67) of the battery by means of the wire (22). If you love your neighbors, don't do this anywhere except in the country where you are at least five miles from the nearest receiving set. At least 45 volts should be used on tube (T2) and preferably from 67.5 to 90 volts so that we gain the maximum audio amplification. The high voltage on (T2) has no radiating effect.

Working Blueprints
of this famous

ULTRA-AUDION
HOOKUP

Are to be found on
pages 38 and 39

Another set of
BLUEPRINT SURPRISES
in September RADIO AGE

Owing to the fact that full control of the regeneration is had by the adjustment of rheostat (R1) it is sometimes a good policy to make this a vernier rheostat, but fair results will be obtained from a plain rheostat of the proper resistance. The rheostat (R2) is not critical and any type can be used here. The resistance of the rheostats depends upon the type of tube used. Any tube can be used for the detector (T1) but the amplifier (T2) must be some hard amplifier such as the "11,""12,""199," or "201A" type. For small sets the "11" and the "12" tubes work very well, but of course the 201A is preferable where a storage battery is justified. The soft "200" tube is probably a more sensitive detector at (T1) but it is more critical and difficult to manage and also takes more current than the other tubes.

Any good make of audio transformer can be used at (AT) with a ratio of from 5-1 to 6-1. This single stage of audio amplification is sufficient to get good volume on distance, and with local stations, very good loud speaker volume can be obtained. In fact, I have had fair loud speaker volume on local with the detector tube alone, so intense is the regeneration in the ultra-audion circuit. The output (p-p') is connected to the phones or speaker, as may be desired. No jack has been placed between the detector and audio stage, as this would introduce "unbalance" into the circuit and also give phone cord capacity effect, which is disastrous to proper performance.

Only a very small panel is required, and the set has been assembled satisfactorily on a 6"x10" and 6"x12" size with plenty of room for all of the parts. Its portability is a great feature and the small panel permits of placing batteries and all in a comparatively small cabinet, thus making the set self-contained and handy to move about. When the detector is used alone, without audio amplification, a 6"x7" or a 7"x9" panel will be ample for the accommodation of the parts.

In regard to the tap switch (TS), I wish to say that the number of contact buttons used will depend upon the number of tapping points on the coil and this is likely to vary somewhat among different makes of coils. I have shown seven taps on the drawings, but this must be regulated by the coil used. Some commercial honeycombs use five taps, others use seven taps and there are coils with nine taps. It should be understood that the number of taps connected to the contacts is one less than the total number of wire ends, since one end of the coil is permanently connected to the aerial by wire (1).

In Fig. 1 is the picture diagram by which the most inexperienced should be enabled to hook up the set. Fig. 2 is a conventional drawing using symbols, while Fig. 3 is an isometric view showing the back of the panel and the arrangement of the apparatus as it actually appears, but it should not be used in making the actual connections, as some of the wires and connections are hidden from view. For making connections, use either Fig. 1 or Fig. 2. An isometric is very useful for gaining an idea of the general arrangement of the parts and main runs of wire, but if it is made so that all of the wires are in plain view, then the view is so distorted that its principal value is destroyed. All sense of proportion and scale are lost in this way.

IN GENERAL, it is best to place a spiderweb coil (L1), or "pure inductance" as it is sometimes called, at right angles to the condenser (C), for by this arrangement practically all electrostatic coupling between the parts is eliminated. The audio transformer should be kept away from (L1) to prevent noise. It seems almost unnecessary to state that all connections must be soldered, and soldered without acid, but I will say it anyway for the benefit of the beginners.

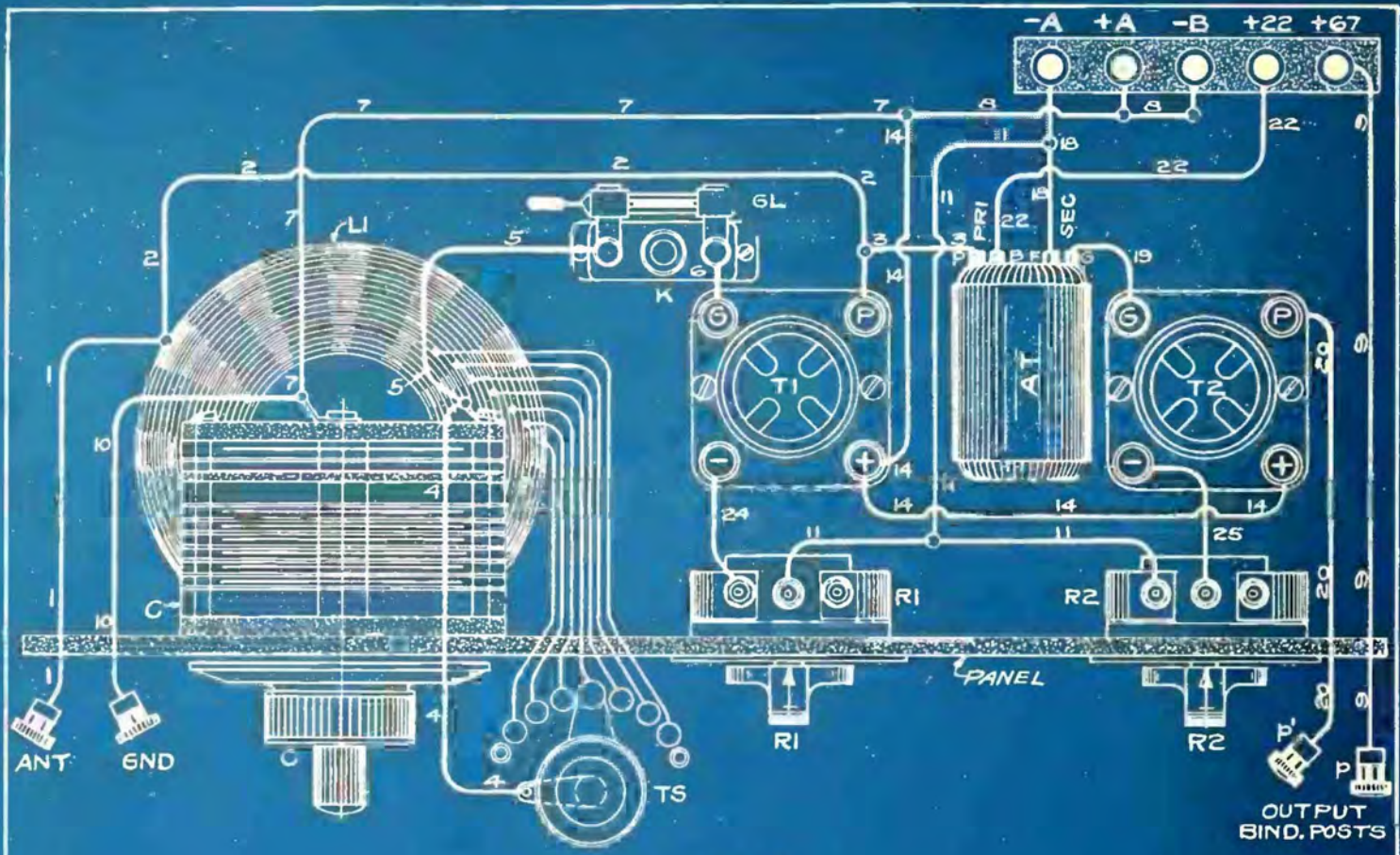


FIG. 1
PLAN VIEW OF ULTRA-AUDION

IN ORDER TO SHOW THE OUTPUT CONNECTIONS FOR EITHER JACKS OR BINDING POSTS AS MAY BE DESIRED, WE SHOW POSTS IN FIG. 1 AND JACK IN FIG. 2.

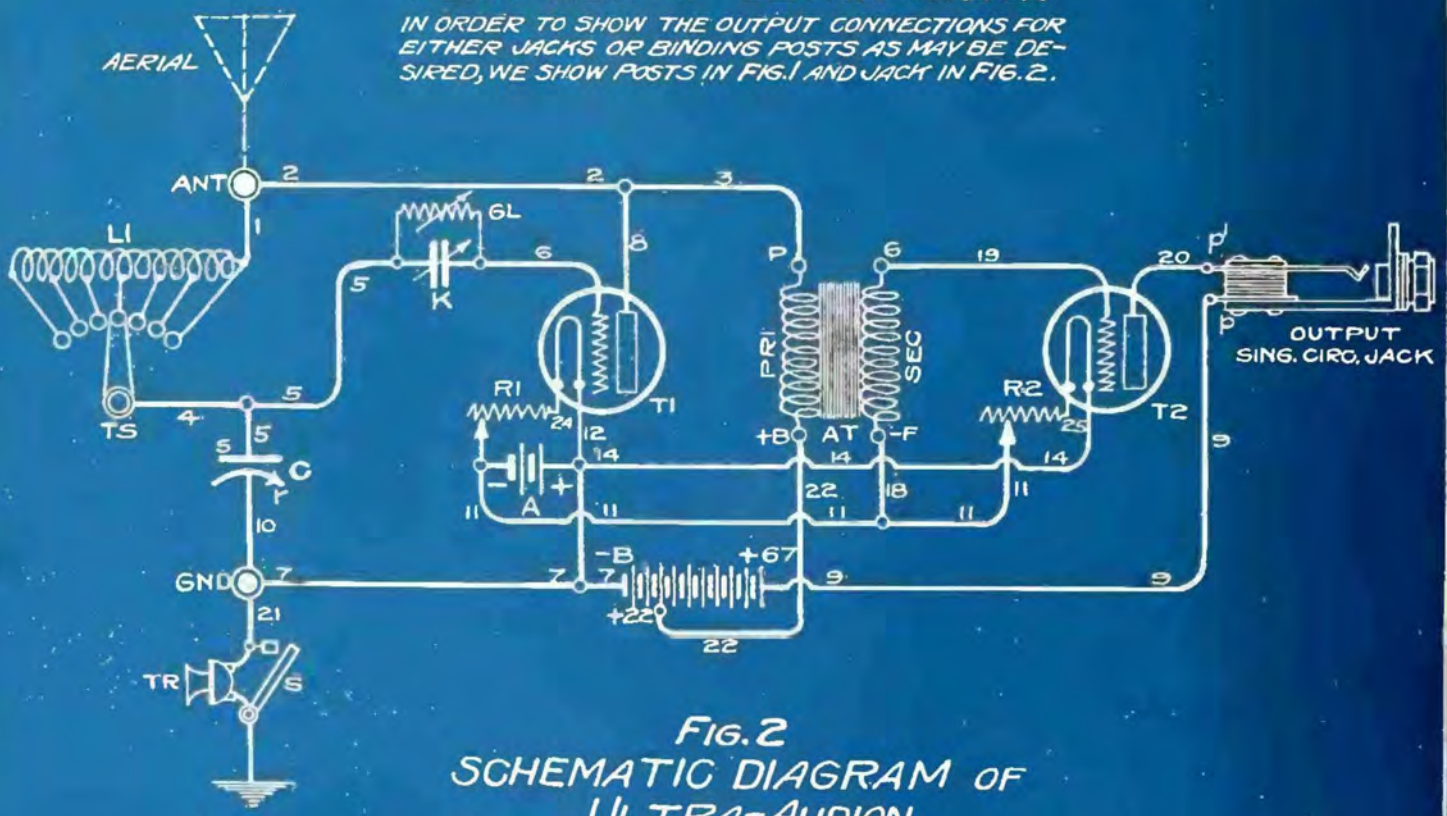
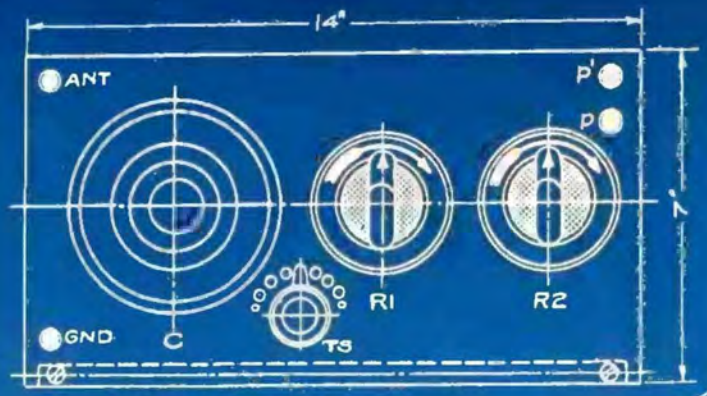


FIG. 2
SCHEMATIC DIAGRAM OF ULTRA-AUDION

SHOWING RECEIVER WITH ONE STAGE OF AUDIO AND EQUIPPED WITH TRANSMITTER FOR SHORT RANGE RADIOPHONE.

J. B. RATHBUN
UA-10

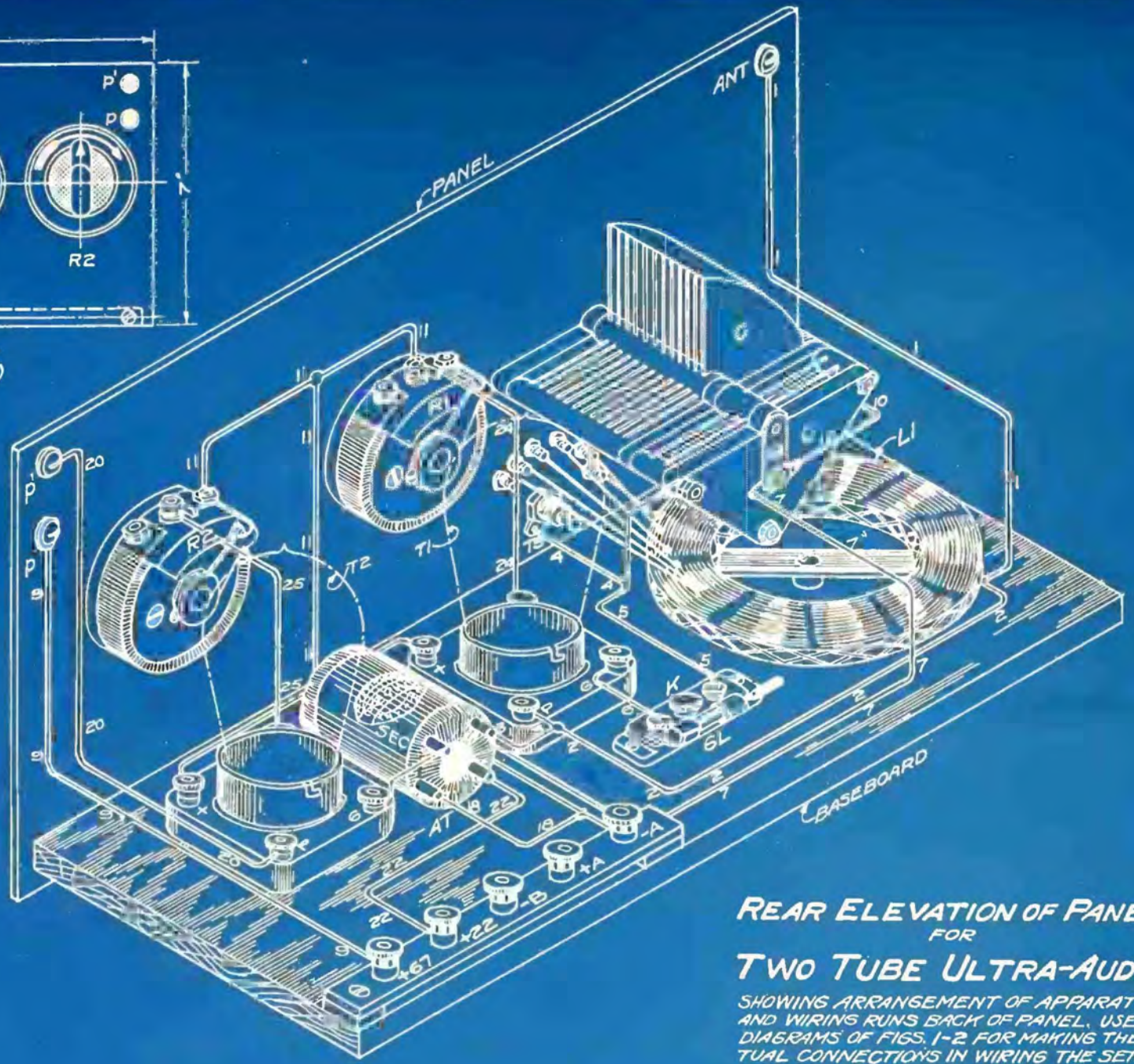


PANEL LAYOUT
(FRONT ELEVATION)

Note!

ANY TUBE, SOFT OR HARD, CAN BE USED FOR THE DETECTOR TUBE T1, BUT A HARD AMPLIFIER TUBE T2 MUST BE USED IN THE AUDIO STAGE. TUBES SUCH AS UV-WD-11, WD-12, UV 199, UV-201, UV-201A CAN BE USED IN ALL STAGES.

FOR MAXIMUM AUDIBILITY USE TRANSFORMER RATIO OF 10 TO 1. FOR BEST TONE USE RATIO OF 4 TO 1, OR 5 TO 1. PLATE VOLTAGE 45-90 V.



REAR ELEVATION OF PANEL FOR TWO TUBE ULTRA-AUDION

SHOWING ARRANGEMENT OF APPARATUS AND WIRING RUNS BACK OF PANEL. USE THE DIAGRAMS OF FIGS. 1-2 FOR MAKING THE ACTUAL CONNECTIONS IN WIRING THE SET.

J. B. RATHBUN
UA-10

An Aperiodic Variometer Set

By JOHN B. RATHBUN

TUNING the grid circuit inductively by means of a variometer is nothing new in radio. In fact, this is practically as old as the use of the fixed inductance tuned by a condenser, but the idea has considerable merit owing to the fact that it is possible to establish higher potentials on the grid of the tube in this way. Thus, the incoming signal has more effect on the tube grid when capacity is lacking in this circuit than when a variable condenser is used for tuning the circuit to wavelength. Better results are therefore obtained.

In the older circuits, the grid variometer was used as a tuning agent for single circuit sets or else it was used in connection with the standard type of tapped variocoupler where the additional losses introduced rather than offset the inherent advantages of the variometer inductance. Used in a single circuit set, there was a loss of selectivity. Used with a standard variocoupler, the losses in the taps and tap switches often offset the increased efficiency of the variometer. In other words, the variometer was never used so that it was allowed to develop its full possibilities in the grid circuit.

Variometer "Switched"

After carefully going over this matter and experimenting with various combinations of variometers, it was finally decided to make the variometer an integral part of the primary and secondary tuning circuits so that the variometer formed the secondary winding of the coupler, while a few turns of wire at one end of the variometer acted as an "aperiodic" primary coil. No condenser was needed, and the full selectivity of the variocoupler was attained without losses in the tapped coils and rotor. The construction is simplicity itself and lives up to expectations in every way.

Applying Variometer Idia to Good Circuit

HAVING progressed this far, the next thing was to apply the idea to some specific circuit where its full possibilities could be developed without complicating the controls. Various circuits were investigated and finally it was decided that this circuit offered an excellent opportunity for the application when the plate circuit was tuned by a second variometer. While the original Wizard circuit worked very well without the plate variometer and with direct inductive feed-back, yet the addition of the plate variometer made the set even more selective than before and greatly increased the signal strength. Regeneration is more easily controlled without accurate filament current adjustment, and by the combined effects of the feedback coil and the tuned plate circuit, a condition of resonance is more accurately approached in both circuits and the impedance of the circuit can be made more nearly the theoretical zero necessary for the establishment of maximum voltages.

In Fig. 1 on page 34 we show a picture circuit of the set called the "Aperiodic Variometer Set" with the two variometers used for the grid and the plate respectively. For maximum results and for loud speaker operation at fair distances one stage of audio amplification has been added permanently which gives an excellent two-tube set with great volume and a very considerable range. Of course, the detector tube can be used alone or else another stage of audio amplification can be added, but for the best results for a given investment, I believe that the circuit is at its best the way that it is shown in the figures. It is certain that the addition of radio frequency steps only slightly increases its range and that the expense and trouble of adding the radio stages is not justified by the slight increase in performance.

Variometer as Secondary Coil

In Fig. 1, page 34, is the grid variometer marked (VI) which is used for tuning the set to wavelength, this variometer acting as the secondary circuit coil of a two-circuit receiver. At the left is the aperiodic primary coil (L) consisting of about 25 turns of No. 26 D. S. C. wire wound on a four-inch diameter bakelite or cardboard tube. In addition to acting as the primary of the

HOW TO USE RADIO AGE BLUEPRINTS

The RADIO AGE blueprints are arranged in the ANNUAL so that they may be used as actual working drawings by the set-builder. For instance, each hookup described in the RADIO AGE ANNUAL blueprint section consists of four pages, two of which are explanatory pages and the other two real blueprints.

The Aperiodic Variometer set, for example, is described in the text on this page and on page 41, while the blueprints for this hookup may be found on the two pages following.

Blueprints in the ANNUAL blueprint section are arranged in the same manner for the convenience of the reader.

Blueprints for the Aperiodic Variometer Set on Pages Following

Now We'll Tell One!

It's just like this; you pride yourself on being a subscriber of a magazine with a large circulation. No magazine ever has a large enough one, regardless of how high in the hundred thousands its circulation runs.

So at this time of the year, when you are revamping your set for the Winter, you have a chance to add to RADIO AGE'S family of readers by rounding up annual subscribers and, incidentally, trying for some of the prizes offered each month for the reader who brings in the largest number of paid up yearly subscriptions.

On page 18 you will find the terms of the contest. Each reader and contestant knows perhaps a lage number of individuals interested in radio who do not subscribe to this magazine. Just a little exertion on your part and two things are accomplished: You win one of the prizes and we add members to our radio family circle.

An Aperiodic Variometer Set for Efficiency

circuit, the coil (L) also acts as the tickler or feed-back coil which induces additional impulses into the secondary by connections with the plate circuit. The tube of (L) is fastened to the side of a standard molded variometer in any way that may be convenient with the instrument used. The distance between the coil and variometer is not critical and can be made as shown. Any type of molded or honeycomb variometer can be used, but a wooden variometer is not usually practical owing to the great clearance space ordinarily found between the rotor and stator of the wooden variometers.

AT (V2) we have the standard plate variometer used for controlling regeneration and for varying the inductance of the plate circuit. This can also be any standard type of molded or honeycomb variometer but usually the inductance value must be greater than can be attained with the ordinary wooden variometer. Very frequently the inductance of wooden variometers is so low that they have absolutely no effect on the regeneration when turned in any direction, and this fact is emphasized for the benefit of those of our readers who may attempt the building of the circuit with this type of variometer. The tuning is exceedingly sharp and fairly critical so that the addition of a "Tiny Turn" vernier button to the dials of the variometers will be of importance, or any other type of geared vernier adjustment which can be conveniently attached to the dials.

At (K1) we have the usual type of grid condenser with a capacity of from 0.00025 to 0.0005 mf., the former value usually proving best for the UV201A and UV199 tubes. Tube (T1) is the detector tube which is controlled by the filament rheostat (R1). Of course maximum results are obtained with the power tubes operated by a storage battery such as the UV201A, but very good results can also be obtained by the small dry cell tube known as the UV199. The WD11 and WD12 are not so selective but can be used if the other tubes are not practical under the given operating conditions. The soft detector tubes such as the UV200 will not give as much volume on strong signals as the UV201A or the UV199 for the reason that we cannot carry such high plate voltages on the soft detector tubes.

Distortion Eliminated

As shown in the diagram, 45 volts are used on the detector tube (T1) and 90 volts on the audio amplifier tube (T2). This gives the maximum results without distortion when the UV201A and UV199 are used. Using a higher voltage on the detector tube (T1) gives a somewhat greater signal strength on local stations but it also introduces undesirable tube noises and distortion. Lower voltages than those specified naturally give weaker signals, and the weaker voltages on the plate also reduce the selectivity of the circuit.

The grid leak (GL) is of the pencil mark or other variable leak. Its value is to be adjusted until the signals are strongest and clearest. If the resistance is too high, then there will be noises and the reception will have a whiney tone. If the resistance is too low, then too much radio frequency current will be bypassed and the signal strength will be reduced. The proper value for any one tube can only be tried by direct experiment.

USE THE ORIGINAL BLUEPRINTS
On Pages 42 and 43
to make This
Aperiodic Variometer Set.

THE aerial connection at (ANT) together with the ground (GND) and battery connections are placed at the rear of the set, thus allowing all wires to enter the rear of the cabinet and improve the appearance of the receiver. The binding posts at the rear are mounted on two strips of bakelite or hard rubber about 1 inch to 1 1-4 inch wide and about 3-16 inch thick. The strips are raised above the surface of the bottom board, so that no metal parts or wires will come into contact with the wood. This construction is clearly shown in both Fig. 1 and Fig. 2, page 35, the latter being the isometric view of the set.

Audio Amplification

For aid in picking up distant stations at good volume and for loud speaker operation on local and at moderate distances, one stage of audio frequency amplification has been added. Stations 200 miles away have been picked up with good volume on the loud speaker with the single amplifying stage, and local comes in with terrific volume. In fact, local stations can be had on the loud speaker with the detector tube (T1) alone, but as will be explained, it is considered desirable to have the detector and the amplifier connected in one permanent unit.

A five-to-one ratio audio frequency transformer is shown at (AFT). The primary of the transformer is connected at the posts (P) and (B) to the detector circuit at the output wires (e) and (f).

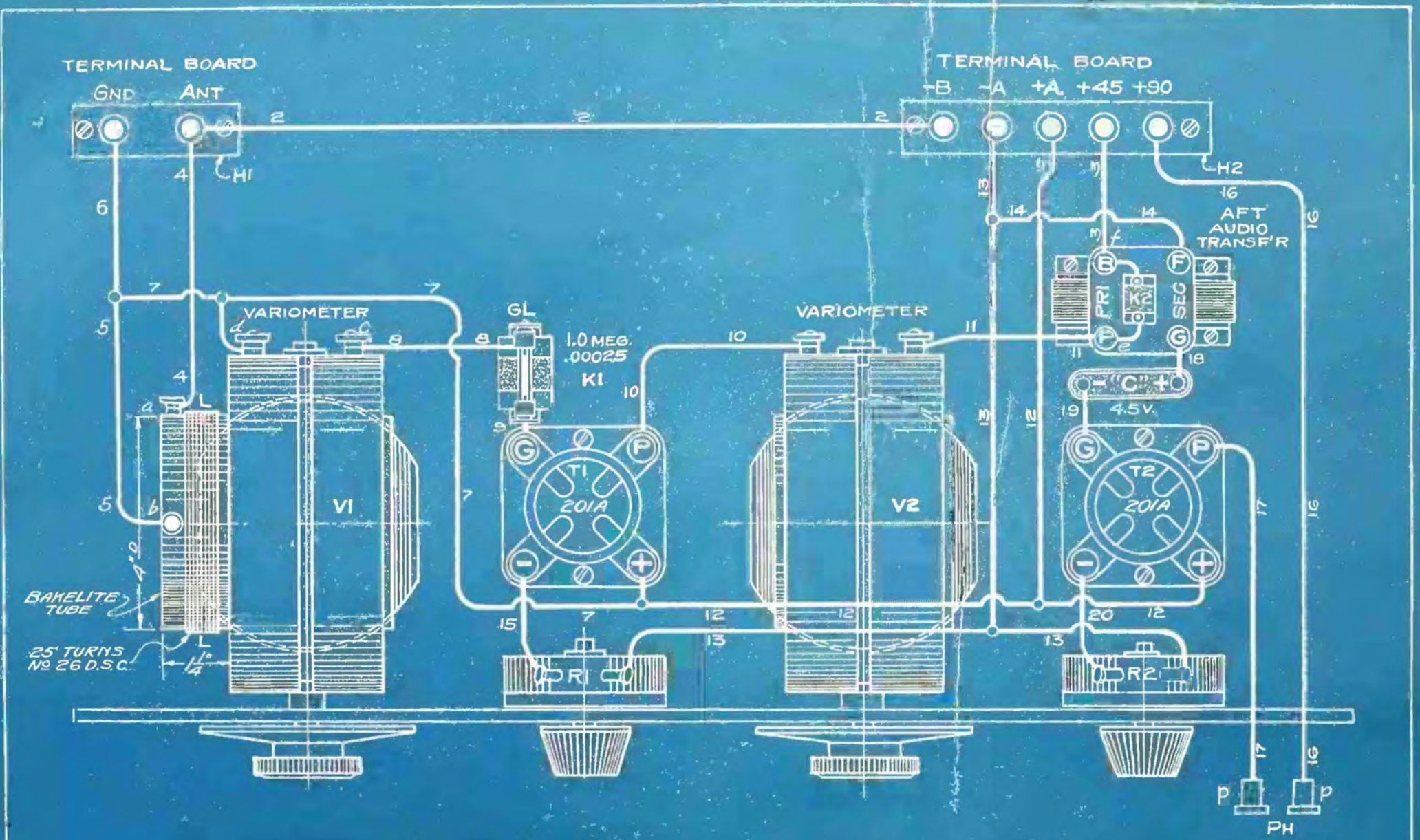
The secondary of the transformer is at (G) and (F), and is connected into the circuit of the amplifier tube (T2). A three cell, 4.5 volt "C" battery is connected in the grid circuit of the amplifier tube for biasing the grid and is of great assistance in clearing up the reception and for obtaining maximum amplification. In all cases, the negative (−) terminal of the "C" battery should go to the grid (G) of the tube, so that the grid will receive a negative charge or bias. The output or plate (P) of the tube (T2) goes to the phones or loud speaker (PH).

In laying out this circuit, it was considered advisable to omit the usual jack between the detector tube and amplifying stage, both on the score of simplicity and effective operation. While both tubes must be used at all times with the present arrangement, yet it has certain advantages which are lacking when intermediate jacks are installed. For example, there are no losses or noises due to imperfect contacts in the jacks, and, further, as the audio stage is always in circuit, there is no danger of detuning a distant station when the audio stage is plugged in. When a jack is installed after the detector, and when one picks up a faint signal, it often happens that this station is lost when a stage or two of audio is plugged in at the jacks.

In this arrangement, this cannot happen; and when the reception becomes too strong, we have merely to turn down the rheostats.

In the circuit shown here, patterned after the basic Armstrong with a few changes made by Mr. Rathbun, the energy from the plate is fed back to the grid circuit through the aperiodic primary. The absence of a variable across the secondary circuit and the use instead of a variometer increases the signal voltage on the tube grid.

While it is true that variometers are gradually going out of existence, nevertheless there is a place for them in circuits of this type, and many an experimenter will never rest until he has tried out the scheme outlined above by the conductor of the blueprint section.



AN APERIODIC VARIOMETER SET

WITH TWO STAGES OF AUDIO AMPLIF.

FIG. 1

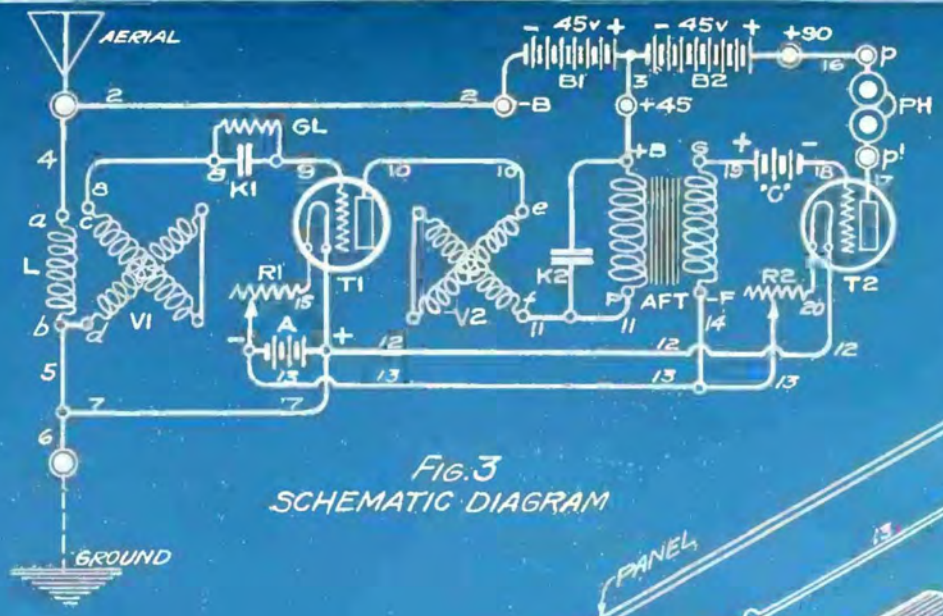


FIG. 3
SCHEMATIC DIAGRAM

OUTPUT OF SET TO BE CONNECTED TO PHONES OR LOUD SPEAKER AT POSTS P-P.

NOTE!
USE ONLY AMPLIFYING TUBES SUCH AS UV-201A OR UV-199 FOR BOTH THE DETECTOR (T1) AND THE AMPLIFIER.

PLATE VOLTAGE ON DETECTOR TUBE = 45 VOLTS: PLATE VOLTAGE ON AMPLIFIER TUBE = 90 VOLTS. USE TWO BLOCKS OF 45 VOLT "B" BATTERIES.

FIG. 2
REAR PANEL ASSEMBLY
FOR
APERIODIC VARIOMETER

J.B.R.

A Tuned Plate Regenerative Set

By JOHN B. RATHBUN

Attaining Selectivity With An Aperiodic Coupler Added To a Well Known Circuit

PROBABLY one of the most effective types of straight regenerative circuits and the simplest to build is the "tuned plate" type in which the plate circuit is tuned to resonance with the grid circuit by means of a variable inductance such as a variometer.

While I do not present this well known circuit as anything new in its entirety, yet by the use of an aperiodic coupler I am sure it is far more selective than the older arrangement with a variocoupler and that it is far easier to tune. With a single stage of audio amplification as shown in the following blueprints, it is an exceedingly good DX set and gives good volume on distant stations.

Fig. 1 is a "picture diagram" of the circuit arranged for the use of the beginner. In Fig. 2 is a schematic diagram by which the action of the circuit can be more easily traced out by those experienced in handling symbolic diagrams. In the following description we will refer, therefore, particularly to Fig. 2, although all three views bear the same reference numbers and figures. By this system of lettering, the novice can trace back and forth between the two diagrams and thus become acquainted with the conventional symbols which mean so much to the experienced radio man.

How to Increase Range

TO BEGIN with, in every type of straight regenerative circuit, some of the amplified plate energy is fed back into grid or input circuit of the tubes, thus increasing the potential acting on the grid of the tube and increasing the range and signal strength of the circuit. For example, the feeble little impulse induced by a distant station in the aerial enters the antenna binding post (ANT), passes through the primary coil (L1) and thence to ground through the ground post (GND) and the dotted ground wire. That is, the antenna current of the station to which the set is tuned passes to earth in this manner, the remaining waves from other stations being "choked back" by the self-inductance of the system

While passing through the primary coil (L1), the current sets up a slight magnetic field which threads its way through the turns of the adjacent secondary coil (L2) of the tuner and "induces" or creates a current in (L2). The induced current, known as the "secondary current" acts on the grid of the tube through the grid condenser (CG) and leak (GL), thus causing the relatively powerful local battery current to flow in step with the pulsations in the aerial. In effect, the tube is now simply a form of current relay or valve by which a feeble pulsating current controls a relatively much more powerful battery current in the same way that a slight movement of the hand on the throttle regulates a powerful steam engine or heavy stream of water.

Inductance is Varied

By means of the variable condenser (C1) the inductance of the coil (L2) is varied so that the circuit can be tuned or brought into step with the frequency of the desired station. Coil (L2) by acting inductively on (L1) allows only the current of the desired frequency to pass to earth. The number of turns of wire on (L2) and the capacity of the condenser (C1) determine the frequency of the circuit or the wavelength to which it may respond. Increasing the number of turns on (L2) or increasing the capacity of (C1) increases the wavelength of the circuit. In the same way, cutting down the number of turns or the capacity of condenser (C1) lowers the wavelength of the system. As it is far easier to vary the capacity of (C1) than to alter the number of effective turns, the number of turns on (L2) is fixed at some value so that the operation of (C1) will cover the complete band of broadcasting wavelengths. The number of turns on (L1) is not of so much importance in this respect, but in any case the turns on (L1) are only a small fraction of those on (L2)

Tubes or Crystal?

IF WE were to depend completely upon the signals produced in this way, the vacuum tube would not be so very much more effective than a crystal detector for the reason that the potentials acting on the grid of the tube are very feeble and the amount of battery current controlled would be correspondingly small. The "amplification" or "multiplication" of the tube would not be sufficient to give us the tremendous distance and signal strength attained by the tube when used in a "regenerative" circuit. As matters stand at this point, the relayed battery current from the "B" battery (B) passes through the plate circuit (12-13) from the positive side of the battery (+), through the phones (PH) and back to the tube plate at (P). Inside the tube this current flows through the vacuous space between the plate (P) and the filament (F) and returns to the negative side (−) of the battery through the wires (9-15). Each change in the rate of flow in this circuit moves the diaphragms of the phones (PH) and thus produces a sound.

As the grid (G) of the tube is between the plate (P) and filament (F), it acts like a valve on the current flow. When the aerial current induces a negative charge on (G), the current flow is instantly checked. When the incoming signal imparts a positive charge to (G) then the rate of flow is increased. Each one of these changes in the rate of flow causes movements of the head-set diaphragms in proportion to the intensity of the incoming waves. During this process of amplification, the incoming waves are "rectified" or checked so that only waves of like polarity pass through the tube. This rectification makes it possible to develop the "modulation" or voice frequency waves upon the phones, as the frequency of the radio frequency waves is far too high to cause diaphragm movement.

Thus the tube aets in two roles. In the first place it amplifies the incoming signal waves, and (2) the tube rectifies these waves so that the voice frequency impulses are developed in the phones. We are not directly concerned with the rectification factor at present in describing the regenerative circuit; hence we will let this matter drop and consider only the means of amplification.

Named according to the tube elements with which they are connected, we have the grid circuit at (6-4-L2-7-8) and the plate circuit at (11-VA-12-13-14-9-15-F). The grid circuit is the "input" of the tube while the plate circuit is the amplified "output." As the current in the plate circuit is very much heavier than that in the grid circuit, it is evident that the output could be further increased if we could feed some of the plate current back into the grid circuit for re-amplification in the tubes.

Thus, the plate current could be amplified a second time with corresponding increase in the output, and this is exactly what is done with the regenerative circuit. In one type, the conductively coupled regenerative, the plate (P) is directly connected to the grid circuit as at (4) or to the aerial circuit wire, (2). In another type, the plate current is led through a "tickler" coil which acts inductively on the secondary coil (L2).

In the present "tuned plate" regenerative, the feedback is "capacitative"; that is, the plate current is fed into the grid circuit through the internal capacity of the tube, control being had by means of the variable inductance or variometer (VA.) It will be seen from Fig. 2 that the grid (G) and the plate (P) are like the plates of a condenser in regard to

Blueprints of the Tuned Plate Regenerative on Pages 46 and 47

A New Twist to the Tuned Plate Regenerator

each other, and therefore grid current can be fed into the plate circuit or plate current can be fed into the grid circuit through the capacity of this condenser, providing that the two circuits are brought nearly into step or "resonance" with each other.

The inductance of the variometer (VA) is varied until the grid and plate circuits are nearly in resonance, and when this is attained, plate current feeds across (P) and (G) into the grid circuit, producing "regeneration." This causes a tremendous increase in the output of the circuit with corresponding increases in range. Without regeneration the ordinary range of the tube would probably be between 50 and 100 miles. Adopting the regenerative principle makes 1,000 miles an ordinary range on voice transmission and even 2,000 miles is not unheard of.

Units and Dimensions

NOW we will get down to the practical description and give specific instructions for the building of this receiver. We can now include the picture diagram, Fig. 1, and the isometric view of Fig. 3, which shows the general arrangement of the apparatus behind the panel. With the exception of the aperiodic coupler (L1-L2) all of the apparatus is standard. There is nothing at all critical about the set and even the inexperienced need not hesitate. For those experimenters who have built the Baby Heterodyne II, I will say that the same tuner, variometer and condenser can be used for building this circuit, and several of our readers have already done this successfully. The aperiodic coupler has been described many times in these columns, but for the benefit of the newcomers, I will repeat these specifications.

Both the primary (L1) and the secondary coil (L2) are wound on the same cardboard or bakelite tube. This tube is about three inches in diameter and four inches long. Coil (L1) consists of 15 turns of No. 26 double silk covered wire, wound 1-2 inch from one end of the tube. The secondary coil (L2) contains about 60 turns of the same size wire and is started about 1-2 inch from the end of coil (L2). In other words, there is 1-2 inch space between (L1) and (L2). Under certain conditions, particularly with long aerials, it may be necessary to reduce slightly the number of turns on (L2), say by five to eight turns, in order to bring in stations on short wavelengths around the 200-meter mark. This is best determined experimentally at the time the set is built, owing to the great variation in the constants of commercial condensers and variometers.

To avoid long wires, it is generally best to support the coil on the back of the condenser by means of short brass brackets which also serve as the connections (4-7) between the coil (L2) and condenser (C1). The jumper wire connection (3) may or may not be necessary, depending upon local conditions, but as a rule this is desirable, as it greatly reduces body capacity. The extreme outer turn (c) of coil (L2), the end farthest away from the primary (L1) should be connected to the grid line (4-5), and it should be particularly noted that the "stator" or stationary plates of (C1) should be connected to (c), and also (4-5). If this is not done, then there is likely to be trouble with body capacity.

Any standard variometer will work well in this circuit, but if possible, obtain a "plate variometer" especially designed to work in the plate circuit. This variometer has fewer turns of heavier wire than the "grid" type variometer. However, both will give results if it is impossible to obtain these distinctive windings. It will be well to keep the variometer well away from the tuning coil (L1-L2) so that there will be no coupling between the two units, and for the best results it is better to incline the coupler at a considerable angle so that the axis of the coupler does not coincide with the axis of the variometer stator.

Condenser (C1) should be of the vernier type, capacity 0.0005 m. f. (23 plates). This form of coupler is very sharp and a vernier arrangement of some kind is therefore highly desirable. For the tubes ordinarily used, the grid condenser (CG) should be of the mica type with a capacity of 0.00025 mf. While a variable grid leak is the best, a 1.0 megohm fixed leak will generally be very satisfactory. The bypass condenser (K1) has a capacity of 0.002 mf. and is effective in reducing the impedance of the plate circuit, for the phones (PH) and the "B" battery both introduce a high resistance to the radio frequency currents in this circuit. The "B" battery voltage may range from 16 to 45 volts, but with the average tube it is likely that 22.5 volts will be perfectly satisfactory.

Picking the Tubes

ANY type of standard tube will give satisfactory results, ranging from the WD-12 to the UV-201A or the UV-200. The latter is somewhat more sensitive as a detector and will give good results on voltages not much exceeding 22.5 volts. This tube is sharper and more critical than the hard tubes. The battery "A" depends upon the tube used. For the WD-12, a single 1.5 volt cell of dry battery is used. For the UV-199 we use three dry cells in series, giving a total of 4.5 volts, while for the UV-200 and UV-201-A a six volt storage battery is best.

It is best to leave the aerial and ground wires (1) and (2) connected temporarily until the set is completed and can be tuned in. Now connect the aerial (AN) and the ground connection (GND) to (a) and (b) alternately, until the best results are obtained. When this is determined, the connection of the primary (L1) can be soldered in permanently. There is one connection that is best and experiments alone can determine this.

As with all regenerative circuits, this circuit will radiate from the aerial if not carefully handled, but owing to the small ratio between the turns on coils (L1) and (L2) this effect is not as bad as with the majority of circuits of this nature. It is nowhere near as bad as a single circuit tuner and is better than the majority of vario-coupler types having a greater number of turns on the primary. The looser the coupling between (L1) and (L2) the less trouble there will be from local "razzing" and interference.

Do not let your tube whistle or howl in tuning, and when you tune into a wave, tune in sharply. Don't get in on the fuzzy edge of a wave. Don't keep your tubes heated up to bright incandescence. If you obey these instructions, you will not cause much disturbance in the neighborhood.

From those of our readers who have tried out this circuit from sketches mailed to them before this article was written, we have had remarkable reports on its selectivity and range. It is a simple, stable circuit without any gew-gaws, and should appeal to the beginner in radio.

HERE again we have the conventional Armstrong, which seems to have survived all the fads and foibles of the game. Circuits have come and gone, but this form seems to have stuck about as well as the crystal. In a way this is the same with the basic circuits; they survive while the adaptations and substitutes are gradually eliminated from the field.

Of course, any of the regenerative sets coupled to an antenna will emit a strong or a weak wave when the tube is oscillating, the strength of the antenna emission depending upon the amount of coupling between the antenna circuit and the secondary. If the coupling is close, stronger emission will be noted than if the coupling is kept very loose. By the same token an increase of selectivity is noted whenever the coupling is loosened more and more until a point has been reached where the feeble energy in the now distant antenna coil will not induce current in the secondary.

For those who wish to follow he "golden rule" of radio, a step of radio frequency ahead of any regenerative circuit, if properly arranged, will eliminate the emission from such regenerative circuits which emission has been the bane of existence of countless thousands of cliff dwellers in the thickly populated areas.

Symposium on methods of doing away with Oscillation

In the September issue of Radio Age fans will find an article dealing with all the known methods of preventing oscillation. Such an article will be an invaluable aid to those experimenters who are troubled with undesired oscillations.

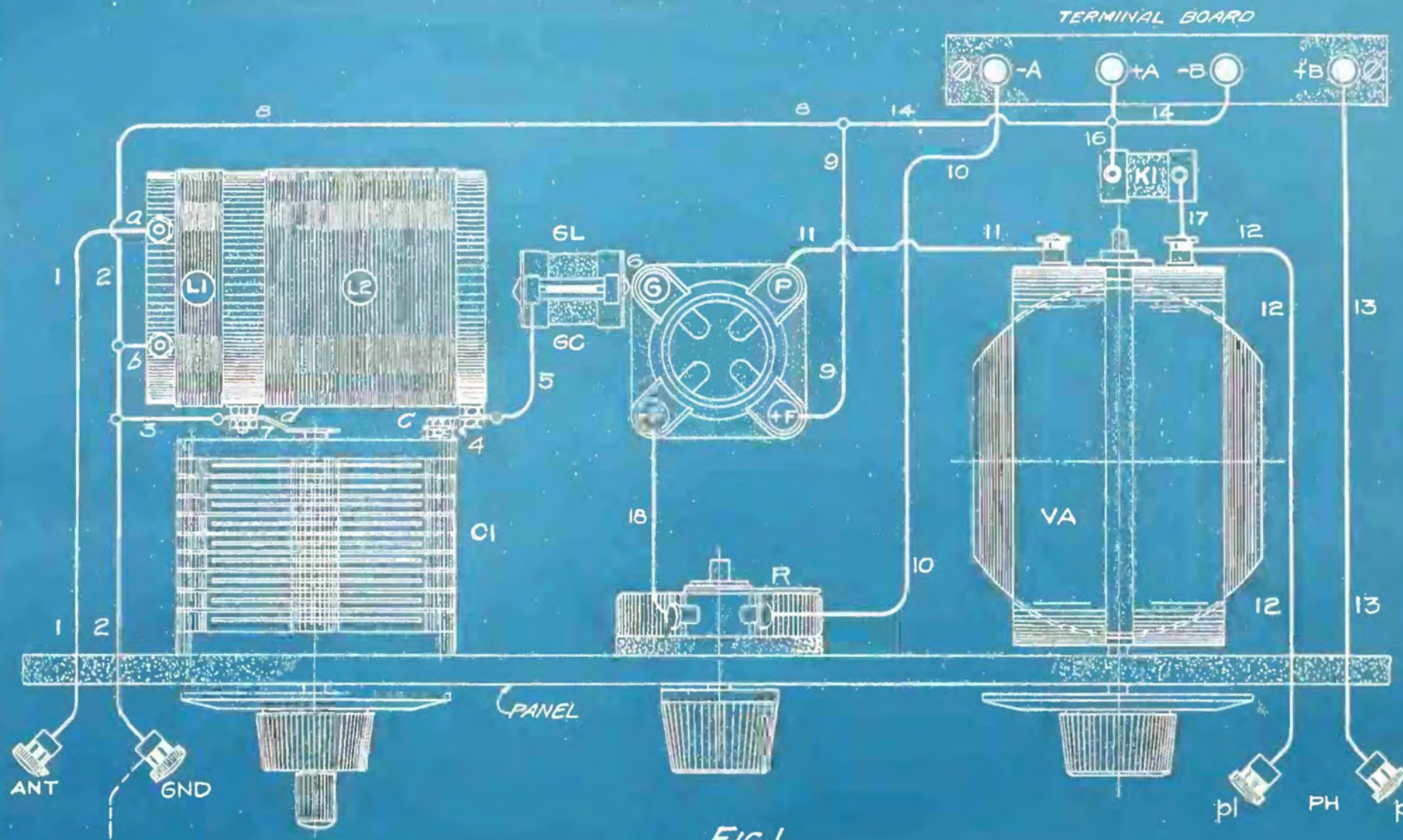


FIG. 1

TUNED PLATE REGENERATIVE

PLAN VIEW SHOWING WIRING AND APPARATUS AS IT APPEARS WHEN LOOKING DOWN ON TOP OF THE SET. ANY TUBE MAY BE USED WITH FROM 16 TO 67.5 VOLTS ON THE PLATE. "A" VOLTAGE DEPENDS ON TYPE OF TUBE.

J. B. RATHBUN
TP-202

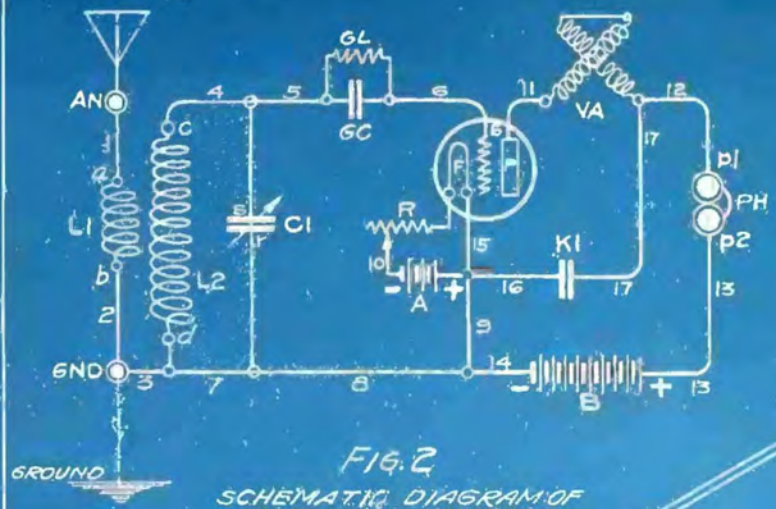


FIG. 2
SCHEMATIC DIAGRAM OF WIRING CONNECTIONS

NOTE!

THE BYPASS CONDENSER K1 MAY OR MAY NOT BE NECESSARY, DEPENDING ON LOCAL CONDITIONS. IT SHOULD AT LEAST BE TRIED.

ANY STANDARD TUBE CAN BE USED IN THIS CIRCUIT, THE "A" BATTERY VOLTAGE DEPENDING ON THE TYPE OF TUBE ADOPTED.

PLATE OR "B" BATTERY VOLTAGE FOR HARD AMPLIFIER TUBES IS FROM 16 TO 67.5 VOLTS. FOR THE SOFT UV-200 OR C-300 TUBES THE VOLTAGE IS FROM 16 TO 22.5 VOLTS.

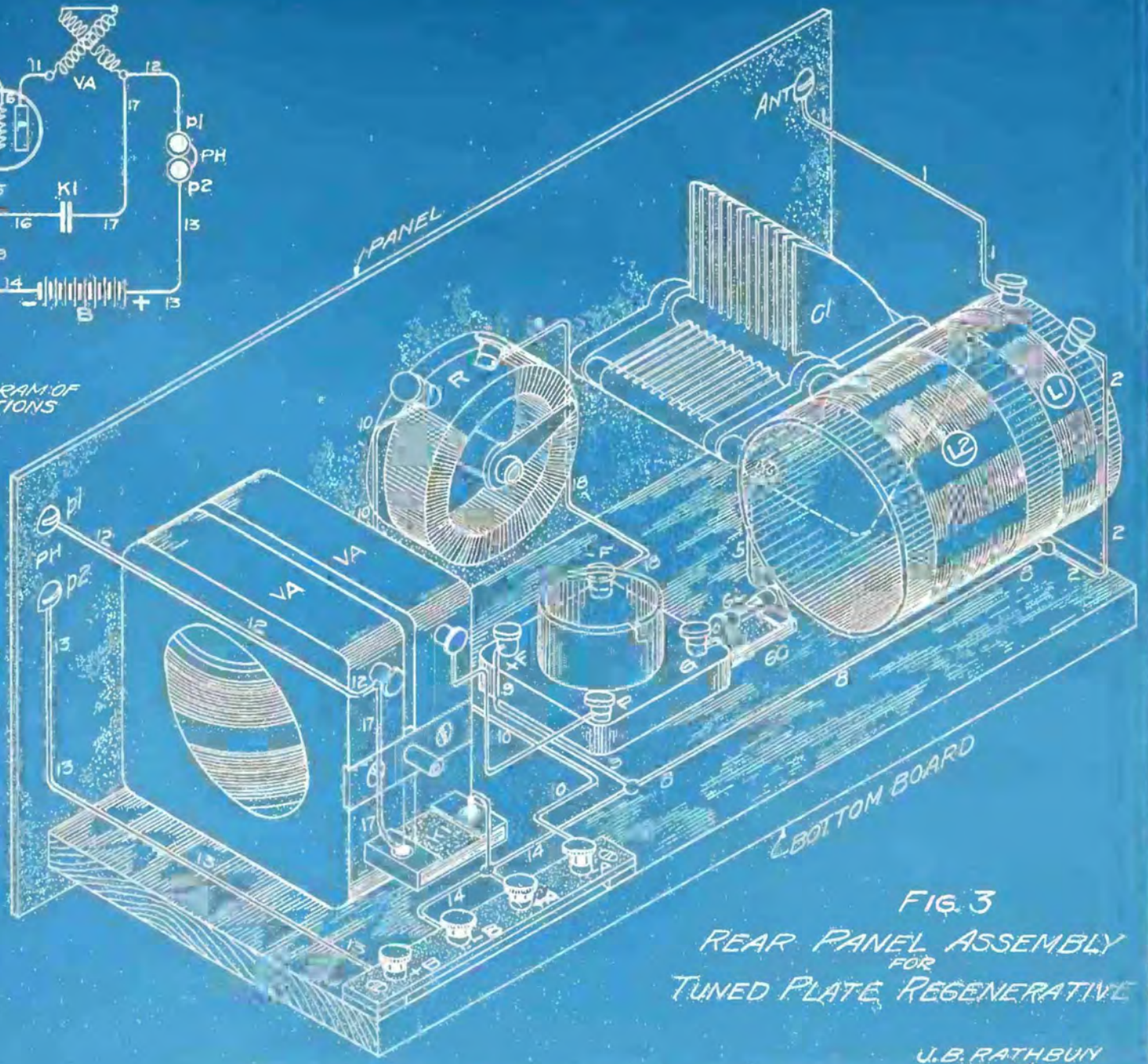


FIG. 3
REAR PANEL ASSEMBLY FOR TUNED PLATE REGENERATIVE

U.B. RATHBUN
TP-202

A Regenerative Reflex Circuit

By JOHN B. RATHBUN

Getting the Most From Your Detector

REFLEX circuit experimenters are divided into two camps. First, those who are adherents of the crystal detector, commonly known as the "Tube Conservationist Party," and second, those who believe in the use of the standard three-element tube as a detector, and derisively called the "Howl Hounds."

There are arguments in favor of both methods, but when it comes down to the final analysis, it is not so easy to give an opinion as to the merits of either side. In fact, I am very glad I am not in a position to take a stand one way or the other and have declared a condition of neutrality so far as these columns go.

There are those who go so far as to state that a reflex circuit never functions properly until there is at least some regeneration in the radio frequency stage, and if this is the case, why not carry out the regenerative idea throughout and dispense with the crystal? The other party to the argument claims clearer reception, but when you come right down to the bottom of the matter, the principal objective is the elimination of the detector tube and conservation of the battery current. So it goes. As reflex circuits with crystal detectors have been presented time and time again in RADIO AGE, I am going to hand you a circuit this time which employs a three element tube detector and which works this detector to the limit of its capabilities; that is, the detector tube will be made regenerative so as to squeeze out the last drop of blood remaining in it.

Advantages as Detector

ALWAYS remembering that I am neutral (?) I will start the ball rolling by stating the following advantages claimed for the tube as a detector. (1) A standard detector tube is capable of considerable amplification within itself, while a crystal detector cannot amplify. (2) A tube detector can be made regenerative, which adds still further to the range and signal strength. (3) The use of a tube detector eliminates "cat-whisker punching" from the game of radio hide-and-seek, and this is truly an advantage. (4) Properly installed, a tube tends to stabilize oscillations in the radio frequency circuit (Perhaps). (5) That the detector tube is so efficient when regenerative that it gives just as much volume as one reflexed tube with a crystal; therefore there is no real tube or battery economy when a crystal is used. In other words, one two-tube set with a tube detector will give just as good performance as two reflexed stages with a crystal detector, so what is the use of the latter? (6) That a crystal detector is not a perfect rectifier as so often claimed, and that it introduces just as much distortion and noise as an improperly adjusted tube detector if not more. There you are; choose for yourself.

While all of the above statements are academically correct, it is not always so easy to make them work out in practice. I have seen some tube detector reflexes which were wonders, and then there were others which were far from having this distinction. I have seen two-tube reflexes (with a detector tube) which would put a three tube and crystal detector outfit to shame, both as to clarity and range, and then I have seen the reverse. It depends a good deal upon who builds the circuit and how it is put up. I have seen both circuits howl with considerable vigor, and the tube detector has nothing on the crystal when the latter is out of adjustment.

It might be well to remark at this point that a soft gas detector tube seems to be more effective in stabilizing the circuit than a hard tube, so a soft tube should be used as the detector when possible. Probably one of the best tubes from this standpoint is the "sodion" tube, which really does cut down the oscillating tendency to a marked degree. Then do you remember the little Welsh (501-D) tubes with the filament wrapped around the outside? These were quite good detectors for this sort of circuit, but they lacked the sensitivity of the sodions and the volume was less. These tubes were not oscillators and could not be made regenerative, but they were far more effective than a crystal and were much quieter.

The Circuit Itself

NOW we come to the actual circuit which is illustrated by the accompanying blueprints, Figs. 1, 2, and 3, which are respectively the picture diagram, the conventional symbolic diagram and the isometric view. These pictures and diagrams are clear enough for the class of amateurs I am appealing to without the use of extensive description, for I believe that this job should be tackled only by those who have had previous experience in building reflex circuits. It is not so difficult, but it does need that experience by which we can make adjustments by the sound of the disturbance. Some of the bypass condensers are likely to be rather critical, and with some makes of transformers, it may be necessary to change the values of the units from those given here.

Tube (T1) is the amplifier tube which amplifies at both radio and audio frequencies, and therefore this must be a hard tube similar to the UV-199 or UV-201A. Tube (T2) is the detector tube and can be anything that we may choose to use in the tube line. Either a hard or soft tube can be used as a detector with the preference in favor of a gas-filled sodion type. The rheostats (R1) and (R1) must be adapted to the tubes used, and if controls are to be at a minimum, an amperite can be used in the filament circuit (R1) of the amplifier (T1), but a rheostat must be always used with (T2) as the filament adjustment for this tube is rather critical. Just as a suggestion as to how an automatic filament control can be used with an amplifier tube, I have indicated an amperite at (R1) in place of the more usual rheostat, but the rheostat can be substituted if desired. An automatic filament control gives us just one less adjustment to bother with, and when once right, it remains right.

At (L1-L2) we have the usual aperiodic coupler consisting of about 15 turns on the primary coil (L1) and from 55 to 60 turns on the secondary coil (L2). The coils are separated by about 5-8 inch for selectivity and are wound on a three inch diameter tube with No. 26 D. S. C. wire. The secondary is tuned by the 0.0005 mf variable vernier condenser (C1). This concludes the tuning unit.

The output of the amplifier tube (T1) passes through the primary of the radio frequency transformer (RFT), and the secondary of this transformer forms the detector circuit of the detector tube (T2). We can have either an untuned transformer at this point or an air-core transformer of the neutrodyne type with a condenser tuned secondary, but for the sake of simplicity in the controls (RFT) is shown of the untuned type which will give good results on the average broadcasting wavelength range of 200 to 600 meters. A tuned transformer gives us slightly more amplification, but it runs up our controls to a total of three, and this is not always desirable in a set of this kind.

As shown, regeneration in the detector tube circuit is had by the plate variometer (VA) which tunes the plate of the detector into resonance with the grid circuit. This not only increases the range and volume but it also helps in obtaining selectivity. In place of the variometer we can also use a "tuned impedance" in the plate circuit consisting of a 0.0005 mf variable condenser with a 50 turn honeycomb coil. This is for the benefit of those readers who are not provided with a variometer, but the results will be about the same in either case. If it is desired, the tube (T2) can be made non-regenerative with the variometer or tuned impedance omitted altogether, and while the amplification will not be as great this way, yet it will be considerably greater than with a crystal detector.

An audio frequency transformer (AT-1) with a ratio of from 5-1 to 6-1, is used for coupling the detector stage output with the amplifier input. This is of the usual iron core type and needs little further comment. Both the primary and secondaries of the transformers are bypassed by the fixed condensers (K1) and (K2). These will probably work out at 0.002 mf, but in some cases the transformer characteristics are such that they can be eliminated altogether. The usual grid condenser (GC) of 0.00025 mf is used in the grid circuit of the detector tube, and a one megohm grid leak (GL) is connected across the grid condenser. As the detector tube is not in the aerial circuit, a higher grid leak value can be used than when the detector is in the forward position and there will be no trouble with oscillations and radiation.

From 45 to 90 volts of "B" battery can be used on the amplifier tube (T1), but the plate voltage of the detector tube depends upon the type of tube employed at (T2). If a soft detector tube of the UV-200 type is used for (T2) we cannot have more than 22.5 volts at this point, and as a rule it is not advisable to have more than 45 volts with any detector (T2) as higher voltages give greater tendency toward squealing and oscillations. To provide for the use of two plate voltages for the detector and amplifier, a detector tap is shown at (DB).

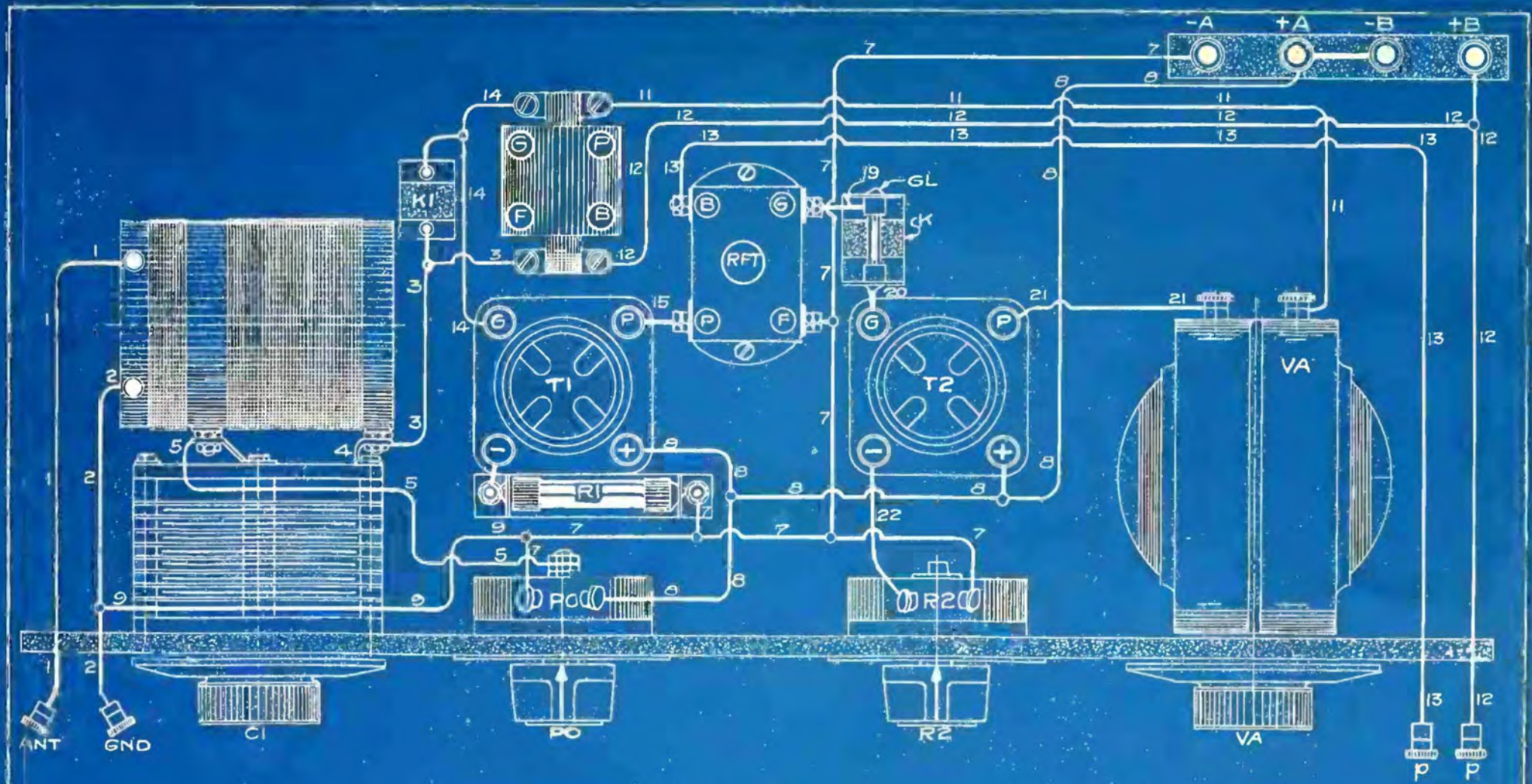


FIG. 1

REGENERATIVE REFLEX

PLAN VIEW (TOP) OF PARTS & WIRE

J.B. RATHBUN
RFX 575

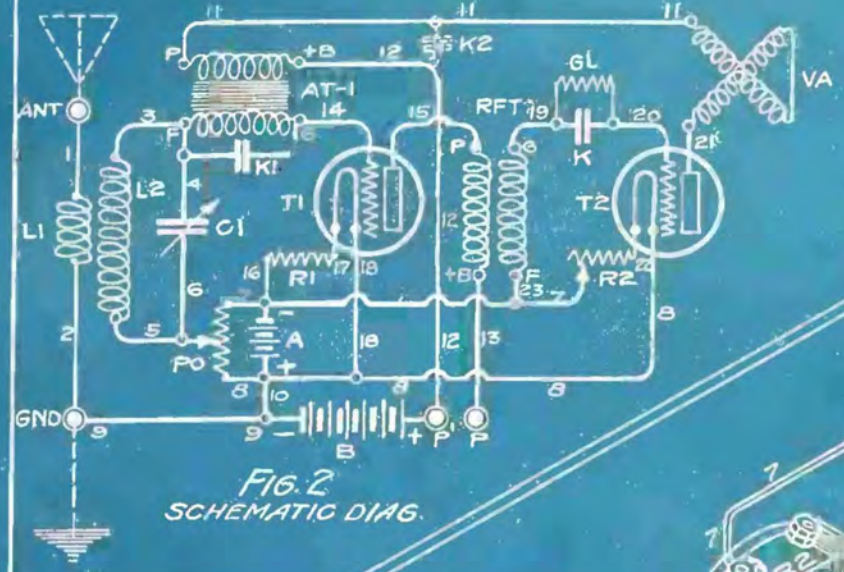


FIG. 2
SCHEMATIC DIAG.

NOTE!
THE POTENTIOMETER P0 USED FOR THE CONTROL OF THE FREE OSCILLATIONS MAY BE EITHER OF THE 200 OR 400 OHM TYPE, PREFERABLY THE LATTER. ANY MAKE MAY BE USED

FIG. 3
REAR VIEW OF PANEL
FOR
REGENERATIVE REFLEX
THE ABOVE DIAGRAM SHOWS THE SET AS IT ACTUALLY APPEARS WHEN ASSEMBLED AND WIRED. FOR MAKING CONNECTIONS USE FIGS. 1 AND 2, NOT THE ABOVE FIG.

J. B. RATHBUN
RFX-575

A Three-Tube Neutrodyne

By JOHN B. RATHBUN

PROBABLY the most popular multi-tube circuit of the present time is the tuned radio frequency type, of which the neutrodyne is the most prominent example. In fact, the neutrodyne was one of the first radio receivers employing more than three tubes which became popular with the broadcast listener and therefore stands alone as being the representative long range circuit, at least in the minds of the average home builder. This popularity led to the development of a long series of "dynes" which bear more or less resemblance to the original neutrodyne and all of which are members of the tuned radio frequency family.

Tuned RF Arguments

In a tuned radio frequency circuit the distinguishing feature is the employment of tuned transformers (air core type) in the radio frequency stages. Each radio frequency transformer is individually tuned to wave length by means of a variable condenser connected across the secondary coil and by this means the maximum amplification or "peak" is obtained on all wavelengths within the range of the condenser and coils. Further, the tuning of the independent stages very greatly increases the selectivity, since each transformer is an additional tuning coupler which augments and corrects the selectivity of the first antenna coupler. With two stages of radio frequency amplification, we have three tuning controls, the antenna coupler condenser and the two variable condensers used in connection with the two radio transformers. Should the wave of an undesired station succeed in passing the antenna coupler, it will be eliminated in either the first or second transformer of the succeeding tuned radio transformers.

Because of the condenser effect between the grid and plate of the tube, we cannot attain maximum amplification in the radio stages unless the feedback through this capacity is offset by some external device. Starting from the antenna end of the circuit, we find that some of the radio energy will feed straight through the internal capacity of the tube without any amplification. Starting at the output or plate end of the radio stages we can see that some of the plate current is fed back to the antenna through the tube capacity and thus produces regeneration with its annoying noises and re-radiations from the aerial. When regeneration in the radio stages occurs in this way, we cannot carry the electron emission to the point required without also producing troublesome audio oscillations or squealing, and this of course limits the possible amplification.

Clear Tone Assured by a Crystal Detector

MANY AMATEURS who have wished to work the neutrodyne circuit have been held back by the expense of the usual five tube standard set. It is for this reason that the writer has worked out a three tube neutrodyne which will give many of the advantages of the more elaborate circuit with only a slightly reduced output and range. A crystal detector is substituted for the more usual detector tube and only one stage of audio frequency amplification is employed, thus doing away with two of the tubes.

Fig. 1 is a picture diagram of the three tube neutrodyne, where it will be seen that we have two radio frequency stages, a crystal detector, and one audio stage. This will insure very good distance reception and loud speaker volume on all but the more distant stations. The crystal avoids the noises of the detector tube, thus giving a very pure, natural tone that is unapproached by the standard five tube set. Further, when properly adjusted it will not squeal nor howl under any tuning conditions.

All Tubes Amplify

In Fig. 1 the two radio frequency tubes are at (T1) and (T2), the crystal detector is at (CD), and the audio tube at (T3). All tube filaments are controlled by the single rheostat (R), the resistance of which depends upon the type of tubes used, and as this carries the current for all tubes the resistance must be somewhat lower than when a single rheostat is used for each tube. It must be borne in mind that all of the tubes are amplifiers such as the UV-201A, C-301A, UV-199 or C-299 and that soft detector tubes will not give the necessary amplification.

(Continued on Page 56)

In this article you find the original neutrodyne, the patents on which are chiefly held by Prof. Hazeltine. This type of a receiver long held sway, and still does to a large extent, but the chief difficulty seemed to be in getting proper neutralization at all wavelengths.

With the newer forms of inductance winding, this trouble was gradually lessened, until today by proper design it is almost possible to arrange tuned r. f. circuits without means of neutralization. We say "almost" for the sake of conservatism, though there are many who claim total elimination of necessity for neutralization by the type of inductances now in use.

Blueprints for Three-Tube Neutrodyne on Pages Following

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Radio Age is the only Radio Magazine you can buy in which you can find *real* Blueprints of Radio Hookups. The Blueprints in this section are but a sample of what's in store for you in each issue of RADIO AGE—The Magazine of the hour

Subscription, $2.50 a Year

A Simple But Effective Neutrodyne

(Continued from page 55)

In the aerial circuit (ANT) we have the fixed coupler (RFT-1) with the aperiodic primary coil (1) and the secondary coil (2). The secondary (2) is tuned to wavelength by the variable condenser (C1) while the lower end of the primary (1) is grounded to the ground post (GND) and to the (-A) line. The plate output of tube (T1) is fed into the primary coil (1) of the radio frequency transformer (RFT-2) where it induces a current of higher voltage in the secondary coil (2) of RFT-2. The *outer end* of the secondary (2) is connected to the grid of the second tube (T2) where the next radio amplification takes place. The secondary of (RFT-2) is tuned to wavelength by the variable condenser (C2) which is the second control. In the same way, the output of the tube (T2) is fed into the crystal detector circuit (CD) by means of the third radio transformer (RFT-3). The crystal detector (CD) rectifies the radio current into the modulated audio frequency current.

ALL THREE units (RFT-1), (RFT-2) and (RFT-3) are standard air core radio frequency transformers commonly known as standard "Neutrodyne Transformers," and it is far better to buy these transformers ready made than to attempt making them at home. Unless properly made, such transformers will greatly reduce the effectiveness of the circuit and cause trouble in tuning. In the diagram of Fig. 1, the transformers are shown laid flat down in a horizontal position so that the connections can be more easily seen, but actually they are tilted up at an angle of about 60 degrees with the horizontal so that there will be no coupling between the adjacent stages. It is of the greatest importance that we avoid having the magnetic flux from one transformer feedback into the following transformer, hence, the arrangement must be made as in Fig. 2 where the transformers are shown tilted up at an angle of 60 degrees with the baseboard.

As shown by Fig. 3, the center to center spacing between the transformers and condensers is 5 1-2", and the transformers should not be closer than this if maximum results are to be obtained. With this spacing we can get the apparatus on a 7x18" panel without difficulty but if we consider adding a second stage of audio in the future it would be better to use a 7x21" or 7x24" panel.

Returning to Fig. 1, we see the neutraling condensers (NC) used for neutralizing the internal capacity of the tubes. At one end they are connected to the grids (G) of the tubes while at the other end a connection is made to an intermediate tap in the secondary of the transformers. By adjusting these condensers (NC) we can completely offset the internal capacity so that maximum amplification is attained. The neutralizing condensers (NC) should be purchased ready made, and as they can be obtained at a comparatively low cost we will not enter into their construction.

Tuning Condensers

The secondary tuning condensers (C1), (C2), (C3), should be a reliable make of variable condenser. Plain condensers are used and verniers are not necessary. The majority of the commercial neutrodyne transformers on the market require a condenser having a maximum capacity of 0.00035 mf or what is commonly known as a 17 plate condenser. Usually, a 23 plate condenser is too large for this purpose, and makes the tuning unnecessarily critical and difficult. The condensers can be connected to the transformer secondaries by the brackets shown or else by wires when the transformers are of the type which are fastened to the floor.

USE THE ORIGINAL
RADIO AGE
BLUEPRINTS
On Pages 53 and 54
to Make This
Three Tube Neutrodyne

In connecting the condensers to the secondary coil of the transfromers we should take particular care to have the stator or stationary plates connected to the wire which runs to the grid of the tube, as shown in the diagram. The rotor or movable plates should be connected to (-A) and ground. If this is not followed out, then we will be sure to have trouble with body capacity. The outside turn of the secondary coil (to the right), the stator of the condenser and the grid wire must be connected together for the best results. This is clearly shown in the diagram and should be followed out carefully by the builder.

Any Ratio Possible

At (AT) we have the usual iron core audio frequency transformer for the audio stage. Almost any ration can be used with slightly varying results. With a ratio of 3-1 or 5-1 we obtain very clear amplification with a slight decrease in volume. With a 10-1 ration we have a somewhat greater amplification but with slightly increased distortion. A ratio of 5-1 probably is the best compromise but this is not exactly the case with all makes of transformers. In any case there will be less distortion and noise with a crystal detector circuit than when a detector tube is used, and therefore we can probably use a higher ratio with this circuit than would be permissible with a circuit employing a detector tube.

A 0.001 mf. fixed condenser (K1) is connected across the primary (P'-B') of the transformer to bypass the radio frequency component. No jacks are used for the detector and final stages, since they introduce complications into the circuit. We have only three tubes and the small additional current taken by the final tube doesn't make it practical to introduce jacks at this point. A fixed bypass condenser (K2) bypasses the radio current across the phones and "B" battery. The value of this condenser is not critical and may range from 0.0025 mf. to 0.006 mf.

Battery and Voltages

TO produce the maximum range and volume, we will require a 90 volt "B" battery for supplying the plate current. This is connected between the (−B) and (+B) battery binding posts. The audio amplification will be made somewhat greater if we introduce a 4.5 vole "C" battery between the secondary transformer post (G') and the grid (G) of the tube (T3). Full details of this arrangement were shown on Data sheets JJ-9-25 and JJ-9-26 of the September RADIO AGE. The installation in Fig. 1 of data sheet JJ-9-26 shows the installation exactly as it would be made. Be sure that the negative (−) post is connected to the (G) post of the socket.

After the circuit has been wired up according to the diagram in Fig. 1, with the apparatus located as in the isometric view of Fig. 3, we can connect the batteries, insert the tubes, and then make the neutralizing adjustments. With the tubes lighted up to normal brilliancy we can tune in some local station by means of the variable condensers until we obtain maximum volume. Now note the position of the dials on the condensers, and after loosening the dial, set the screws and turn them until the same number on each dial comes exactly opposite to its stationary pointer. This will save much time in tuning, as we are now able to get all three condensers in exact agreement by turning to the same number on each dial.

With everything running at full pitch, remove the first radio tube (T1) from its socket and place a piece of paper across the "A" battery contacts so that the tube will not light when replaced in the socket. With this tube in place, but not lighted, see if you still hear the local station with the rest of the tubes at normal brilliancy. If you do, then adjust the first neutralizing condenser (NC) until you can no longer hear the signals. With this accomplished, take tube (T2) out of its socket, place a piece of paper across the battery springs as before, so that the filament of tube (T2) will not light. With the other tubes burning, try again to see if any signals are being heard through the capacity of the dead tube. If signals are still heard with (T2) dark, adjust the second neutralizing condenser (NC) until signals cease or are reduced to a minimum.

The set is now only partly neutralized at best and further adjustments of the neutralizers (NC) will probably be necessary until the best tone and volume, and the best all around reception is had. There should be no squealing or howling and the "tweet-tweet" of the carrier wave should be very faint when tuning into a station

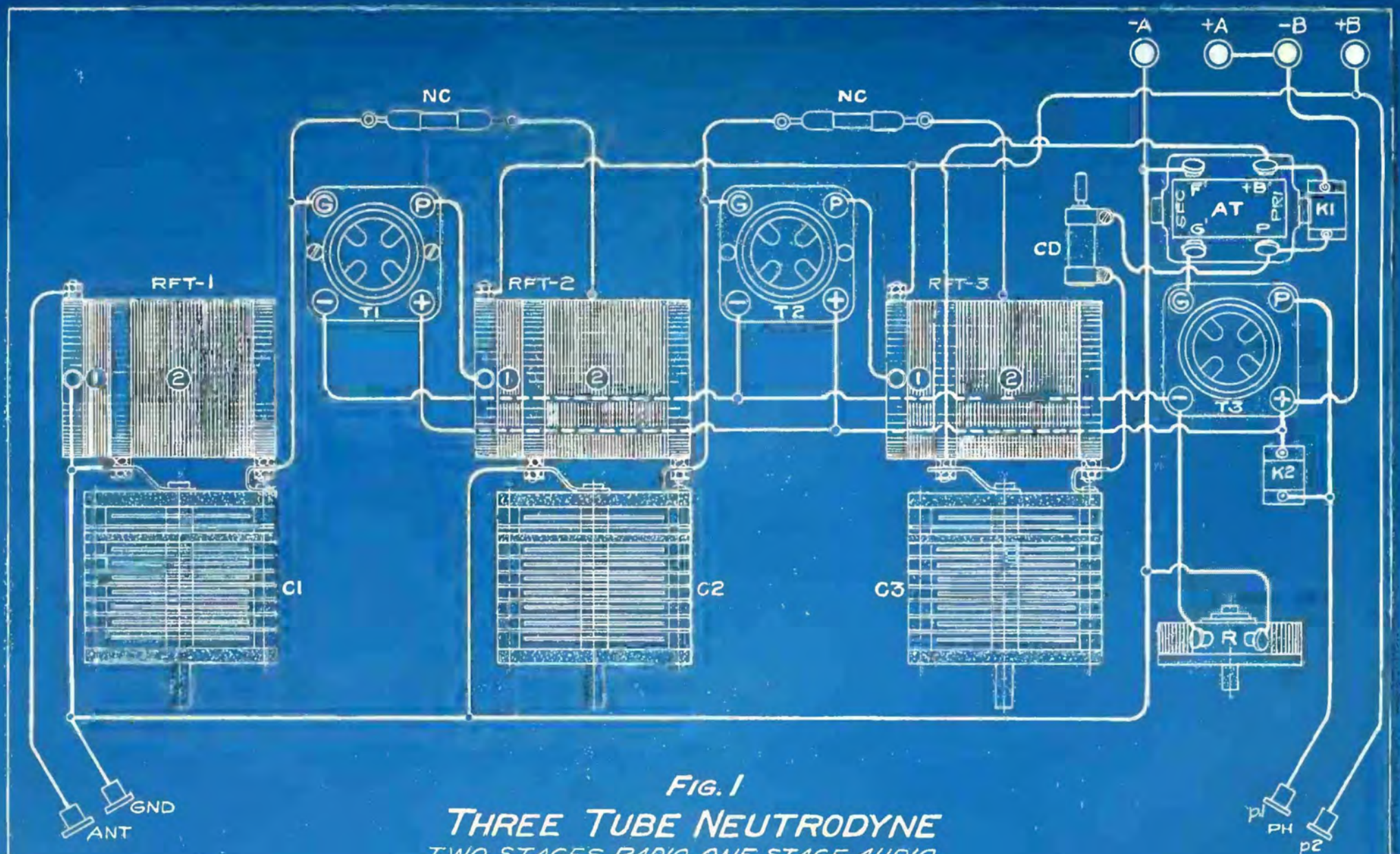

FIG. 1

THREE TUBE NEUTRODYNE

TWO STAGES RADIO, ONE STAGE AUDIO

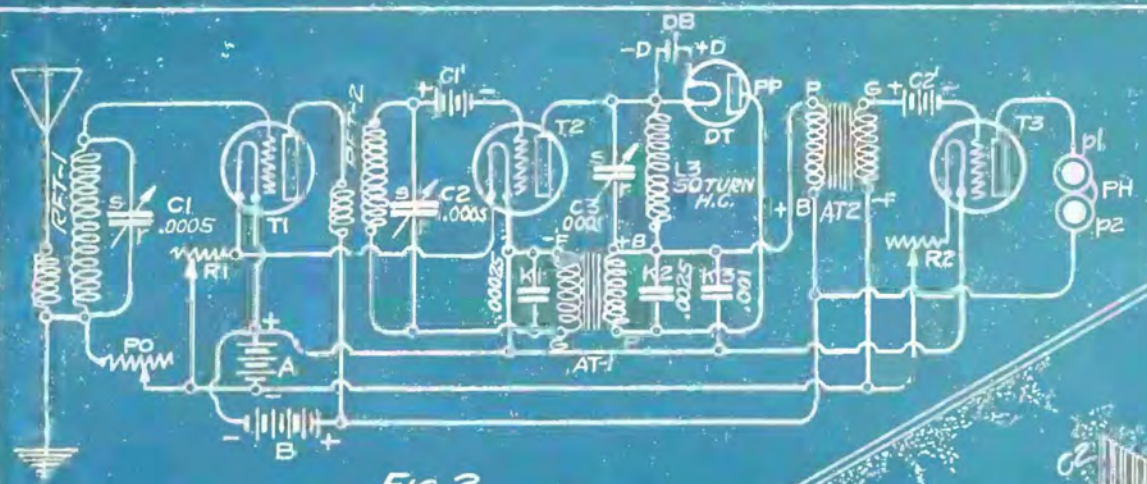

FIG. 2
SCHEMATIC WIRING DIAGRAM

FIG. 3
REAR ELEVATION OF PANEL
FOR
TWO STAGE "99" REFLEX

J. B. RATHBUN
RFX-550

A 3-Tube Portable Reflex

By JOHN B. RATHBUN

Reversed Capacity Feedback Cuts Out Free Oscillations

TO BE truly portable, according to my idea, means that a receiving set should be easily carried about from place to place without seriously straining its owner's physique, and at the same time it should be so compact that it will not take up any more room than necessary in a trunk. There are portables and portables, but the absolute zero in portability is the set made up in a traveler's sample case which weighs about 100 pounds and occupies about fifty per cent of the trunk space. On the other extreme is the freak midget set which has been variously fitted into pill boxes, fountain pens and pickle bottles, and which has absolutely no purpose in life except to exhibit the make's ingenuity. The real portable should have a good range and sufficient volume to operate a loud speaker, and yet at the same time should not take up a great deal more space than a camera, even when fully equipped with batteries.

No really practicable portable has been turned out with less than three tubes, for it is impossible to operate a loud speaker satisfactorily with less tubes on anything but local stations. For this reason I will assume a three tube set from the beginning and will build up all the other data about this premise. Whether this is to be a regenerative, radio frequency or reflex still remains to be seen, but as the maximum volume is to be obtained from a minimum number of tubes and batteries, I have strong leanings for the reflex type. The reflex circuit is not always the greatest distance getter, but what it does get, it gets good and loud.

Batteries Consume Space

PROBABLY the most important item in a portable is that of the batteries, for the batteries weigh more and take up more space than the rest of the equipment. Our current supply system must be reduced to the lowest possible limit even at some sacrifice in the life of the batteries. If the batteries stand up for a month while traveling about, it is generally considered satisfactory for vacation tours. At home, we can substitute larger batteries installed outside the set, but in touring, the space and weight are the principal items. With this idea in mind, we will study the battery situation and the proper tubes to go with these batteries.

"EVERYTHING I NEED IN RADIO"

"I bought a copy of the RADIO AGE ANNUAL for 1925 and I found that everything I wanted to know about radio, from crystal sets to complicated multi-tubers, was contained between its two covers," wrote an enthusiastic beginner.

"I never knew so much could be contained in one book without crowding or omitting necessary details. But you haven't left a thing out of the ANNUAL for 1925."

Letters such as the above are sent to us every day, voicing sincere appreciation of the ANNUAL for 1925, the most complete radio hookup book ever printed. And the price for the 120 pages of technical "nuggets" is but ONE DOLLAR, postpaid.

Send your order *now* while our supply of the limited first edition lasts.

Dry Cells Used

Storage batteries are out of the question, of course, hence only dry cells are available for the filament and plate current. This means that the tubes must either be of the WD-12 or the UV-199 type, which are specially designed for dry cell service. They do not give the volume of the 201A power tubes used with storage batteries, but they give excellent results if properly handled.

The WD-11 and WD-12 are the same tube with the exception of the base. The base of the WD-11 is a special small size, while the WD-12 fits in a standard socket. Both tubes operate on the 1.5 volts produced by a single dry cell and take 0.25 ampere per tube. Each tube therefore takes $1.5 \times 0.25 = 0.375$ watt, or 3-8 watt. One No. 6 dry cell is provided for each tube, which can be connected independently to each tube of a multi-tube set or to a multiple connected battery with as many cells as tubes. As 0.25 ampere is the rated discharge rate for a No. 6 cell, it is not possible to use a smaller battery.

Next come the UV-199 or the C-299 tubes, which require 3.0 volts at the filament, and which take only 0.06 ampere of current. As the voltage of a battery falls off with use, we must use three dry cells in series, which gives us a total of 4.5 with a fresh battery. This excess is taken care of by a 30 to 40-ohm rheostat, which permits the use of a battery between the limits of 4.5 volts and 3.0 volts, the battery being discarded when the voltage drops to the latter point. The power taken is therefore: $4.5 \times 0.06 = 0.27$ watt, very much less power than is required with the WD-12.

(Turn to page 56)

Blueprints of the 3-Tube Portable Reflex on Two Pages Following

RADIO AGE is the only radio magazine on the market to originate and maintain the blueprint form of printing hookups in its columns.

The popularity of such a process is shown by the countless letters from fans, many of whom would rather work from a blueprint than the best black-and-white drawing available.

Every month you will find in RADIO AGE a set of blueprints together with a descriptive article by John B. Rathbun on how to construct a certain type of set. By becoming a subscriber of RADIO AGE, you have a steady stream of accurate and workable blueprints coming into your home; a handy reference for the future, or a necessity for the present in the making of a good receiver.

(Continued from page 55)

Qualities of "199" Tube

NOT only is the power loss with the UV-199 tube, but the amplification is greater than with the WD-12, and the 199 is much more satisfactory in the amplication of radio frequency currents in reflex sets. In fact, the 199 comes next to the 201A tube in regard to amplication and only takes one-quarter of the current. Three No. 6 "A" batteries will operate three 199 tubes for a long time, for the discharge rate is only 3x0.06 = 0.18 ampere, or less than a single WD-12 tube. The 199 is the ideal tube for a portable set from many standpoints, and takes up a minimum of room.

As the rating of a No. 6 dry cell is 0.25 ampere for filament lighting, this size of cell will operate three 199 tubes for a very long period, much longer, in fact, than would be absolutely necessary with a portable receiver. For this reason, we can use a smaller filament battery with satisfactory results, and if the set is not used for too long a period, a 4.5 volt C battery can be used for each tube. As the C battery takes up much less space and weighs much less than a No. 6 cell, we can use a 4.5 volt C for each tube or a total of three C batteries in all. For home use, where less frequent replacements are desirable, we can use a larger external battery—a storage battery if necessary.

An alternative will be to use two C batteries in parallel for each tube. This will give longer life than the singles as connected above, but will take less space than three No. 6 cells. The following table will give the comparative sizes:

NO. OF CELLS	SIZE OF CELLS	SPACE OCCUPIED
3 No. 6	5"x5"x6.5 =	162.5 cubic in.
3 C	4.1"x3"x4" =	49.5 cubic in.
6 C	4.1"x6"x4" =	99.0 cubic in.

In effect, the three C batteries will be connected in parallel through a switch, and we will use the C batteries, as we wish to get the smallest possible set. If longer service from No. 6 cells is required, then the only change necessary will be to use a single group of three cell in series of the No. 6 type, and to correspondingly enlarge the battery compartment of the set.

The Hookup in Detail

In general, the "Junior Reflex" is a regenerative reflex using a tube detector with a tickler coil feed-back and equipped with one additional stage of straight audio frequency amplification. This arrangement gives us one stage of radio frequency amplification, a regenerative stage, and two stages of autio amplification. Enough for three tubes. A short, temporary aerial of from 40 to 60 feet will be all that is ordinarily required, either of the indoor or outdoor type, and I have had good service with a 30 foot indoor aerial run around the picture moulding of the room. So far as possible, small or miniature parts are used to economize space, and it is surprising how much apparatus we can get into a small cabinet when we make up our mind to concentrate our efforts to this end.

A special method of avoiding oscillations by means of a reversed capacity feed-back is applied to the radio frequency tube, which has proved effective in all the cases experimented upon by the writer. The plate current is fed back into the primary of the tuning coil through a very small variable condenser in such a way that it opposes the free oscillation tendency of the first tube. It is a simple application of the reversed feed-back system without the necessity of a tickler coil. As the suppression of free oscillations is one of the most difficult propositions met with by the amateur in the construction of a reflex circuit, he will find this a most important point.

MATERIALS FOR "JUNIOR PORTABLE"

Code Letters	No. of Pcs.	Name	Size
A	3	"C" batteries, large.	4.5 volt.
AFT	2	Audio Frequency Transformers,	4-1 to 6-1 ratio.
B	4	"B" batteries.	22.5 volt blocks. Small size (1200 m. h.).
C1-C2	2	Vernier variable condensers.	0.00035 mf 17 plate).
C3	1	Equalizing variable condenser.	0.00006 mf.
"C"		Small bias battery.	
D	1	Bakelite panel	10"x8 3-4"x3-16".
E	1	Bakelite tube shelf	4"x6 1-8"x1-8".
F	6	Marked binding posts.	
GL	1	Grid leak (adjustable or fixed),	1.0 to 2.0 megohms.
J1	1	Single circuit jack.	
K1	1	Fixed condenser, mica ins. type	0.001 mf.
K2	1	Fixed condenser, mica ins. type	0.002 mf.
K3	1	Fixed condenser with leak lugs	0.00025 mf.
K4	1	Fixed condenser mica ins type	0.00025 mf.
R1-R3	2	Amperites for fila. control (199.	4.5 volts).
R2	1	Filament rheostat, vernier.	40 ohm type.
RFT-1	1	Standard air core R. F. transform	neutrodyne type.
RFT-2	1	Bakelite tube,	2 1-4" diam. 3" long.
RFT-2	1-4	lb. silk covered magnet wire	No 26 D. S. C.
S	4	small brass shelf or support angles.	
12'		Bus wire. No. 14, tinned copper.	
1'		Rosin core solder.	
1'		Spaghetti.	
25		Miscellaneous machine screws.	
U	2	Condenser dials (If not with con.)	3" Diam.
SW	1	Battery cutout switch.	Standard.
T1-T2-T3	3	UV-199 tubes.	
V	3	"199" tube sockets, absorb. base.	
W	4	Condenser angles for holding coils on condensers.	
X	8'	Flexible fixture cord for battery connections,	No. 18.
Y	1	Special cabinet (Complete).	
1		Phone plug.	
60'		Annunciator wire, wax cotton or	No. 18 flexible fixture wire for aerial.

Fig. 1A is a schematic diagram of the "Junior Portable," showing the three tubes, the transformers, and all connections. The tube (T1) is the reflexed radio frequency and audio frequency tube; tube (T2) is the detector, and (T3) is the straight audio frequency amplifier. All radio frequency stages are tuned by variable condensers so that the maximum amplification peak is attained, and at this same time this is a valuable aid to the selectivity of the set. The second tuning coil or radio frequency transformer is of a special type, as it contains three coils which act respectively as the primary, secondary and tickler coils. Only two dials are required for the tuning operation proper, the regeneration being controlled by the detector rheostat, a method that is entirely practicable with a vernier rheostat, and which greatly simplifies the construction and tuning.

At RFT1 we have the usual aperiodic tuning coil with the primary (P) and the secondary (S) which is tuned by the 17 plate (0.00035 mf) variable condenser (C1) connected across the secondary in the conventional manner. A detail of this tuning unit is shown in Fig. 1B, which shows the principal dimensions. There are 58 turns on the secondary and 12 turns on the primary coil (P), with a separation between the two coils of approximately 1-2 inch. The wire is No. 26 D. S. C. magnet wire.

Condenser for Suppression

OSCILLATIONS in the radio frequency circuit are suppressed by the very small variable condenser (C) connected between the primary coil (on the aerial side) and the plate of the first tube (T1). This is a condenser such as the "Chelton Midget" or the "Amplex" neutralizing condenser, having a maximum capacity of from 0.000025 to 0.00006 mf. This is somewhat critical on most sets, hence the condenser (C3) is represented by a dial on the front of the panel. When properly adjusted the first stage can be cleared up quickly and easily by this simple adjustment.

The output of the first tube passes through the primary (P) of the special transformer (RFT-2) which transfers the radio frequency current to the detector tube (T2). This coil (P) is located about 1-4 inch from the end of the secondary coil (S), and at the other end of (S) is the tickler coil (T) provided for regeneration in the detector stage. All three coils are in fixed relation on the same tube, and the detector circuit is tuned to wavelength by the variable condenser (C2) connected across the secondary coil (S). The tickler (T) has about 25 turns, the secondary (S) has 58 turns and the primary (P) is a 12 turn coil. The general details of this coil or transformer are shown by Fig. 1C, but it may be found necessary to give a few more or less turns on (T) until the proper regeneration is obtained with the vernier rheostat (R2) turned to the "half-on" position.

Need Accurate Rheostat

As the current flowing through the coil (T) is almost entirely dependent upon the filament emission, and hence the rheostat adjustment, a very accurate rheostat will be required. A 40-ohm rheostat will be found about right at this point for the proper control of regeneration by the filament emission system. If the tube has to be turned up bright for the regenerative effect, increase the number of turns on (T) until it starts to "flop over" with the rheostat turned about half way on. The regulating resistance for the radio reflex tube (T1) is an Amperite shown at (R1), and a second Amperite is at (R3) for the automatic control of the amplifier filaments. The amplifier tubes (T1-T3) are not critical, but the detector tube (T2) is very critical so that a rheostat must be used instead of an Amperite at this point.

The detector tube circuit is a conventional feed-back circuit and has the usual grid condenser (K3) and grid leak (GL). The grid leak is from 1 to 2 megohms, and the condenser (K3) is probably best at 0.00025 mf. A bypass condenser (fixed) is placed at (K2) which is of assistance in reducing the R. F. resistance of the detector plate circuit. The value may range from 0.001 mf to 0.002 mf, depending upon conditions in the circuit. The circuit tuning condenser (C2) has a capacity of 0.00035 mf., so that (C1) and (C2) will "log" well together.

As is usual, the output of the detector

tube is reflexed back to the first tube (T1) by means of the audio frequency transformer (AFT-1), the latter being in the grid return circuit of the first stage. This can be any make of transformer having a ratio varying from 4-1 to 6-1, but as we wish to gain every inch possible, I have shown the miniature Premier Hegehog transformer in the picture diagrams. In some cases, a 0.00025 mf fixed condenser (K4) improves results when connected across the secondary coil of (AFT-1), and again, this seems to have but little effect. It seems to be a matter of experiment with each individual set to determine whether (K4) should be used. Its effect is principally on DX rather than on volume with local stations, so that we should try for distance in making this adjustment rather than to experiment for volume alone.

The output of the reflexed tube (T1) now passes to the primary coil of the second audio transformer (AFT-2), and this latter transformer is a part of a straight audio stage that is not reflexed. Connections are made to (T3) in the usual standard manner, and the total output of all three tubes passes out through the output jack (J1) to the phones or loud speaker. This is not a complicated circuit to hook up, but it requires some readjustments as with any reflex circuit, particularly in regard to the values of the bypass condensers.

For the smallest portable set, three 4.5 volt "C" batteries are used for the filament current as at (A1-A2-A3), the cells being in parallel and connected to the circuit through the battery cutout switch marked (SW).

22.5 Volts for Detector

PLATE or "B" battery connections are tapped according to the requirements of the various stages. A voltage of 22.5 volts generally proves best for the detector circuit under all around conditions, although 45 volts may give greater volume and selectivity on local stations. A potential of 45 volts is most effective on the radio frequency tubes on distance, hence a 45 volt tap is indicated for this stage. The audio stage requires 90 volts for the best performance, and 67 volts gives nearly as good results with one less block of "B" battery. The set can also be operated with 45 volts on the audio stage, but with greatly diminished volume on all stations. I do not recommend placing the full 90 volts on the radio frequency stage, and never on the detector stage, and after experimenting extensively I find that the best all around results will be found with the plate battery connections as indicated.

Four small B batteries (90 volts total) can be used for this set and will last most of the season. The smallest B batteries are the 450 milliampere-hour cells which measure 2" wide, 3-3-8" long and 2-9-16" high. The next largest size take up very little more space and give much longer service. This is the 1200 milliampere-hour size which is 2-9-16" wide, 4-1-6" long and 2-3-4" high. The latter size are the more practicable, especially with three tubes, and are shown in the assembly diagram. With three tubes kicking out from 10 to 12 milliamperes, the 450 m. a. h. type does not last very long before the voltage runs down and the volume falls off.

In the table on page 38 is listed all of the material required for building this set, each item in the list being preceded by a letter corresponding to the letters on the diagram. All of these parts are standard and the majority are built by a number of radio concerns so that it will not be difficult to pick up all of the parts at your dealer's. The only special parts are the cabinet, which must be built to fit the job at hand, and the tuning coils and RF transformer, which can easily be wound up at home. A neutroformer or tuning unit can be purchased for use in place of RFT-1, but RFT-2 is special and is not stocked.

Outdoors or Indoors—You Will Find All Your Radio Needs Satisfied In RADIO AGE Every Month.

Another Blueprint Hookup In September RADIO AGE—Out Aug. 15

Fig. 2 shows all of the parts connected up in "picture" form for the benefit of the novice who does not understand conventional or symbolic diagrams. Either Fig. 1 or Fig. 2 can be used in making the actual connections, for both show the same circuit and the parts are lettered with corresponding letters.

Fig. 3 is a rear elevation of the set with the back panel removed and shows how the parts are assembled, ready for wiring. The three tubes and sockets are mounted on the top of the shelf (E) while the audio transformers are hung underneath. This not only saves room but it also shortens and simplifies the wiring. Of course, machine screws must be used for this assembly instead of the more usual wood screws, as all parts are fastened to bakelite. The shelf is attached to the panel by means of the small brass angle brackets (S) which can be made at home or purchased at almost any radio store.

I wish to call your attention to the fact that the two radio frequency transformers or tuning coils (RFT-1) and (RFT-2) must be placed at right angles to one another, as shown, to prevent coupling back between stages and to prevent oscillations being set up by induction. The coils are supported by brass lug connections to the terminals of the variable condensers so that their weight is substantially supported. It should be particularly noted that the stator or stationary plates of the variable condensers (C1-C2-C3) connect to the grids of the tubes to prevent the body capacity effect from being carried out to the front of the panel through the shafts of the condensers. The grids are at a high potential, and anything connected to the grids is easily affected by the capacity of the hand and is detuned by this capacity effect.

All of the batteries are carried in the bottom of the cabinet, very closely packed together to prevent movement, and connections are made with the circuit above through the flexible cords (X). Connections are more certain and more easily made if "spade" type clips are soldered to the ends of these cords. Do not use solid wire for this purpose or simple cotton covered wire, as such wire is likely to short-circuit. Flexible fixture wire has a rubber covering which is further protected by a cotton braid, making a short circuit unlikely.

The Aerial Wire

THE aerial wire can be a temporary affair run around the picture moulding of the room, strung up temporarily from room to room, hung between trees or other supports. It is connected to the antenna post (ANT) with the other end left free and unconnected. For indoor service about 60 feet of annunciator will be sufficient and no supporting insulators will be needed, as the waxed cotton cover will be sufficient insulation when laid along the plaster of the walls or along wood surfaces. For outdoor work, or where it is likely to be damp, a wire with rubber insulation should be used, such as flexible fixture wire or lamp cord. Lamp cord is excellent for this purpose, as it has a low R. F. resistance and is sufficiently flexible to allow winding up in a small coil.

After cutting the batteries into circuit by means of the battery switch (SW), the detector rheostat (R2) and the equalizing condenser (C3) are adjusted until all whistling and howling stop. There should be a slight hissing or frying noise which will indicate that the tubes are functioning, but the adjustments should not be much above this point. Next, turn the wavelength adjustment condensers (C1) and (C2) very slowly and at about the same rate of speed until a "station whistle" or voice is picked up. Juggle the condenser dials until the signal is at a maximum, and then manipulate the detector rheostat (R2) just under the point where it is about to break down into free oscillations and where the signal is at a maximum. Working the detector rheostat in connection with the condenser (C3) will give the maximum volume.

Remember that (C3) is for the purpose of checking oscillations in the radio frequency circuit, and that this controls the radio frequency circuit in about the same way that the detector rheostat controls the detector. Howling can be checked by either (C3) or (R2) depending upon whether the trouble is in the radio frequency or detector circuits.

The selectivity depends upon the

(Turn to page 58)

Blueprints of the 3-Tube Portable Reflex on Pages Following

Battery Problem Easily Handled

(Continued from page 57)

distance of the primary coil (P) from the secondary (S). The greater the distance the looser will be the coupling and the greater the selectivity. This applies to both (RFT-1) and (RFT-2). Usually the best spacing of the coils is as shown by Figs. 1B and 1C, but with some types of audio frequency transformers, this must be increased. The wavelength range is determined by the number of turns on the secondary coils (S), and as shown, will cover a range of from 200 to 600 meters.

Fig. 4 is a front e.evation of the panel, showing the dials and other controls. It is advisable to allow the cabinet to project beyond the panel in front for the protection of the dials, and to provide a door at this point, so that the set can be completely closed.

Trouble Shooting

WHEN the signals are weak and the selectivity seems poor, the trouble is usually due to coil reversal; that is, the various coils in the tuner or transformer do not bear the proper inductive relation to one another. If, for example, the primary coil should be connected so that it produces a magnetic field that opposes the field of the secondary coil, then the output will be practically neutralized and there will be little reception. It is for this reason that I suggest that you connect up all of the primary coils permanently when you wire the set, and make temporary connections to the secondary coils and tickler coil with magnet wire.

After you connect up the set, you can tune in, and if results are not satisfactory at the first attempt, try reversing the connections to the secondary and tickler one at a time, until you get the best results. After the best point is found, you can complete the wiring by substituting soldered bus wire connections for the temporary wires. This may save you a lot of work and should be observed.

Be sure that the prongs of the tubes are making proper contact with the springs in the sockets, and try this out before you screw the sockets down into place. A loose tube or loose contacts mean all kinds of trouble, and trouble that is difficult to remedy after the set is completed and in the cabinet. Also carefully examine the jack connections, and make sure that a projecting lump of solder is not short-circuiting the jack. The lugs are very close together and it is easy to short-circuit at this point.

Use only the small "midget" type variable condensers for the transfer (C3). A standard condenser, even as small as a three plate, is much too large to cover the range even with all of the plates out of engagement. The zero capacity of standard condensers is very frequently greater than the maximum capacity desired at (C3).

Sometimes reception is improved by connecting a 0.001 mf fixed condenser across the ends of the jack (J1), and sometimes this has no effect at all. It all depends upon the winding characteristics of the coils in your phones and speaker.

In making battery connections, be sure that the positive pole of your "B" battery is connected into circuit at the point indicated in the drawings, that is, the positive of the "B" battery must always go to the plate directly, or to the plate through the tickler coil or transformer primary. If this polarity is not observed, the set will be absolutely dead without a hiss or grunt to be heard.

A biasing "C" battery for the grid of the audio amplifying tube (T3) can be connected in at (−C) and (+C) as shown just under the audio transformer (AFT-2) in Figs. 1–2. This will save enough "B" battery current to pay its way, but if it is not desired at the present time, the binding posts or connections (−C) and (+C) can be sort circuits as indicated by the dotted line running between these two connections. The "C" battery can be the smallest type of "C" battery or else can be a small flash light battery, either giving a total potential of 4.5 volts on the grid of the tube (T3).

In this article Mr. Rathbun has made up a set that is really portable. Heretofore portability has been a word and not an accomplishment, for whatever was labelled portable was sure to tip the scale around the hundred pound mark. But in this the weight is kept down, which alone should appeal to the camper or traveler.

The future of the portable does not seem to be in doubt. The set will be improved more and more as time goes on, so that eventually it will be down to a small sized outfit that can be readily carried and which will at the same time perform nearly as good as one of the larger sets.

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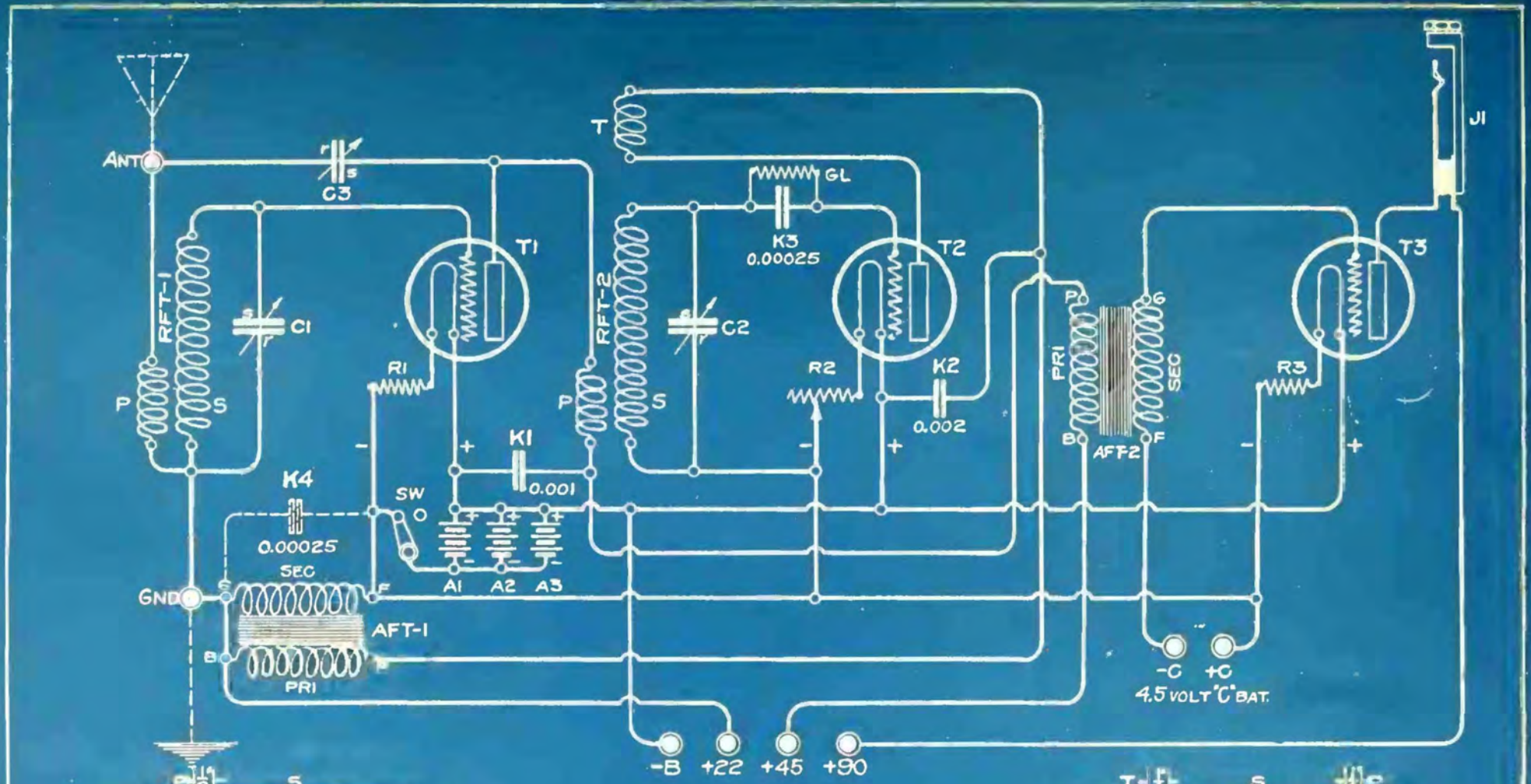

FIG. 1A
CIRCUIT DIAGRAM

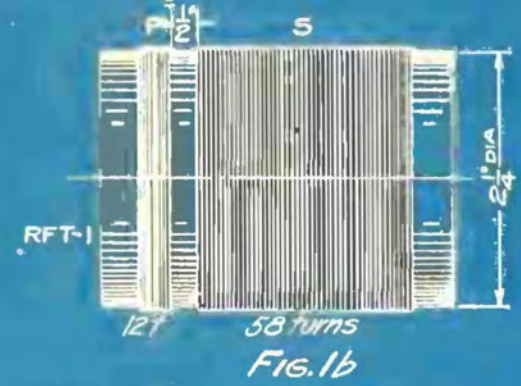

FIG. 1b

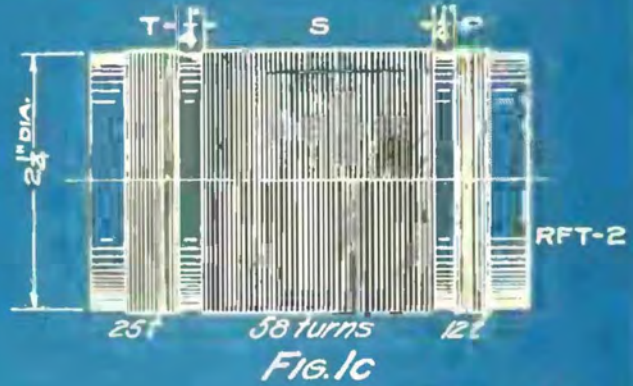

FIG. 1c

"JUNIOR PORTABLE"

ONE REFLEXED STAGE, REGENERATIVE TUBE DETECTOR, ONE STAGE OF AUDIO AMPLIFICATION ON THREE TUBES.

J. B. RATHBUN
RFX-126

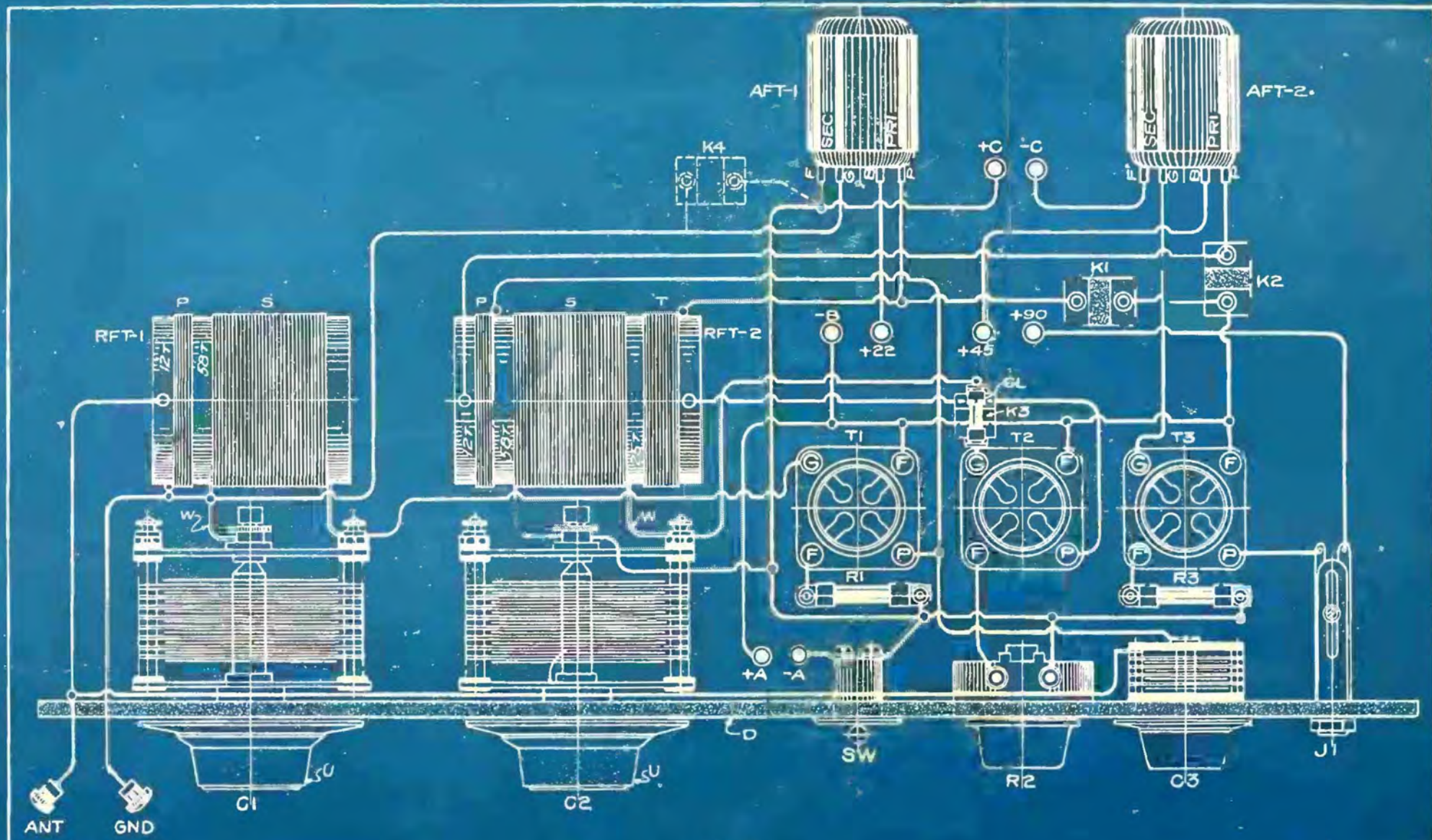

FIG. 2

"JUNIOR PORTABLE"

"PICTURE" WIRING DIAGRAM SHOWING ELECTRICAL CONNECTIONS BUT NOT ACTUAL MECHANICAL ARRANGEMENT OF PARTS. THE COILS RFT-1 AND RFT-2 ARE REALLY AT RIGHT ANGLES TO EACH OTHER, AND THE CONDENSERS C1 AND C2 ARE IN A VERTICAL ROW.

J.B. RATHBUN
RFX-146

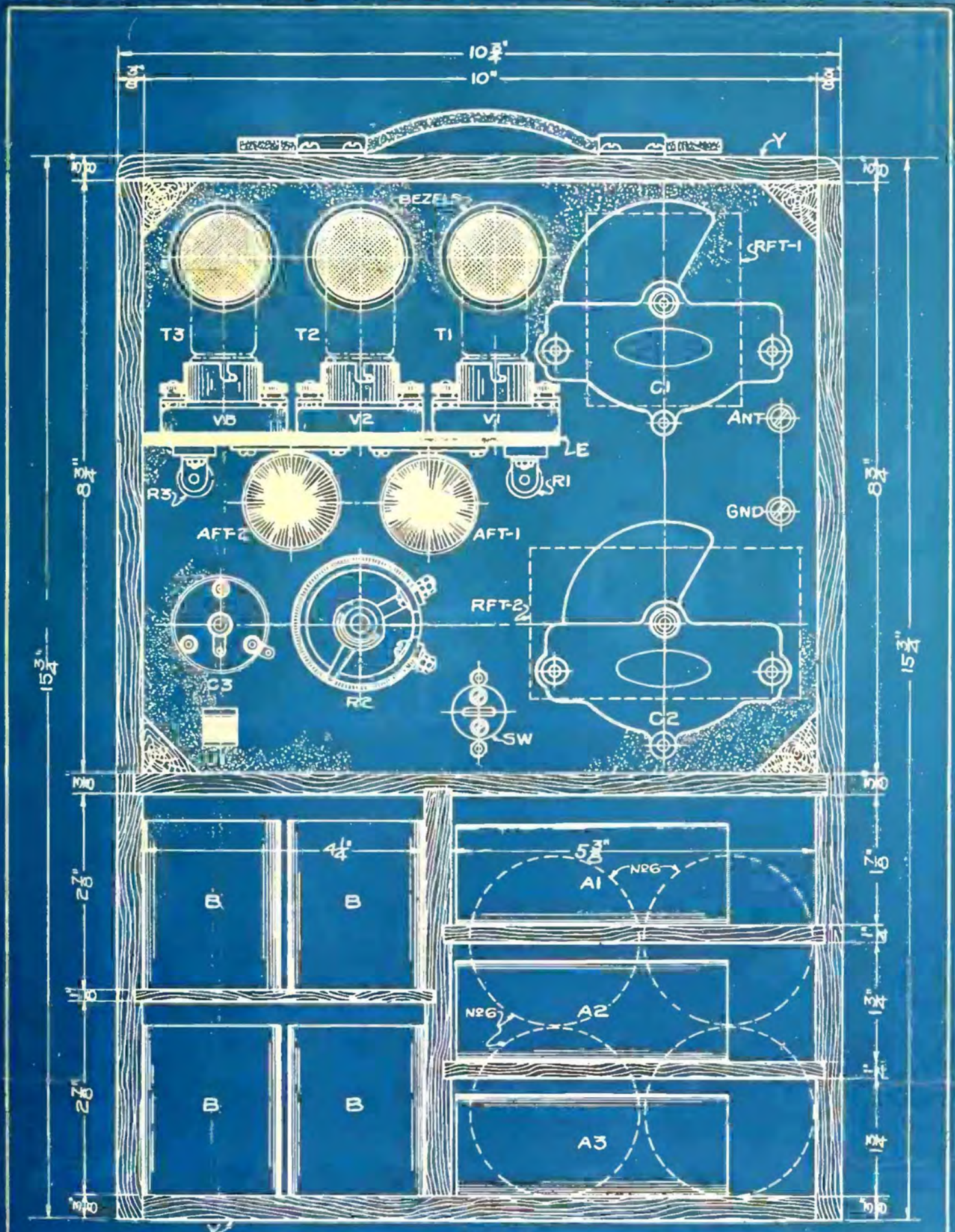

FIG 3

JUNIOR PORTABLE
REAR ELEVATION OF PANEL-CABINET

J.B. RATHBUN
RFX-126

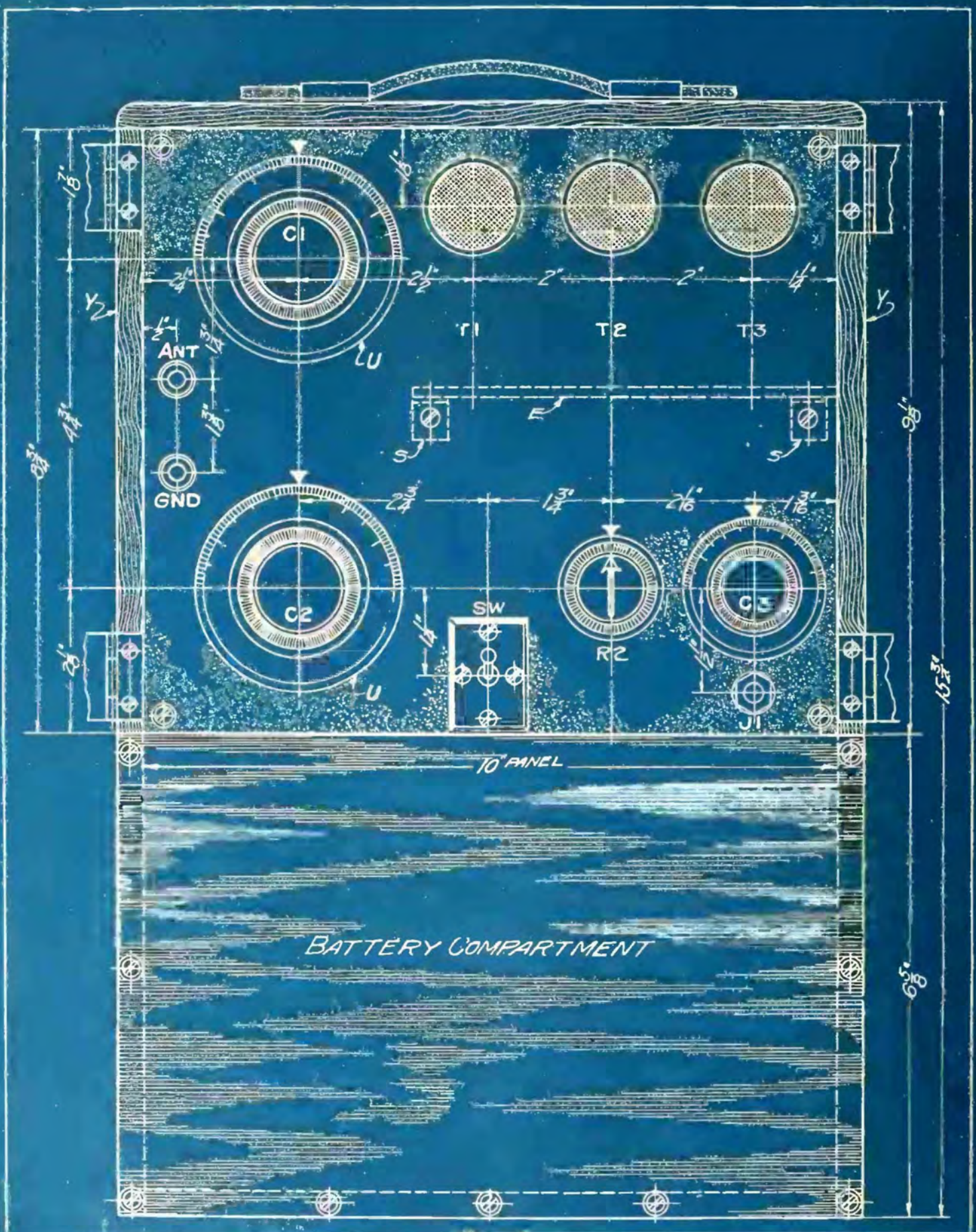

FIG. 4
"JUNIOR PORTABLE"
FRONT ELEVATION "A"
(PROCESS PAT. PEND.)

J. B. RATHBUN
RFX-146

More Volume and Range with

A 5-Tube Radio Frequency Set

By JOHN B. RATHBUN

A Receiver that Will Minimize Distortion

SINCE the introduction of the five-tube neutrodyne about two years ago, we have had an almost endless stream of five-tube radio frequency "dynes" which testify to the popularity of this sort of radio receiver. This neutrodyne was the first really high powered type introduced to the general public for broadcast reception. The fans to this time had been limited to the three-tube regenerative with the conventional detector and two stages of audio frequency. The addition of the two stages of radio frequency to the detector in the neutrodyne not only increased the range enormously, but also very considerably added to the selectivity, and I believe that the selective feature of the tuned radio frequency set had as much to do with its promotion as the increased range and the possibility of coast-to-coast reception on the loud speaker.

Untuned radio frequency reception with untuned radio frequency coupling units had proved somewhat of a fizzle, not only because the maximum range and signal strength were not developed but also for the reason that such receivers were hardly more selective than the regenerative set of that period, and even two years ago the question of interference was becoming a serious proposition. By tuning the transformers between the radio frequency stages, we reach the amplification peak in each stage and also increase the losses at a number of points so that undesired stations could be eliminated with certainty, even through strong local interference. Using three tuning controls made long distance reception possible for the city dweller on every night in the week.

The Typical 5-Tube Set

USUALLY the five-tube outfits consisted of two stages of radio frequency amplification, detector, and two stages of transformer coupled audio stages. There was seldom any attempt at regeneration in the detector tube circuit or any other means of amplification outside of the simple amplifying powers of the tubes themselves. True, the first neutrodyne introduced by Prof. Hazeltine was of the reflex type, but strange to say, little interest was taken in the reflexed neutrodyne until a few months ago. Experimenters seemed content to stick to straight radio frequency amplification without the assistance of either regeneration or reflexed R. F. or audio amplification. In the most part they confined their inventiveness to contriving schemes for the elimination of oscillations in the radio frequency stages.

For a long time the suppression of oscillations in the radio frequency stages was a problem to which many solutions have since been offered. We have the well-known neutralizing system introduced by Prof. Hazeltine, the reversed feed-back system, the potentiometer, and similar devices, and it is in this part of the circuit that most five tube radio frequency circuits differ from each other. It would be almost impossible to say which of these systems has proved the most sensitive and efficient, for each type has its band of adherents who defy any of their opponents to show better reception or greater range.

It has long been the belief of the writer that very marked improvement could be made in the five tube radio frequency receivers by the introduction of regeneration in the detector circuit or by reflexing certain of the stages so that some of the tubes could be made to perform dual duty. Shortly after the introduction of the neutrodyne, I made several experiments in obtaining regeneration in the detector circuit by means of a variometer or tuned impedance in the plate circuit, but while this increased the range and signal strength considerably, it did not meet favor for the reason that it introduced a fourth control, and a rather critical sensitive control at that. Further, regeneration was not always dependable with neutralized grids, and as neutralization held the floor at that time to the exclusion of every other idea, the matter was dropped for the time being.

Rheostats Cause Trouble

TO ELIMINATE the fourth regenerative control, I next tried several

(Turn to page 64)

WHAT KIND OF A SET DO YOU WANT?

The RADIO AGE ANNUAL for 1925 has a blueprint section in actual color, in which is contained every kind of hookup from one-tube simple sets to an efficient 8-tube superheterodyne. Whether you are contemplating building your first set or branching out into complicated "multi-tubers," you will find the ideal receiver for your needs in the 32-page blueprint section of the ANNUAL FOR 1925. Every hookup a tried and true winner.

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Blueprints of the Five-Tube Radio Frequency Receiver on Pages Following.

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So—Let Our Hookups Be Your Guide

Results with a Reflexed Detector

(Continued from page 63)

regenerative stunts in the detector circuit such as the fixed tickler used in the Wizard receiver, and the Ultra-audion single control method, both of which gave strong regeneration and sensitivity but which made the rheostat controls critical and difficult to manage. With such circuits, control of the regeneration is had entirely by the rheostatic or filament emission method, and a vernier rheostat is absolutely essential for the proper adjustment. Unless it was brought just below the oscillating point, the circuit would break out into violent free oscillation with accompanying howls and shrieks. While this gave wonderful results in the hands of an experienced operator, it certainly was not a circuit to install in the home or for the everyday broadcast listener.

It seemed for a while that the only resort was to reflex the detector circuit and this is what I finally accomplished after a number of experiments. The reflexing of the so-called detector stage or third tube both increased the volume and improved the quality of the reception, and from many standpoints was an advance over the regenerative principle or the totally reflexed method by which all of the tubes were reflexed. Reflexing the third tube alone gave us approximately three stages of radio frequency amplification with the same number of tubes ordinarily used to obtain two stages, and in addition it added about 0.8 of an audio stage. Further audio amplification was then obtained by two stages of resistance coupled audio, which gave the total audio volume without the distortion usually introduced by iron core radio frequency transformers.

Summing up the matter, we obtain practically three stages of radio frequency amplification and the equivalent of two audio frequency transformer coupled stages by five tubes, and without distortion or "razzing" even when the tubes are being pushed to the limit. The audio stages consist of one transformer coupled stage and two resistance coupled stages, which give us a volume slightly better than two transformer stages. A crystal detector performs the rectification without introducing the tube noises that ordinarily affect the output. In short, it is just like adding two stages of radio amplification to a single reflex circuit and then increasing the volume by the further application of two resistance coupled stages.

The Circuit Layout

IN FIG. 1 we have the layout shown by a schematic diagram and in Fig. 2 the same circuit is given in "picture" form, which not only shows the wiring in simplified form, but also suggests the arrangement of the apparatus behind the panel. Fig. 3 is the front elevation of the panel with the control dials and knobs located.

Looking at Fig. 1 or Fig. 2 we see the usual first two radio frequency tubes (T1) and (T2), and the three radio frequency coils or transformers, (RFT-1), (RFT-2) and (RFT-3) connected up in the usual way of radio frequency transformers. The transformers are tuned by the 17 plate (0.00035 mf) variable condensers (C1), (C2) and (C3) connected across the secondary coils of the transformers. There is little to say about the transformers except that they are of the conventional type used in standard radio frequency circuits, and that it is far more desirable to purchase these parts than to attempt making them at home.

BILL OF MATERIALS FOR THE SET

MARK (LETTER)	NO. OF PIECES	NAME OF ITEMS	SIZE
A	1	Filament "A" Battery, Storage type	6 Volts
AT	1	Audio Frequency Transformer	6-1 Ratio
B	2	45 Volt Blocks of "B" Battery	Large
C1-C2-C3	3	Variable Condensers	0.00035 mf (17 Plt.)
CD	1	Fixed Crystal Detector	
*GL1-GL2	2	Grid Leaks	1-2 Megohms
J1	1	Two circiut Jack	Standard
J2	1	Single Circuit Jack	Standard
K1	1	Fixed Mica Condenser	0.006 Mf.
K2	1	Fixed Mica Condenser	0.002 Mf.
K3	1	Fixed Mica Condenser	0.002 Mf.
*K4	1	Fixed Mica Condenser	0.006 Mf.
*K5	1	Fixed Mica Condenser	0.006 Mf.
K6	1	Fixed Mica Condenser	0.002 Mf.
K7	1	Fixed Mica Condenser	0.500 Mf.
*N1-N2	2	Resistors or Coupling Resistances	50,000 Ohms
PO	1	Potentiometer	400 ohms, or 200 ohms
R1-R2	2	Rheostats for filament Control	6 Ohms
RFT-1-2-3	3	Radio Frequency Transformers, (Tuned)	Standard
RFX	1	Untuned Radio Frequency Transformer	200-600 meters
SW	1	Battery Switch	Standard
S	5	Tube Sockets	Standard
T1-2-3-4-5	5	201A Amplifier Tubes	Standard
VM	1	Battery Vultmeter (Flush Type)	8 to 10 Volts
W	1	Panel	7"x26"x3-16"
Markad.	6	Binding Posts	Standard
X	1	Terminal Strip (bakelite)	1"x7"x3-16"
Y	1	Bottom Board (Wood)	6 1-2"x25"x1-2"
Z	1	Radio Cabinet	7"x26"
	30'	Tinned Copper Square Bus Wire	No. 14
	6'	Spaghetti	Standard
	50	Solder Lugs	Standard
D	3	Dials and Knobs	4" Diameter

NOTE! Items marked (*) can be substituted for by complete resistance coupling units.

The three tubes (T1-T2-T3) are controlled by the six ohm rheostat (R1) while the two audio frequency amplifying tubes (T4) and (T5) are regulated by the six ohm rheostat (R2). In giving the resistance of these rheostats, I am assuming that 201A tubes are used, because they give better results than the dry cell type. If 199 tubes are used, then the resistance of the rheostats must be higher, say 15 or 20 ohms. With five tubes, dry cell operation is not recommended, for in the end it will be far more expensive to replace dry cells than to purchase a storage battery and recharge it from time to time. Dry cell tubes do not give the amplification of the storage battery 201A type.

Grid potentials are regulated by the potentiometer (P9). While there are certain objections which can be leveled at this type of control, yet it is the better method for the beginner, especially when it is not known what make or type of apparatus he intends to use. A 400 ohm potentiometer is the best, but a 200 ohm can also be used, and to reduce the radio frequency resistance in the grid return line, a fixed bypass condenser (K1) of 0.0006 mf capacity is connected between the slider and the negative "A" post of the potentiometer resistance coil. The impedance of a wire wound potentiometer is considerable, and unless the bypass condenser is installed, the tuning will be upset at every adjustment of (PO).

Reflexed Third Tube

TUBE (T3) is the tube ordinarily used as the detector tube, but in this case it is the tube of a special reflex circuit, acting both as a radio and audio amplifier at one time. In fact, there is no detector tube in the circuit since the major part of the rectification is performed by the crystal detector (CD). Transformer (RFT-3) connects the radio stages to the reflex stage and the reflex is tuned by the third variable condenser (C3). Note that all of the radio frequency and audio frequency transformers are marked according to the connection posts as at (P), (+B), (G) and —F), to correspond with the markings on the actual coils.

At (RFX) is an untuned radio frequency transformer used for coupling the plate circuit of (T3) with the crystal detector and the audio transformer (AT). The latter is of the usual iron core type, bypassed on both the primary and secondary sides by the fixed bypass condensers (K2) and (K3). Ordinarily the capacity of these condensers is 0.0015 mf to 0.002 mf, but much depends upon the type of audio transformer used. In some cases it will be found advisable to omit (K3) altogether when there is much distributed capacity in the primary winding.

On carefully examining the circuit of tube (T3) you will see that it is a simple single tube reflex circuit giving the equivalent of one stage of radio and one stage of audio amplification, so that up to and including (T3) we have three radio and one audio stage on three tubes. This alone will give good results, but for the proper loud speaker volume under all ordinary conditions, it was considered advisable to add the two resistance coupled stages as shown by tubes (T4) and (T5).

By plugging in at jack (J1) we obtain the output of three radio and one audio stage. By plugging in at the jack (J2) we obtain three radio and about 2.6 audio stages.

A typical resistance audio coupling is made for the tubes (T4) and (T5). The fixed condensers (K4) and (K5) of 0.006 mf capacity are the coupling devices in the grid lines, while the resistors (N1) and (N2) are non-inductive resistances of from 48,000 to 50,000 ohms. Both of the resistors are connected between the positive "B" (+B) and the plate (P) of the tube, and it is

Tubes Do Dual Duty in This Set

the difference of potential established across these resistors that causes the amplification. The grid leaks (GL1) and (GL2) are of one megohm to two megohms capacity and are connected between the grids and (—A) just as with any grid leak. Such resistors introduce no distortion into the circuit, and when worked in connection with one transformer coupled stage as at (AT), we obtain both volume and purity of tone. The ratio of (AT) should be from 5 to 6 but no higher.

The resistors (N1-N2) can be obtained from a number of RADIO AGE advertisers, either as separate units or as assembled units containing the fixed condensers, resistor and leaks all in one compact mounting.

Fig. IA at the bottom of the circuit drawing shows the method of connecting up the resistance coupling units in compact form when the resistors and leaks and condensers are purchased separately and assembled by the builder of the set. Spring clips can be obtained for mounting the resistors and grids just as tubular grid leaks are mounted

Bypass condensers such as (K6) of 0.002 mf capacity and (K7) of 0.5 mf capacity are frequently of advantage in reducing the resistance offered to the radio frequency current by the "B" battery and the impedance of the output circuit, particularly after the "B" batteries become old and dried out. In some cases and using certain materials in the circuit, these bypasses work a great improvement, while under other conditions their effect is unnoticeable. However, the set will perform better and more consistently throughout the life of the "B" batteries when the bypasses are used than when they are not installed.

Materials Used

ALMOST any of the standard materials advertised in RADIO AGE can be used for this circuit, and as it is against our policy to recommend one make of apparatus over another, we cannot specify any particular make in these specifications. The only effect that will be caused by changing parts will be on the values of the bypass condensers, and this is always more or less of an experiment in any case. However, the bypasses are quickly and cheaply shifted about, and this should prove no objection to the user. Experience will show that it is very seldom that any one value of bypass will apply to all conditions in any circuit.

In the accompanying list I have given the number of parts needed and their size, all items being given a letter corresponding to the lettering on the drawings so that their location can be quickly identified.

Assembly of Set

THIS receiver will assemble easily on a 7"x26" panel, and by a little crowding can be put on a 7"x24" bakelite or hard rubber panel. The inside dimension of the cabinet (depth) should be at least seven inches to accommodate the apparatus. Care should be taken not to crowd the radio frequency transformers RFT-1-2-3 too close together and the tubes should be well oustide the magnetic field of the transformers to prevent back coupling between the stages. The panel thickness should be at least 3-16 inch so that it will not be necessary to cut down screws or shorten the shafts.

In arranging the reflexed part of the circuit, see that the untuned transformer (RFX) is placed as close to the tube (T3) as possible, so that the line from the post (G) on the transformer to the (G) post on the socket is very short. This is important. Again, keep (RFX) well away from (RFT-3) and the audio transformer (AT). If these parts are so close that they are coupled by the magnetic flux, there will be trouble. The crystal detector, which is of the fixed or semi-fixed type, can be placed in such a position that it does not complicate the wiring, say near the rear edge of the bottom board. It is not advisable to put the crystal detector on the panel, as it is likely to be knocked out of adjustment every time we handle the dials.

Are You Going to Take a Radio Set with You on your Vacation This Year?

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The coupling resistances for the audio stages are small and easily disposed of in the arrangement, and as shown in Fig. 2 these audio coupling units are placed quite close to the two audio-tubes (T4) and (T5). All of the arrangement should be made with an eye to simple wiring and simple connections. You will not go far wrong if you follow the diagrams in every detail.

A voltmeter (VM) is very useful in a five tube set for keeping the potential constant across the filaments as advised by the makers of the tubes. As shown in the diagrams, the voltmeter registers the potential across the filaments of the radio frequency and reflex tubes, as these tubes are the most critical of the series and require the most accurate adjustment for the filament control. Cutting the large hole for the body of the voltmeter is a problem for the home mechanic unless he has some form of "fly-cutter" for the job. However, this can be cut by any machine shop or radio store.

Unless the transformers (RFT) are marked at the connection post by the makers, the builder often has trouble from "bucking" or opposed coils. If you do not think that you are getting the proper volume or the distance, try the effect of reversing the connections to the primary of these coils, one by one. In fact, it is best to connect up the transformers temporarily with small insulated wire until you are certain that the polarities of the transformers are correct.

All crystals do not work equally well when reflexed, and for this reason it is best to get some sort of a crystal detector in which the crystals can be easily changed. With a small stock of crystals, say five or six, experiment until you find the best crystal. Crystals do not cost much and they may be the reason your circuit is not functioning as it should. After the crystal detector is once adjusted, and put in an out-of-the-way place where it is not likely to be disturbed, it will require very little attention.

Use Care in Building

I AM sure that if you construct this receiver with care and use judgment in the operation of it, you will get exceptionally fine results. Its freedom from distortion and extreme sensitiveness are remarkable. Stations from both coasts have been heard repeatedly on the loud speaker from my laboratory here in Chicago.

As I stated before, Professor Hazeltine's original neutrodyne was of the reflexed type, but for some reason little interest was taken in it. Why this should be is hard to explain. I suppose the reason is that most fans were a little bit afraid of the reflex circuits. We really have no reason to fear them, as they are quite simple. It just requires a little patience to get them to operate correctly.

Most of the trouble experienced seems to be in getting fixed and by-pass condensers of the right capacity. However, these are cheap and if the builder will supply himself with a selection of these, he can change the capacities of each in the different parts of tne circuit until the best results are obtained.

One of the probable reasons for the clear tone of this receiver is the resistance coupled method of amplifying after the detector. To those who have not tried this system of increasing the signal strength to loud speaker volume, this system will be a revelation. All distortion and transformer noises will be eliminated. If you are undecided as to whether or not you shall use resistance coupling, my advice to you is to try it by all means.

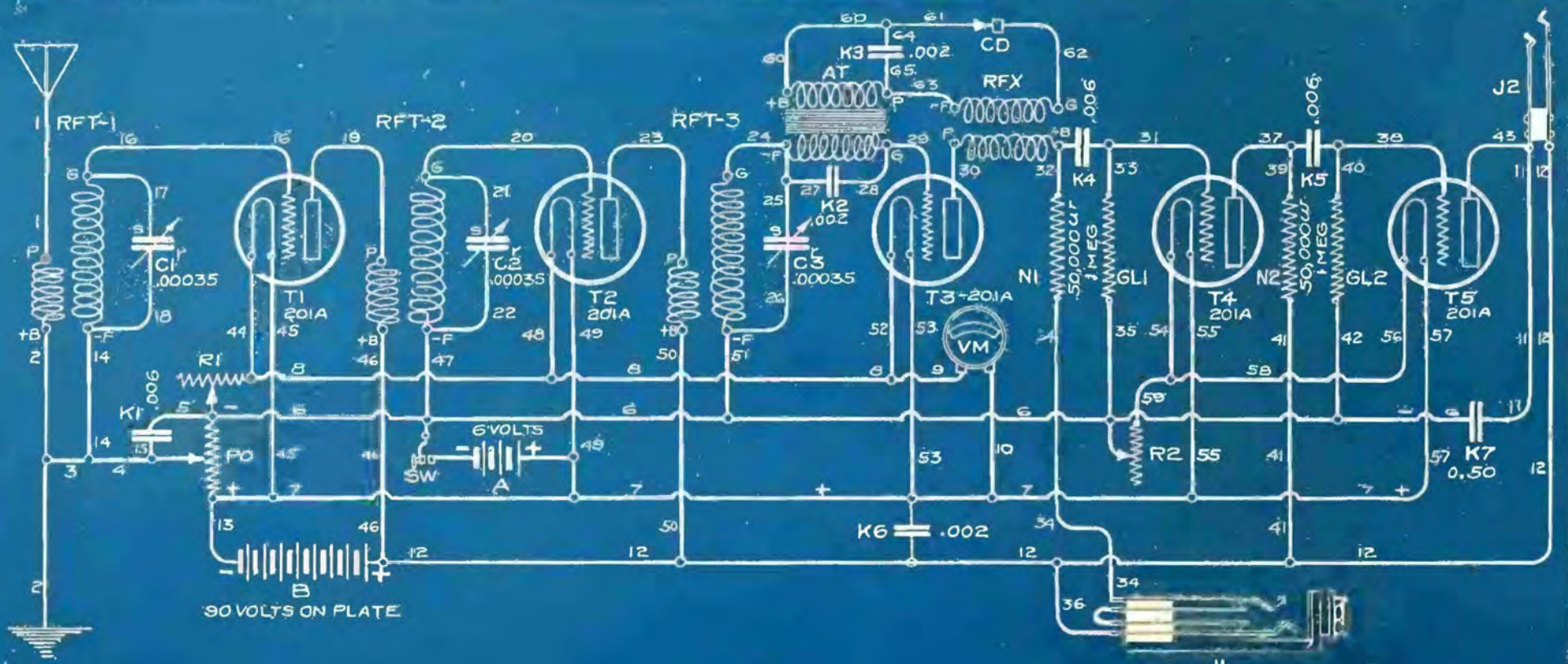

FIG. 1

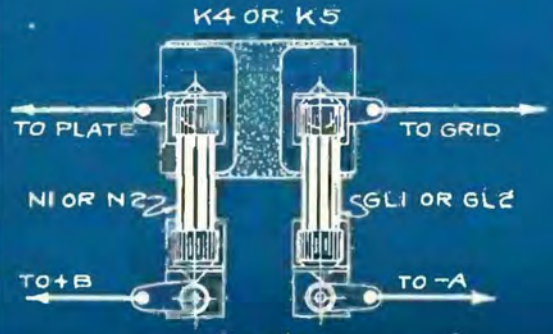

FIG. 1a
DETAIL OF RESISTOR COUPLING UNIT

5 TUBE RADIO FREQUENCY RECEIVER

THREE STAGES OF RADIO AND THREE STAGES OF AUDIO BY REFLEXING THIRD TUBE MARKED (T3) ABOVE.

ALL TUBES ARE OF THE 201A TYPE WITH A FULL 90 VOLTS APPLIED TO PLATE BY "B" BATTERY. A 6 VOLT STORAGE BATTERY WILL BE REQUIRED FOR THE FILAMENTS.

THE AXES OF THE RADIO FREQUENCY TRANSFORMERS AT RFT-1-2-3 ARE TO BE INCLINED AT AN ANGLE OF 60° WITH THE HORIZONTAL TO PREVENT INTERSTAGE COUPLING. CONDENSER CLIPS FOR MOUNTING COILS.

CONNECT STATORS (S) OF THE VARIABLE CONDENSERS C1-C2-C3 TO THE GRID LINES, AND THE ROTORS OR ROTATING PLATES (P) TO THE -F OF THE TRANSFORMERS TO ELIMINATE BODY CAPACITY EFFECTS.

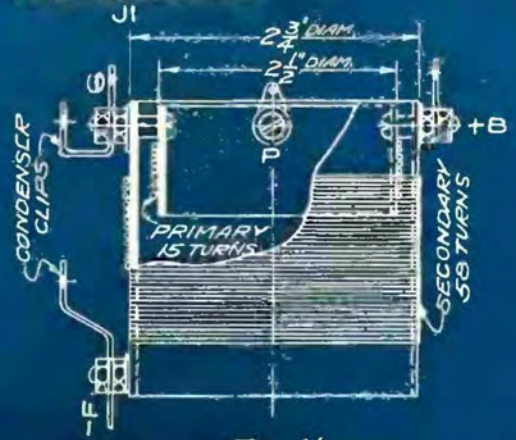

FIG. 1b.
DETAILS OF R.F. TRANSFORMERS MARKED RFT-1-2-3 ON DIAGRAM.

J. B. RATHBUN
RF-700

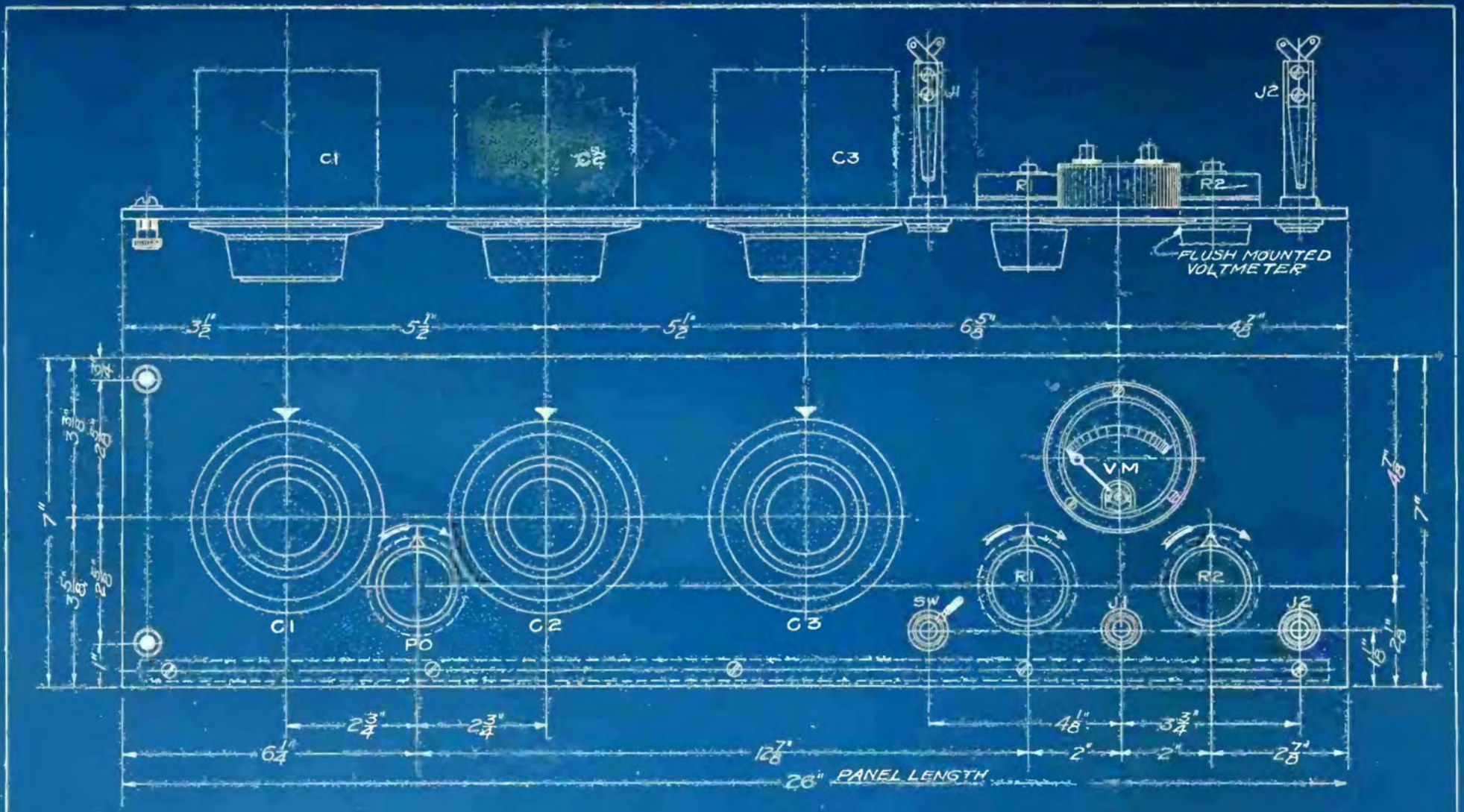

FIG. 3.

PANEL LAYOUT

SHOWING THE GENERAL ARRANGEMENT AND DIMENSIONS OF PANEL AND OF THE APPARATUS MOUNTED ON THE PANEL. SAME LETTERING AS IN FIG. 1.

J.B. RATHBUN
RF-700

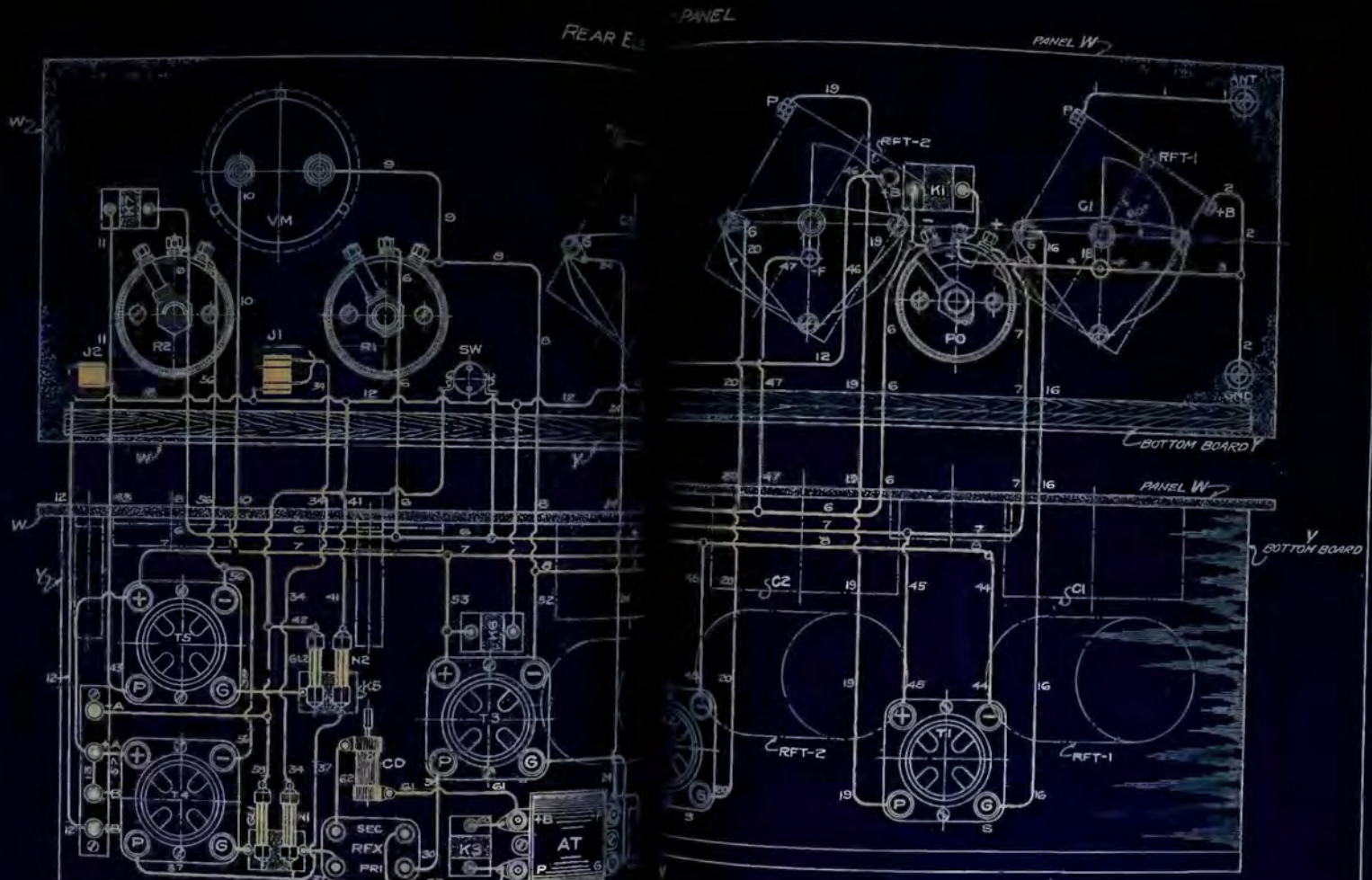

FIG. 2
REFLEXED RADIO FREQUENCY SET

TOP VIEW SHOWS REAR ELEVATION OF PANEL WITH PANEL MOUNTED APPARATUS. LOWER VIEW IS A PLAN VIEW LOOKING DOWN ON APPARATUS FASTENED TO BASE-BOARD. LETTERS AS IN FIG. 1.

J.B. RATHBUN
RE-700

The 6-Tube "Portatron"

By JOHN B. RATHBUN

COMPACT portable radio receivers, having sufficient power to operate on either loop or flat top aerial, are desirable for home use as well as for camping and motoring trips. Provided with self-contained batteries, such outfits can be easily moved about from room to room in the house or can be carried to the home of a friend to provide music for a dance or for other similar occasions. The portable has a much wider field of application than the conventional, cumbersome cabinet with external batteries, and should be seriously considered by those who desire a receiver of the all-round type.

For the sake of simplicity, such an outfit should be of the single control type, or should not have more than two controls at the most. It should have at least two radio frequency stages for distance and for operation on a loop aerial, and at least two audio frequency stages for loud speaker operation. With transformer coupling this means at least five tubes, if the tubes are not reflexed, and we must therefore carefully consider the methods of coupling the stages to conserve space and to minimize the number of controls.

Dry batteries must be used for the filament "A" battery, and the type of tube must be such that not more than three or four No. 6 dry cells will be required. This, of course, suggests the "199" tube, which is ideal for a portable rig because of its low filament current consumption.and small size. Five "199" tubes will take 5 x 0.06 =0.30 ampere which is not prohibitive for dry cell service, and the cells will last for a considerable length of time on such work. Six tubes will take: 6x0.06 =0.36 ampere which is within reason.

Transformer coupling between either the radio frequency or audio frequency stages takes up considerable room. If the R. F. transformers are of the "tuned" type then they must be spaced well apart to prevent coupling back between stages,

Controls are Simple and Operation Quiet

and this system must therefore be discarded right at this point, both for the reason that it takes up much room, and also for the reason that a separate dial control will be required for each radio stage (and for the tuner unit in addition) which will bring the total number of controls up to three or more. This is out of the question in a portable outfit; hence we must look farther for a means of radio frequency stage coupling. We should have only a single selective control for the tuner unit, and no variable controls after the first stage that are represented by dials or knobs on the front of the panel.

Resistance Coupling

Resistance coupling for the radio frequency and audio frequency coupling requires no separate interstage controls, but unfortunately, resistance coupling in the radio frequency stages is only efficient on long wavelengths, say on wavelengths above 1,000 meters. This resistance coupling method will be fine for the audio stages, and is just what will be used for the output, but we will have to guess again in regard to the coupling on the R. F. end of the hookup. The untuned or fixed radio frequency transformer at once suggests itself, but for this time it must be rejected because of the space occupied and for the reason that such transformers are likely to "back-couple" between stages if crowded to gether as closely as we intend to crowd the stages of this outfit.

THERE is only one other coupling possible on the R. F. end, and that is by means of inductances of the "choke coil" order, which are connected into circuit just like the resistance units of a resistance coupled stages. One end of the choke coil is connected to the plate of the tube, while the other end goes to the (+B). The connection between the first tube plate and the grid of the following tube is made through a fixed condenser just as in the case of the resistance coupling scheme. The choke coils must have a very much higher inductance than commonly used with radio frequency tuning units. They should consist of several thousand turns of very fine wire. The secondary coil of an audio frequency transformer will be just about right for this purpose when standard 100 Millihenry chokes cannot be obtained. The inductive value must be sufficient to choke back the high frequency plate current so that it will not short circuit back through the "B" battery connections, and at the same time the coil resistance should not be sufficient to interfere with the supply

THE RECEIVER FOR YOUR NEEDS

This Summer's tendency will be for simplified radio receivers, with compact parts and ease of operattion and control. A radio set without these characteristics cannot be called up-to-date.

THE RADIO AGE ANNUAL for 1925 contains several of these wonder hookups that are easy to build, easy to operate and pleasant to hear. The latest in portable sets as well as the larger models are all in this new ANNUAL, which is yours for $1. Send your remittance now if you want to have this radio handbook with you on your vacation this year as an ever-ready radio guide.

$1 while they last.

Blueprints of the Six-Tube "Portatron" on Pages Following

John B. Rathbun,
Originator of the Blueprints
in this remarkable section,
writes exclusively for
RADIO AGE every month.

of continuous "B" battery current to the plate of the tube. The choke coil permits the "B" battery current to pass to the plate, but chokes back the R. F. current.

Radio Frequency Amplification

THE application of the choke system to the first three tubes will be seen in Fig. 1 and Fig. 2, where Fig. 1 is a schematic diagram using symbols, and Fig. 2 is a picture wiring diagram. The first will be of more service to the experienced builder in "doping out" the circuit, while the latter will show the novice how the wiring connections are actually made to the parts. Fig. 3 is a front elevation of the panel and cabinet, while Fig. 4 is a rear elevation showing the parts assembled at the rear of the panel. Fig. 3A is a sectional view as seen from one side of the assemblage.

Taking Figs. 1-2, we see that an aperiodic type coupler is used at (L1-L2) which is tuned by vernier variable condenser (C1) connected across the secondary coil (L2) of the coupler. This can be a home-made coupler such as has been described many times in these columns; it can be a standard neutrodyne transformer or else a standard adjustable aperiodic tuner. In any event, the primary coil, (L1) is untuned. When the usual flat top aerial is used, the aerial lead-in wire is connected to (ANT) and the ground wire at (GND), a system whch gives the greatest range and signal strength. By connecting the ends of a loop aerial at (XI) and (GND), and then opening the grid switch (T), we can operate on the loop aerial. The tap switch (T) cuts out the secondary coil (L2) which is necessary on loop reception. Coil (L3) suppresses oscilations.

When operating on the flat top aerial, or a type similar to the usual outdoor aerial, the coupling between the primary (L1) and the secondary (L2) must be very "loose;" that is, there must be a considerable space between the two coils. For this reason, it is best to adopt a ready-made coupler in which the coupling gap can be easily adjusted until the proper degree is found by experiment. We have only one control, and to obtain the proper selectivity in local jams we must have the proper "looseness" between the coils. The home-made coil generally contains from 12 to 15 turns of No. 26 D. S. C. wire on the primary (L1), and from 55 to 60 turns on the secondary coil (L2), using the same size wire. The distance between the two coils, or the coupling, may be from ⅝ to ¾ inch or even greater.

By using a 4.5 volt three cell "C" battery at (C), we usually get greater sensitivity and signal strength, and the battery also reduces the tendency towards free oscillations in the circuit. However, the "C" battery can be omitted in many cases without serious loss. The switch (T) can be the usual form of tap switch with one active contact point, and one dead contact.

The first radio frequency tube (T1), which follows the tuning inductance, is provided with the choke coil (CC) connected to the plate at one end and to the (+B) line at the other, so that from 90 to 135 volts of "B" battery will be maintained on the plate. The plate of tube (T1) is coupled to the grid of the second R. F. tube (T2) through the fixed coupling condenser (K1) which is ordinarily of 0.002 mf. capacity. This condenser prevents the application of the plate voltage to the grid of (T2) and thus prevents the high "B" voltage from paralyzing this tube. The choke coil (CC) can be the secondary winding of an audio transformer, and as will be seen, prevents the R. F. plate output from short circuiting through the "B" battery. It allows the "B" battery to go to the plate of the first tube, however, but stops the high frequency current from backing out. This requires no control.

For those who want greater distance, Mr. Rathbun has designed the six tube portable, but with resistance coupled audio amplification shown instead of the transformer method of coupling.

The change lies with the builder. A great deal of space may be saved by the use of resistance coupling and at the same time it delivers good quality.

Filament Controls

ALL of the amplifying tubes, five in number, are provided with automatic filament controls which maintain the amplifying tube current at the proper intensity without rheostats or other manual controls. This is a decided step toward simplicity and compactness, and prolongs the life of the tubes by holding the filaments constantly at the proper temperature. A manual rheostat (R) of the usual form must be provided for the detector tube (T3) as this has a rather critical filament adjustment that cannot be automically controlled. The rheostat (R) is represented on the front of the panel by a knob as shown by Fig. 3, and is the only control outside of the condenser dial (C1). A switch (SW) must be provided for shutting off the filament current when the set is not in use. It is no longer possible to turn off the amplifying tubes independently as when the usual form of rheostat is used. This can be an ordinary battery switch of the type to be found at any radio store.

A second choke coil (CC) is shown connected to the plate circuit of the second radio tube (T2), and as this is exactly similar to the first, there will be no further comment. The output of tube (T2) leads to the detector tube through the 0.00025 mf. grid condenser (K2). It should be noted that a one megohm grid leak (V), shown dotted on the grid of tube (T2), will often prove of advantage. It should at least be tried out in the position indicated by the dotted lines before completing the set, for it sometimes stabilizes the first tubes and increases their effectiveness.

At tube (T3) we have the detector tube which is connected into circuit by the 0.00025 mf. fixed grid condenser (K2), and the one megohm grid leak (GL1). As with all the other tubes, this is a "199" tube, but to prevent critical rheostat adjustments the plate is supplied with 45 volts by an intermediate tap at the "B" battery. From the detector tube on, all of the stages are resistance coupled by the 50,000 ohm resistances (M1-M2-M3) and the grid leaks (GL2-GL3-GL4). The hand controlled rheostat is shown at (R) by which the detector filament can be controlled accurately for any conditions. For use with "199" tubes, the resistance of (R) should be from 30 to 40 ohms, the former for dry cell operation and the latter for use with storage cells.

Resistance Coupled Audio

ALL of the three audio frequency tubes (T4-T5-T6) are supplied with the full "B" battery voltage through the fixed resistances (M1-M2-M3) which have a resistance of 50,000 ohms. The plates and grids of the tubes are connected by means of the fixed condensers (K3-K4-K5) of 0.005 mf. capacity. This value is not critical, and 0.006 mf. fixed condensers can also be used if this is the only capacity to be found in stock at your radio store. They must be of the mica dielectric type, or condensers in which the plates are separated by thin sheets of mica insulation.

The grid leaks (GL2, GL3, GL4) of the audio tubes "taper" toward the rear; that is, the last tube has a higher leak resistance than that of the first audio amplifying tube. (GL2) = 1.0 megohm, (GL3) = 5.00 megohm, and (GL4) = 25.00 megohm. This arrangement gives a stronger bias to the grids on the tubes which are most heavily loaded, and therefore results in a better distribution of amplification through the three stages. The output of the sixth tube (T6) leads to the output jack (J1).

A full 90 volts must be maintained on the plates of all amplifier tubes, and where possible, this should be increased to 112.5 volts as the choke and resistance coupling demands a higher voltage than the straight transformer coupling ordinarily used. Two vertical type 45 volt blocks will take up the minimum amount of space in the cabinet when the batteries are carried in the cabinet, but a third small 22.5 volt block will greatly improve the performance by raising the voltage to 112.5 volts. The great trouble with a portable set is to get the batteries into place without monopolizing all of the cabinet space. When the set is built for ordinary stationary service, then we can use three 45 volt blocks of "B" battery, giving 135 volts, and will thus obtain the maximum output of the tubes. The small size "B" batteries must be used for the portable set.

Filament or "A" batteries are to be No. 6 cells and are connected up in series to give a total of 4.5 volts across the rheostat. When possible, these should be square batteries so that the maximum amount of battery material can be put into a minimum of space. The demand

of the six tubes is slightly greater than that ordinarily recommended for continuous service (0.36 ampere), but with careful handling they can be made to last for a long time before replacement becomes necessary.

Reason for Six Tubes

WITH transformer coupling on both radio frequency and audio frequency stages, a five tube set is commonly built with two radio stages, detector, and two audio stages. With choke coils in the radio stages and resistance coupling in the audio stages, the amplifying power of the tubes is somewhat reduced so that one more tube will be required to give the same results. However, this is more than compensated for by the simplicity of the controls and the clear toned, noiseless operation of the set. It has a far better tone than with the usual arrangements and can be handled by the rawest novice in radio.

Fig. 3, showing the front elevation of the panel and cabinet, gives a good idea of the general arrangement of the receiver when designed as a portable set. The cabinet is really divided into two parts, (1) the upper portion covered by the panel being for the radio circuit proper while (2) the lower compartment houses the "A" and "B" batteries. As this is a special arrangement, the cabinet and panel will have to be made specially for the job and it is not likely that a ready-made cabinet or panel can be found which will exactly fit the conditions.

In the front view of Fig. 3 we see that the panel contains all of the controls, and also the three binding posts for the aerial (ANT–X1–GND). The dial of the tuning condenser is at (C1), and for accuracy this should be a four-inch dial with some sort of vernier arrangement, as the tuning is exceedingly sharp. The rheostat control (R) for the detector tube is at the right of the condenser dial. The battery switch for turning the "A" battery current on and off is at "SW" and the output jack is (J1). In the upper right hand corner of the panel is the grid switch (T) by which the set can be thrown over from flat top aerial to loop operation. This is all there is to the control of the set and its external connections.

As will be seen from the side sectional view, Fig. 3A, the panel is set back from the front edge of the cabinet so that the front door will clear the knobs and dials.

The door swings on two hinges (h) and is just large enough to cover the panel, the top of the battery compartment being at the lower edge of the door. Any suitable catch or lock (I) can be used on the left hand edge of the cabinet for fastening the door, and a lock is not a bad idea even in the home, as it prevents children from tampering with the set. At the top is a leather handle (G) fastened to the cabinet by standard hardware that can easily be obtained from a trunk or suitcase house or from some hardware stores. The lower battery compartment door, just below the panel, is shown closed. It is through this opening that we replace the batteries.

THE finish of the cabinet depends upon the taste and ingenuity of the builder. It can be polished with wax or varnished in natural wood finish, or it can be covered with leatherette or similar black grained covering material. If leatherette is used, then all of the corners must be well rounded off so that the material will not get loose or buckle along the edges. The front face of the battery compartment door comes flush with the face of the cabinet and panel door; hence this part is given the same finish as the outside of the cabinet. Rubber pads or feet (i) prevent the set from scratching finished surfaces on which it may be placed, and further, they prevent or help to prevent, the ringing microphonic noises experienced with "199" tubes.

BILL OF MATERIALS USED

The following list will give the materials used and their sizes. The parts are listed according to the same reference letters used on the drawings so that their relation can be seen at a glance.

PORTABLE RECEIVER MATERIALS

"A"—3 Filament "A" Dry Batteries, 1.5 volt, No. 6.
ANT—1 Loop aerial (optional), 2 Ft. Square.
"B"—2 "B" Plate Batteries, Vertical type, 45 Volt
"C"—1 "C" Bias Battery, Three cell, small, 4.5 volts
C1—1 Vernier Variable Condenser (23 plate), 0.0005 mf
CC—2 100 Millihenry Choke coils, or audio transformer secondary coils.
D—1 Special cabinet, as specified in drawings
E—1 Special Panel, as specified in drawings, 3/16-inch Bakelite.
F-H—2 Special Shelves, as specified in drawings, 3-16 inch Bakelite 5"x6½".
G—1 Carrying Handle Complete, Standard.
GL1—1 Grid Leak, 1.00 Megohm.
GL2—1 Grid Leak, 1.00 Megohm.
GL3—1Grid Leak, 5.00 Megohm.
GL4—1 Grid Leak, 25.00 Megohm.
h—4 Hinges or butts, Standard.
I—2 Lock Catch, Standard.
i—4 Rubber pads or feet, Medium Size.
J1—1 Single Circuit Jack, Standard.
K1—1 Fixed Condenser, Mica dielectric, 0.002 mf.
K2—1 Fixed Condenser, Mica dielectric, Grid clips, 0.00025 mf.
K3—1 Fixed Condenser, Mica dielectric, 0.005 or 0.006 mf.
K4—1 Fixed Condenser, Mica dielectric, 0.005 or 0.006 mf.
K5—1 Fixed Condenser, Mica dielectric, 0.005 or 0.006 mf.
L—4 Brass Angle Brackets, Standard.
L1-L2—1 Aperiodic Type Coupler, Standard.
M1-M2-M3—3 50,000 ohm Resistor Units,
R—1 Filament Rheostat, 30-40 ohms.
r1-r2, etc.—5 Automatic Fila. Controls (Amperites) 199-4.5 volts.
SW—1 Battery Switch, Standard.
T—1 Tap Switch, Standard.
t—2 Contact points, with two stops, Standard.
T1-T2, etc.—6 Tubes, "199."
U—6 Absorber Base Tube Sockets, "199" Type.
40" Tinned Square Copper Bus Wire, No. 14.
75 Solder Clips, Tinned, Standard.
3 Binding Posts, Composition Caps, Standard.
Z—4 Brass angle connections, Standard.
V—1 Leak, 1 megohm.
VM—Filament voltmeter, 0.8 volts.

Shelf for Tubes

The side sectional view of Fig. 3A shows that a shelf (F) is used for carrying the first three tubes, and that this shelf is attached to the panel (E) by means of brass angle brackets (L). The shelf (F) carries the first two tubes (T1-T2) of the radio frequency circuit and also the detector tube (T3). Below the upper shelf is the lower shelf (H) which carries the three audio tubes (T4–T5–T6). As the resistance units and other parts of the circuit are carried on the underside of the shelves with the sockets on top, we must be sure to leave room to accommodate the height of the tubes over their sockets, plus the thickness or height of the resistance units and the condensers, plus clearance.

The material used for the cabinet can be 5-16 inch or 3-8 inch thick, but if carefully constructed with dovetailed or matched corners, will be perfectly safe when built of 5-16 inch stock. The bakelite panels should not be less than 3-16 inch and this also covers the shelves which should be of the same material as the panels; that is, hard rubber, bakelite or formica. The shelves carry the wiring and many of the current carrying parts so that their insulating value should be fully equal to that of the panels.

We cannot go further into the details of the cabinet construction, but the construction will be clearly seen by those who are competent to undertake work of this sort, and if one is not sure of being able to build this cabinet, the drawings are amply dimensioned for a practical cabinet maker. If you give the job to a cabinet maker, I suggest that you also give him the panels and shelves so that he can get a good fit betwen the edges of the panel and the rabbet of the cabinet.

Arrangement of Apparatus

FIG. 4 shows the arrangement of the apparatus as seen from the rear of the panel. The six tube sockets (U) are placed in groups of three on the two shelves (F) and (H), and the outlines of the tubes are indicated by thin dot and dash lines so that the allowance for shelf clearance can be easily seen. The tubes are numbered so that their relation to the circuit drawings of Figs. 1 and 2 can be easily followed, and the sockets can be located in the same way. Fig. 3A and Fig. 4 can be used in combination, thus obtaining the side and rear elevations of the assembly.

It will be seen that the shelves are cut off at the right in Fig. 4 to accommodate the variable tuning condenser (C1) and the tuning inductance (L1–L2). On the lower sides of the shelves will be seen the coupling resistances, grid condenser, gridleaks and the wiring. In making allowance for the space between shelves, measure the height of the tube plus the height of the socket, plus a little more clearance so that the tubes can be taken out of the sockets and replaced without tearing the set to pieces. In other words, the true height of the socket assembly is the sum of the tube height, plus the socket height, plus ½ inch clearance between the lower end of the tube and the top of the socket.

The arrangement of the battery compartment in general with the batteries in place is marked. Strong flat springs made from flat spring brass plates bear on one side of the batteries and hold them in place against jolts and jars when the set is being carried. Connections between the apparatus and batteries are made by means of flexible fixture wire which can be obtained from any electrical store. This is very flexible and well insulated, and makes an ideal connection. The ends of the fixture wire should be provided with "spade" type tips soldered to the copper strands, and these make a permanent contact with the connection screws which is easily attached and which does not loosen under ordinary conditions. Do not attempt placing the strands of wire directly under the binding screws, for when connected up in this way they are almost certain to get undone.

Blueprints of the Six-Tube "Portatron" on Pages Following

Economy of Arrangement Is Vital

AS WILL be seen, the part of the assembly taken up by the receiver proper is very small, the panel measuring 10¾ long and 11⅛ deep, but for some purposes the total height with the batteries included may be too great to be practicable. In such a case, the battery compartment can be made separate, terminating the receiver portion at the board shown running over the tops of the batteries. This, however, makes it necessary to reconnect the batteries every time that the receiver is set up and as a result it is a decided nuisance.

As laid out in the drawings, there is ample room for a fifth "B" battery if it is desired to operate with a plate voltage of 112½ volts, or a sixth "B" battery if we wish to operate at 135 volts. Further, there is room for one spare "A" battery if it is desired to carry this replacement along on a trip.

The voltmeter (VM) is a very desirable instrument, particularly when dry cell "A" batteries are used, for it at once indicates the drop in voltage due to weakening batteries. Unless we have some means of testing the voltage occasionally, we are likely to believe that the set is out of order when the voltage drops, and waste much time chasing for trouble in the wiring when the difficulty actually exists in the cells. Just because automatic filament controls are installed for the regulation of the filament current is no reason why the voltmeter should be omitted.

Voltmeters must be connected properly according to polarity, and you must be guided by the markings on the instrument. If the polarity is wrong, then the needle indicator will be thrown against the wrong end of the scale. The size of the voltmeter should be so chosen that the full voltage will bring the needle near or slightly beyond the center of the graduated scale where the divisions are the largest, and the battery voltage should not throw the needle to the far end of the scale.

Suppressing Oscillations

Free oscillations in the radio frequency stages are the greatest difficulty in the construction of a radio frequency or reflex type of receiver, and we must devise some system for stopping these oscillations if we expect to get the full output of the set. In fact, most of the trouble reported with sets having radio frequency stages can be traced to improper or imperfect methods of damping down the oscillations. There are a number of methods of stopping oscillations, among which are the potentiometer, neutralizing condensers, bias batteries, etc., but in this receiver we have simplified the problem by the use of a plate reactacne coil marked (L3) on the diagrams.

Coil (L3) consists of four or five turns of wire wound on the end of the tuning coil. One end of this coil is connected to the plate of the first radio tube as shown, while the other end is left opened or is unconnected. As one end is opened, only capacitative current will flow from the plate into the coil, and the magnetic coupling is therefore very feeble, as it should be. Some little experimenting will be required in adjusting this coil before it just stops the oscillations. It may be that the plate connection must be connected to the other end of (L3), or that the whole coil must be wrapped on the other end of the tube. Varying the number of turns, or the distance of (L3) from (L2) may be required. Just because you have not hit the proper combination on the first trial is no proof that it will not work. The losses are at a minimum with this arrangement, and there are no separate controls as when a potentiometer is used.

In addition to the compensating coil (L3), the "C" battery will be an aid in keeping down oscillations and increasing the sensitivity of the first two tubes.

In the center, and at the bottom of Fig. 1, will be found a detail of a small radio frequency choke coil which can be used when an audio frequency transformer secondary is not available. This consists of about 450 turns of No. 36 D. S. C. wire wound on a cardboard or bakelite tube as shown, and is mounted on the upper shelf (F) of the set. Some little experimenting may be required to get the most effective number of turns, but the coil is not very critical to the turns, and for most apparatus the number of turns shown will come very close to the best effect. We must have enough turns so that the tubes will not paralyze on the higher wavelengths through leakage of the R. F. current to the "B" battery.

In the lower right hand corner of Fig. 1 is a detail of the resistor assembly used in the audio frequency stages. We can assemble the resistors and grid leaks on the shelves by means of clips as shown, or better yet, we can buy these completely assembled units from our advertisers, at a reasonable figure.

Summary

IN tuning this set, the adjustment of the detector rheostat (R) is of great importance, for there is one position of the rheostat where the detector tube is the most sensitive and gives the greatest volume. This generally occurs when the rheostat is about one-half on, and it is seldom necessary to turn on this tube to full brilliance as with the amplifier tubes.

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RADIO AGE

The Magazine of the Hour

Let America's best known radio experts keep you informed of the latest in technical radio. Here are a few of the radio men who write for RADIO AGE monthly:

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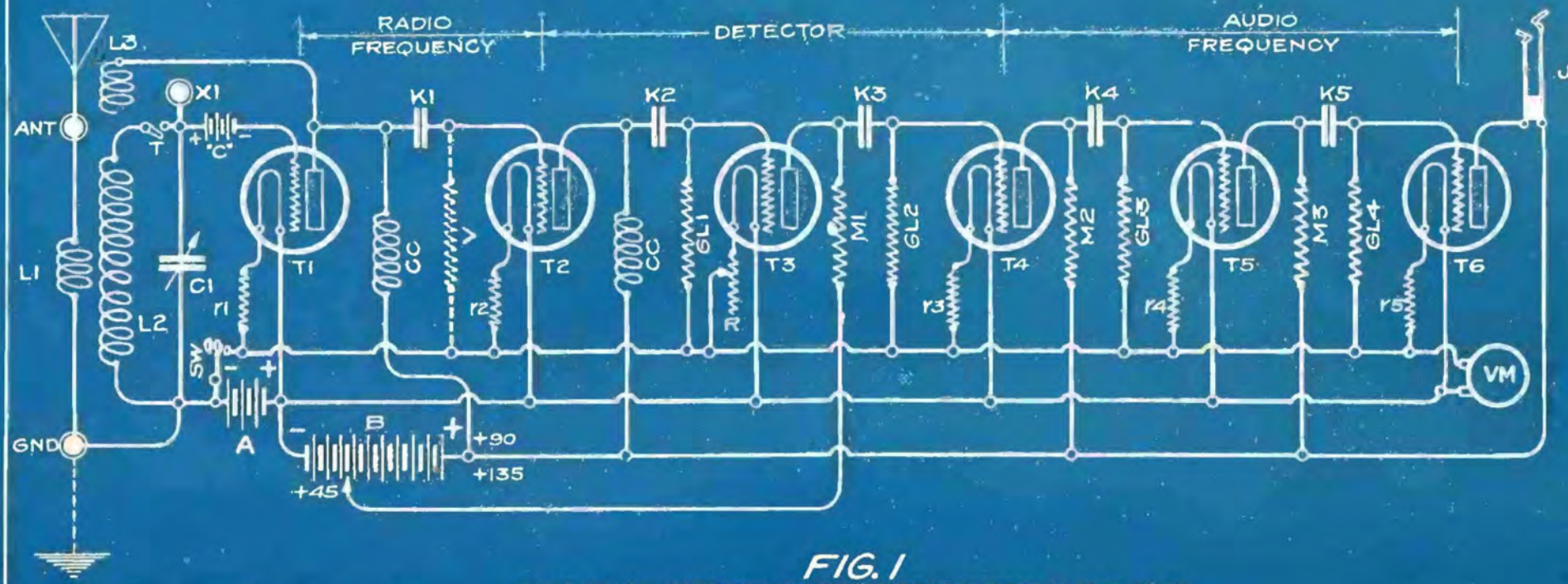
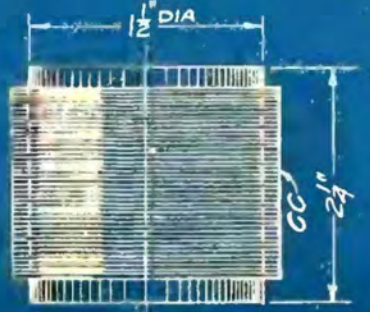


FIG. 1

SCHEMATIC DIAGRAM OF SIX TUBE PORTABLE SET WITH COMBINED IMPEDANCE AND RESISTANCE COUPLING.

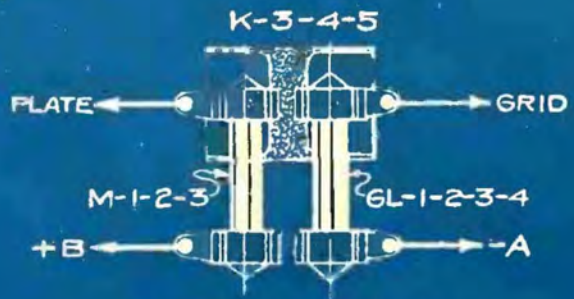
DETAIL OF COUPLER

PRIMARY AND SECONDARY COILS (L1-L2) ARE THE COUPLER TUNER COILS, WHILE COIL (L3) IS TO CHECK FREE TUBE OSCILLATIONS. ONE END OF (L3) IS LEFT OPEN AND OTHER END IS CONNECTED TO PLATE, AS SHOWN IN DIAGRAM ABOVE.



DETAIL OF CHOKE

ABOVE COIL CAN BE USED IN PLACE OF TRANSFORMER SECONDARY. WIND 450 TURNS OF NO. 36 D.S.C WIRE ON TUBE.



RESISTOR COUPLING

SHOWING ASSEMBLY OF RESISTORS, COUP. CONDENSER, AND GRID LEAK, ETC. SEE DIAGRAM ABOVE FOR CONNECTIONS.

SIX TUBE PORTABLE SET

SINGLE CONTROL SYSTEM WITH TWO STAGES RADIO AND THREE STAGES OF AUDIO AMPLIF.

J. B. RATHBUN
RF-786.

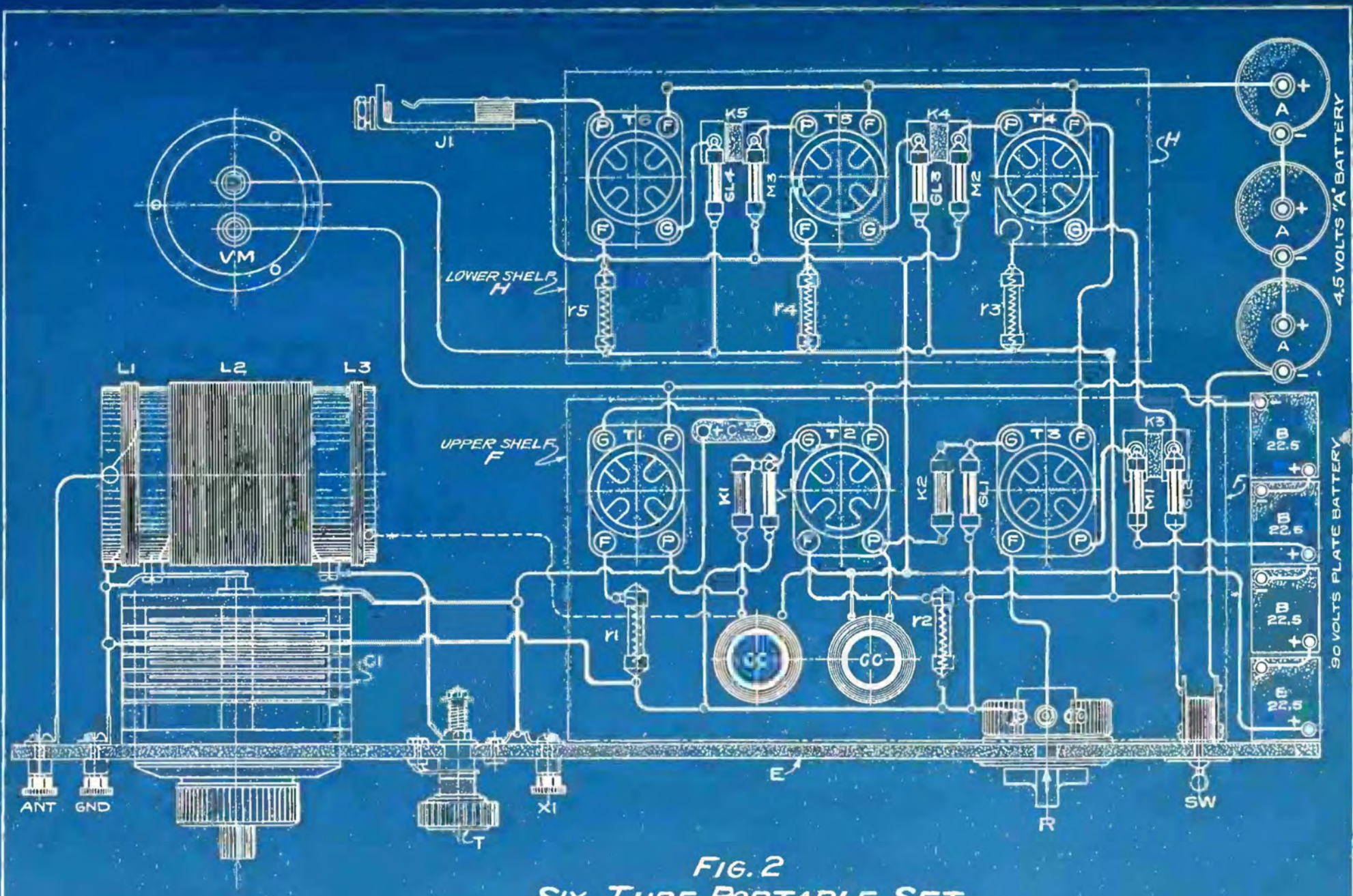
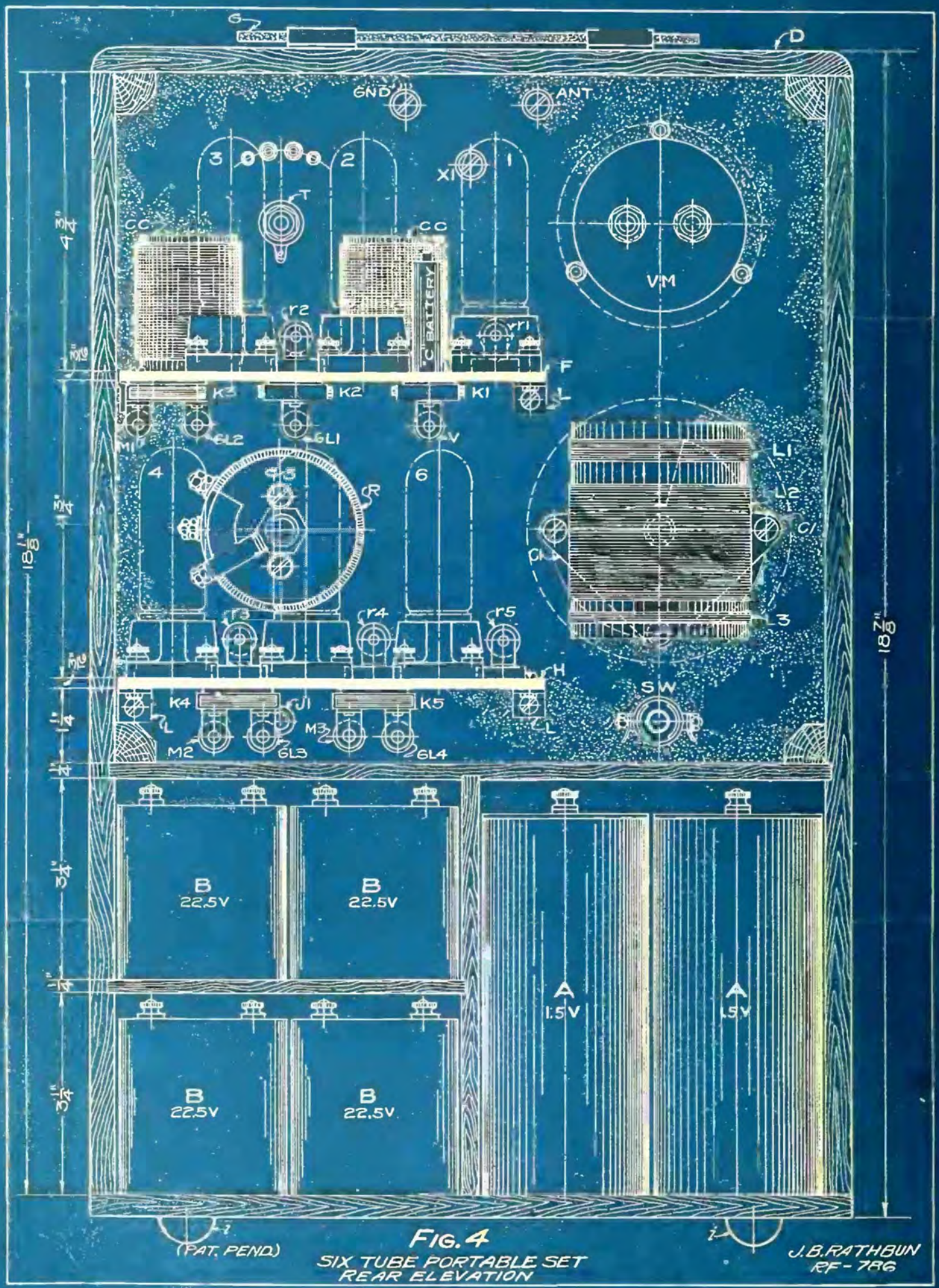


FIG. 2
SIX TUBE PORTABLE SET

"PICTURE DIAGRAM" OF WIRING AND CONNECTIONS SPREAD OUT IN ONE PLANE OR LEVEL. OWING TO THIS ARRANGEMENT, THE TWO CHOKE COILS (CC) APPEAR CLOSER TOGETHER THAN THEY SHOULD. SEE FIG. 4.

J.B. RATHBUN
RF-786



(PAT. PEND.)

FIG. 4
SIX TUBE PORTABLE SET
REAR ELEVATION

J.B. RATHBUN
RF-786

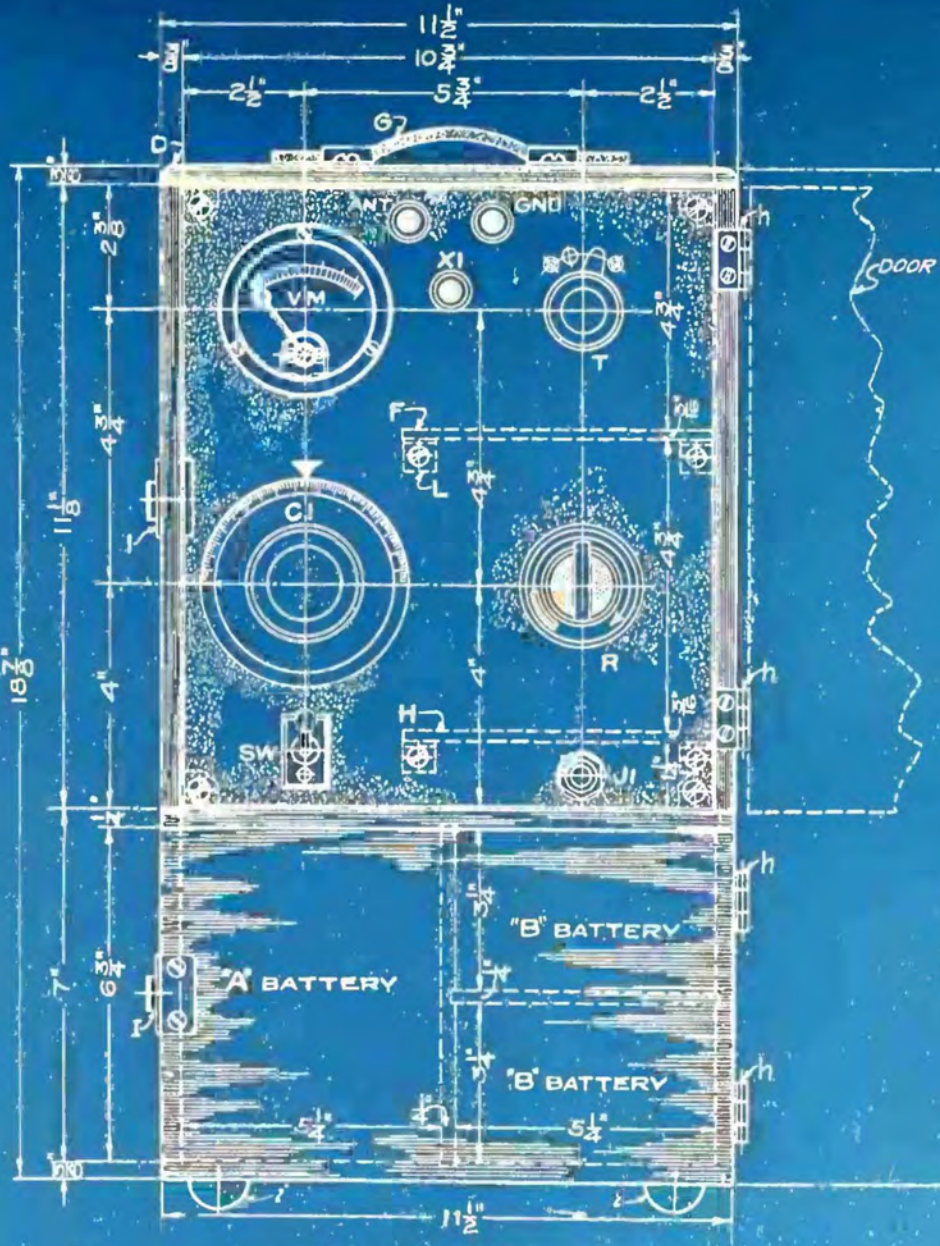


FIG. 3.

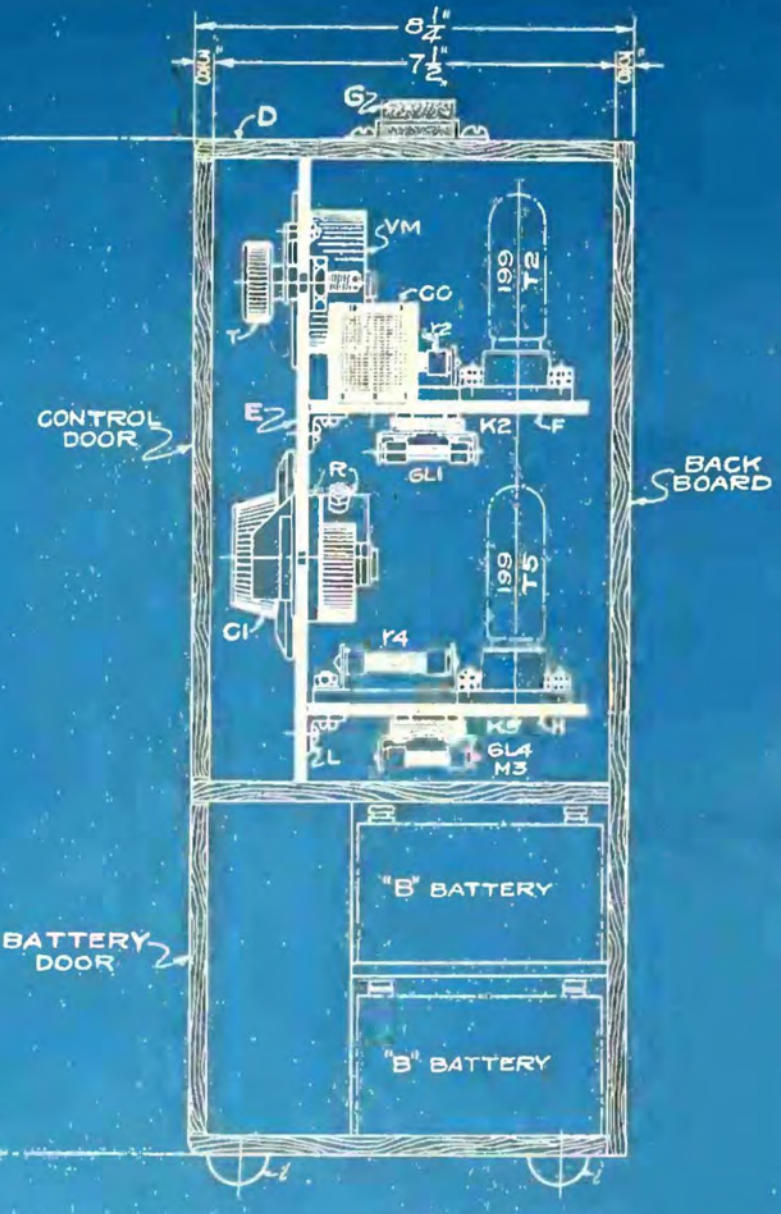


FIG. 3A

SIX TUBE PORTABLE SET

J.B. RATHBUN
RF-786

Here You Are! A Real Receiver

A New 8-Tube Super-Heterodyne

By JOHN B. RATHBUN

SO much has been printed in RADIO AGE upon the elementary principles of the super-heterodyne that it seems hardly necessary to enter again into the theory in much detail.

Briefly, the super-heterodyne is a special form of radio frequency circuit in which radio frequency amplification takes place at a much longer wavelength than that of the incoming radio waves, thus reducing the losses in the tubes and R. F. transformers and adding to the efficiency of the set. Broadcasting wavelengths ranging from 200 to 600 meters are converted into wavelengths approximating 10,000 meters before the waves enter the radio frequency stages. After amplification, the waves then are rectified by the usual detector tube producing audible signals which can be further amplified by one or more audio stages.

A typical eight tube super-heterodyne of the type to be described consists of the following principal unit divisions of tubes:

(1) The first detector tube.

(2) Three radio frequency amplifying tubes.

(3) One oscillator tube used as a frequency changer of the heterodyne type.

(4) One second detector for rectifying the output of the radio frequency stages and thus producing audible signals.

(5) Two audio frequency stages for increasing the volume of the audio component so that a loud speaker can be used.

The Detector Tube

IN a certain respect, the first detector tube (1) can be considered as a radio frequency amplifying stage, and in some circuits is used exclusively for this purpose without the conventional grid condenser and leak, but when iron core radio frequency transformers are used the detector tube is of advantage in providing an audio component in the

A Super That Gives Distance and Tone

first stages of the circuit. It should be noted that the R. F. tubes and transformers work normally at a frequency which is not very much greater than the higher audio or voice frequencies, and therefore a certain amount of audio amplification is also possible in the radio stages, when iron core transformers are used at this point. With air core transformers the audio component receives little if any amplification in the radio stages, and hence under these conditions the rectification of the first tube (1) is not of importance and can be considered and used as a strictly radio frequency stage. The advantages and disadvantages of either system are still a matter of some dispute.

We now come to the oscillator tube (3) by which the wavelength or frequency of the incoming waves is converted into the desired value for use in the radio frequency stages. Really this tube is an independent unit as far as the rest of the circuit is concerned, for it does not enter directly into the amplification or rectification of the waves. It simply produces a series of independent, continuous oscillations, which are combined with the incoming radio waves to form a third series of oscillations having a greater wavelength or lower frequency than either of the original series. This method of changing frequencies is known as heterodyning. The third wave is amplified by the succeeding radio stages. The frequency of the oscillations set up by the oscillator tube is determined by an inductance coil and a variable condenser in such a way that a constant frequency is maintained in the R. F. stages, regardless of the incoming radio frequency The oscillator condenser forms one o the two tuning controls of the circuit.

The R. F. Transformers

ALL of the radio frequency transformers operate at a constant fixed wavelength or frequency at which maximum amplification takes place, regardless of the frequency of the broadcasting station which may then be tuned in. This optimum frequency is determined by the windings of the transformers and more particularly by the filter condensers placed across the first or last R. F. transformers. The transformers are therefore sharply tuned to a single definite wavelength or frequency to which the heterodyned waves must be adjusted by means of the oscillator variable condenser. As the transformers will not respond to any other frequency than that determined by the filter, the oscillator condenser becomes an effective tuning control, which in connection with the aerial or loop condenser insures a high degree of selectivity.

All the radio frequency transformers, whether of the air core or iron core type, are of the "long wave" design especially designed for the super-heterodyne circuit. In the circuit illustrated, the transformers are designed for operation on approximately 45 kilocycles (45,000 cycles frequency) which corresponds to a wavelength of 6,000 meters. This is not a fixed standard frequency which must be maintained strictly in all cases, but has been found in practice as the most effective compromise for the circuit at hand. Actually, the waveband may extend from 1,200 to 25,000 meters in many circuits, but at either extreme certain objectionable features appear which make the 6,000 meter type the logical compromise for iron core transformers.

(Turn the page)

Blueprints for the New Super-Heterodyne on Pages Following

Like a Woman's Heart—

Always room for one more subscriber in the RADIO AGE family. Each month prizes are to be given for those who send in the largest number of paid up yearly subscriptions to this magazine. Details of the contest are to be found on page 18.

Summer-time is the time to go after your prospects; neither you nor the other fellow is too busy. And with this DeLuxe edition as a forerunner of the good things you may expect form RADIO AGE in the future, you should have no difficulty in bringing more radio recruits into the ranks.

Uniformity of Tubes Vital in "Super"

Circuit Diagrams

Fig. 1 is the schematic circuit drawing of the super-heterodyne developed by Mr. Posth of the Radio Doctors, Inc., Chicago, and which has been built by a number of amateurs with excellent results. It is not a radical departure from conventional practice, but is a simple, compact layout which is easily constructed by the novice in "dyne" circuits with an excellent chance of getting results immediately after the completion of the set. It is the result of nearly a year's continual experimenting by one who has alternately added and then eliminated various experimental features which have been brought up from time to time in heterodyne development until the present circuit was arrived at.

Fig. 2 is a picture diagram of the hook-up which will be of service to those who have not yet delved into the mysteries of conventional diagrams. Here each part is drawn out as it actually appears in the proper proportion, with the wiring runs located at the most advantageous points. The letters and figures on Fig. 1 correspond to those marked on Fig. 2, so that the relation between the two drawings can be easily traced out. For convenience, Fig. 2 is divided into two parts. The lower half of the drawing represents a plan view of the baseboard and apparatus as it appears to the observer on looking straight down on the set. The upper half is the rear view of the panel as seen from the rear of the assembly. Between the upper and lower views we see the connecting wiring drawn in heavy lines, which connect the apparatus mounted on the baseboard to that attached to the rear of the panel. Arranged in this way, the connections are easily followed.

Fig. 3 is a front elevation of the panel which shows the controls and the center to center dimensions between the various units mounted on the panel. As will be seen from the blueprints, the panel is 8"x32"x1/4", a reasonable size for a super-heterodyne and a panel not much longer than that used with many tuned radio frequency outfits. The circuit is arranged exclusively for use with a loop aerial, and with this arrangement the loop plays no small part in gaining absolute selectivity in districts where there are a number of broadcasting stations located within a short distance of the receiver.

Starting in with either Fig. 1 or Fig. 2, depending upon the experience of the reader, we note the two variable condensers (C1) and (C2) mounted on the panel at the right. Both are of the low loss type with external vernier adjustments, and both have a maximum capacity of 0.0005 microfarad or the capacity of the standard 23 plate. Condenser (C1) controls the oscillation frequency of the oscillator tube (1) and the oscillator coil (OS). Condenser (C2) tunes the loop and the grid circuit of the first detector tube (2). These are the only tuning controls used and therefore the actual operation of tuning is much simpler than with the usual tuned radio frequency set.

Further along the panel we have four filament control rheostats (R1-R2-R3) with resistances varying according to the number of tubes that they control. Rheostats are based on the use of 201A tubes throughout both for the amplifiers and detectors. The three rheostats marked (R1) have a resistance of 20 ohms and control respectively the oscillator tube (1), the first detector tube (2) and the second detector tube (6). Rheostat (R2) controls the three radio frequency tubes (3-4-5), and because of the greater current has a resistance of only six ohms. Rheostat (R3) has a resistance of 15 ohms for the control of the two audio tubes (7-8).

Watching Potentiometer

AT (PO) is a 400 ohm potentiometer or stabilizer which controls the grid potential of the radio frequency stages. In actual operation the potentiometer has a marked influence on the volume and selectivity but is not frequently used after the set is set into operation in the same sense that the condensers are used. A potentiometer of lower resistance is not recommended, as it does not give sufficiently accurate control of the grid potential. A voltmeter (VM) is desirable for indicating the potential across the filaments of the radio tubes, but it is not absolutely essential. By means of this voltmeter (0-10 volt scale), the tubes can be kept accurately to the point of greatest sensitivity. An ammeter, shown by (AM) gives the total current consumed by all tubes in the circuit. A battery switch as at (SW) is very convenient and is an insurance against the accidental burning of the tubes after leaving the set for the night. It makes the complete readjustment of the rheostats unnecessary when the set is used the second time. All of the above apparatus is mounted on the panel as shown by the upper view of Fig. 2.

Three output jacks are provided. Inserting the plug into jack (JD) gives reception from the tubes up to and including the first detector tube (6) and this corresponds to the detector tube circuit of the ordinary regenerative circuit. Plugging into jack (JI) gives the addition of one stage of audio amplification, while jack (J2) includes all of the tubes or two stages of audio. Experience has shown that one stage of audio is all that is required for loud speaker operation on all but the faintest and most distant stations.

An oscillator coil (OS) of the fixed winding type is located between the first detector tube (2) and the oscillator tube (1). The functions of this inductance coil have been described before. This coil is very compact and requires no adjustment. The inside bakelite tube is 1.5 inch in diameter and carries about four turns of wire near its center which corresponds to the "pick-up coil" of the usual heterodyne oscillator coil. The outer tube is 2.5 inches in diameter and carries both the grid and plate coils of the oscillator circuit. The grid coil carries 20 turns of No. 26 D. S. C. wire and the plate coil consists of 40 turns of the same size wire. The latter is spaced about one half inch from the grid coil. A detail of the oscillator coil is shown in Fig. 4 where the external plate and grid coils are clearly seen. The inner and outer tubes are mechanically connected by short pieces of small fiber tubing through which brass screws are run. When tuned by the 0.0005 mf condenser (C1), this oscillator will fully cover the ordinary range of broadcasting wavelengths.

At (2) we have the first detector tube with the grid condenser (K2) of 0.00025 mf capacity and the grid leak (GL) with a resistance of two megohms. As will be seen from the plan view in Fig. 2, the oscillator coil and the two tubes (1) and (2) are located well back on the baseboard, so as to clear the variable condensers (C1-C2) indicated by the dotted lines. The outline of the baseboard is indicated by (F). A bypass condenser (K1) has a capacity of 0.005 mf.

Next in order come the radio frequency stages consisting of the tubes (3), (4), (5) and the long wave radio transformers (RD1-RD2-RD3-RD4). All of the transformers are of the iron core 45 kilocycle type and are tuned to work in agreement with the oscillator by means of the fixed condensers (K1-K4). (RD1) is the input and (RD4) is the output transformer. Any iron core of 45 kilocycle type can be employed. Condenser (K4) has a capacity of 0.00025 mf. Owing to the body capacity which is sometimes in evidence, it is frequently desirable to ground the metal cases of the transformers as indicated by the dotted line (g).

With the particular transformers shown in Fig. 2, the tube sockets and transformers can be set very close together, about 2 7/8 inch centers. The transformers are of the metal shielded upright cylindrical type, which lend themselves nicely to compact formation. The grid post (G) of the output transformer (RD4) goes to the grid condenser (K5) and grid leak (GL) of the second detector tube (6). The grid condenser (K5) has a capacity of 0.0005 mf, while the grid leak has a resistance of 2 megohms.

201A Tubes Used

BY using 201A tubes throughout with a current consumption of 0.25 ampere per tube, the total current is only 8x0.25 = 2 amperes, the exact amount of current taken by a five tube neutrodyne when a soft detector tube is used. As a soft detector of the "200" type takes about one ampere and introduces a certain amount of hissing tube noise, its use is not recommended in this set. Owing to the high potentials on the grids of the tubes, it is necessary to use the highest grade of sockets to insure against leakage and internal capacity effects. For the same reason, the bottoms of the sockets should be raised well above the

face of the baseboard by means of spacers or liners, say about 1/4 to 3/8 inch above the board.

For the best results all tubes should be carefully matched by the dealer before delivery, for all of the tubes in the radio frequency stages at least must have exactly the same electrical characteristics. When so many radio frequency tubes are connected up in cascade (series), and when the transformers are exactly matched as they should be, any small difference in the tube characteristics will cut down the output to an alarming extent. Matched tubes may cost slightly more than tubes taken out of stock at random, but they are well worth the money. Any one who has constructed a neutrodyne set knows how greatly tubes of the same make and type vary among each other, and how difficult it is to get dissimilar tubes to act together.

Large bypass fixed condensers must be used to shunt the radio frequency currents around the windings of the potentiometer and across the resistance of the "B" batteries. This is even of more importance with long wavelengths than at broadcasting frequencies and the capacities of the condensers must be correspondingly greater. Condenser (K3) has a capacity of 0.5 microfarad and is used to shunt the R.F. current around the potentiometer windings. Fixed condenser (K6) has a capacity of 1.0 microfarad and shunts the "B" battery. Smaller condensers should not be used.

Last are the two audio frequency stages at the extreme left of the board. Tubes (7) and (8) are the first and second audio tubes respectively, while the audio frequency transformers will be seen at (AT). In general, these two audio stages are the same as any audio stages but owing to the nature of the super-heterodyne, it is necessary to filter the output by means of certain fixed condensers so that the second stage can be worked without noise and distortion. To use these stages "straight" without filters means trouble as soon as the output is taken from the second stage through the jack (J2). Any high grade audio frequency transformer can be used for this purpose. The ratio of the first stage should preferably be from 3/1 to 4/1 while the ratio of the second stage transformer can be 5/1 to 6/1. Higher ratios are general not advisable.

Grid biasing by means of the "C" battery is most essential to the proper operation of the set. It at once promotes clarity of tone and effects a saving of "B" battery current in the audio frequency tubes. For a plate potential of 90 volts, a three cell 4.5 volt "C" battery will give the best results with the 201A tubes. There is no current drain to speak of on this battery and it can be the smallest type of three cell battery procurable. While most high grade audio transformers are well shielded, yet it is safest to place them at right angles to one another as shown in Fig. 2. This eliminates any danger of noise or interference.

Two fixed condensers are connected across the primary and secondary of the first stage audio transformer (AT1). Condenser (K4) has a capacity of 0.00025 mf. while (K8) is a 0.001 mf. size. Another filter fixed condenser (K4) is connected between the grid (G) and the (−) post of the "C" battery at (K4) and has a capacity of 0.00025 mf. This completes the audio frequency stages except for the three jacks (JD-J1-J2) which are interconnected with the stages as shown.

The Loop Connections

At the extreme upper right hand corner of the panel in Fig. 2 are the two binding posts for the loop connection. It is best to use binding posts and to avoid the use of a jack at this point as a jack introduces objectionable capacity into the circuit and also permits of some leakage of the already weak radio impulses. As explained, the set is somewhat more sensitive and selective if the lower binding post is grounded, or if the (+A) line is grounded. This ground can be made directly from the post or from some more convenient point in the circuit as at the (+A) binding post. This effect is particularly noticeable in cities where the radio traffic is congested and where the utmost in selectivity is necessary.

In regard to the "B" batteries it must be noted that the demand for plate current is very heavy and that for the best service a storage "B" battery is highly desirable. If a storage "B" is out of the question with the user, then only the largest size of dry batteries are advisable. The eight tubes will run down a small or medium size "B" battery in a very short time and in the end, the smaller dry cell batteries will prove much more expensive than storage batteries or large dry batteries. A full 90 volts should be maintained at all times for the maximum output, and much of the trouble experienced with super-heterodynes can be traced to exhausted "B" batteries which have been allowed to outlive their usefulness.

At the left of the baseboard will be seen the terminal strip of bakelite on which the battery binding posts are mounted. This is 1 1/4 inch wide and 6 inches long with a thickness of 3/16 inch. Wires to the connections run off through the side or back of the cabinet, and this makes a much neater arrangement than with the binding posts mounted on the front of the panel as we sometimes see such sets. Spacers are placed beneath the terminal strip to raise it well above the bottom board and so that the screw heads will not make contact with the wooden bottom board. Wood is not a perfect insulator and therefore we should avoid placing any current carrying parts in contact with it.

While spaghetti can be used with profit on all "A" battery and ground wires, its use is not advised on wiring which carries radio frequency currents, except at points where a short length is necessary to prevent actual short circuits. Spaghetti has a high dielectric value and increases the capacity of the circuits with attending losses.

IT GOES without saying that all joints must be soldered and that particular care must be taken where soldered connections are made to the jacks. Rosin flux must be used exclusively (no acid) and in using the rosin one must take care that the parts are actually soldered and not simply stuck together with the non-conducting rosin flux. After soldering, shake the wire vigorously to make certain that the parts are soldered. In such a complicated set, it is exceeding difficult to trace trouble when due to open joints, hence we must be vigilant during the wiring operations.

Tubes should be matched by the dealer so that all of the radio frequency tubes are electrically identical. If this is not done, then it will be impossible to secure maximum amplification in the radio stages. Much of the success with a super-heterodyne circuit depends upon the accuracy with which the transformers are matched and their agreement with the tubes. When the transformers are successively numbered from the input through to the output transformer, they must then be arranged in numerical order as shown by RD-1, RD-2, RD-3 and RD-4.

For the convenience of the builder the "A" and "B" battery connections are made according to two different systems. In Fig. 1 the negative "B" (−B) is connected to the positive "A" (+A), and in general this will give the best results. The connections can be, seen at the extreme right of Fig. 1 at the terminals. However, under certain conditions it is better to connect (−A) to (−B) as in Fig. 2. Either connection is easily had without labor by changing the cross connection or "jumper wire" at the terminal board. In the first case, the jumper in Fig. 1 runs from the (−B) terminal to the (+A) terminal. In Fig. 2 this is switched from (+A) so that the (−B) terminal is connected to the (−A) terminal. This is simple, and we should try out to find which is best.

In connecting the ammeter and voltmeter, we must observe the polarity marked on these instruments; that is, the wire from the positive bus must go to the positive terminal of the instruments. If these connections are reversed, then the instruments will have the needle come to rest on the zero stop and will not indicate the current or voltage. In connecting up the transformers, the marks on the transformer posts should be observed, the grid (G) on the transformer being connected to the grid (G) of the socket as shown in both Figs. 1-2.

Particular care should be taken to connect up the variable condensers so that the connections between the grid of the tube and the stator (stationary plates) are always observed. If the grid is connected to the rotor or movable plates, then we will have trouble from body capacity effect, as the full grid potential is then carried out to the hands through the condenser shaft. The proper connections are clearly shown in Fig. 2.

In order to absorb undesirable vibrations from the radio stages, a grid leak (1 megohm) is connected across between the negative of "C" and the grid of the last audio tube so that the leak (GL) and the condenser (K2) form the conventional grid leak and condenser. This has a notable effect in reducing noise when the second stage of audio is thrown in. The negative of the "C" battery must go to the grid (G) as shown.

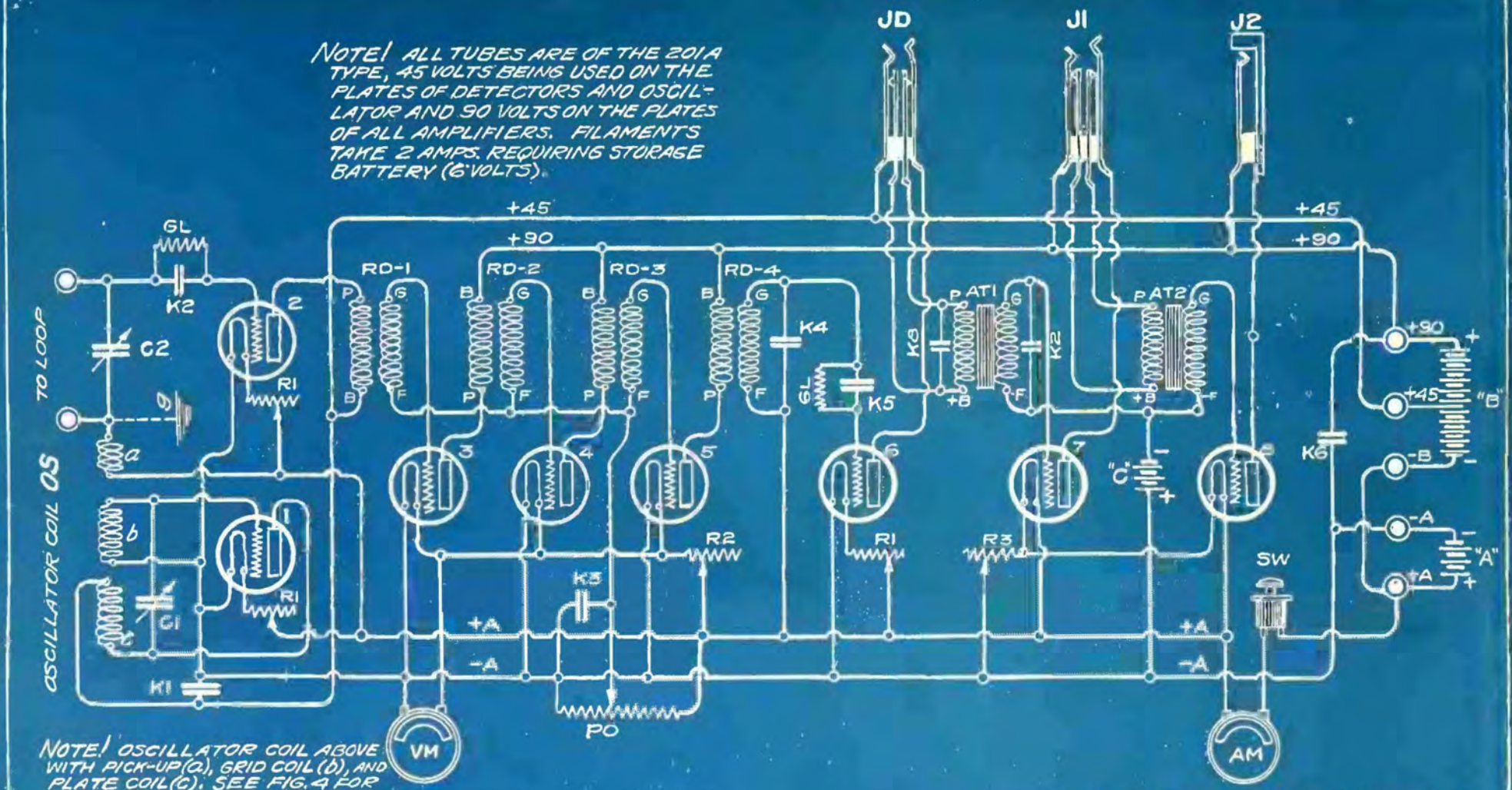


FIG. 1

EIGHT TUBE SUPER-HETERODYNE

OSCILLATOR, THREE STAGES OF RADIO FREQUENCY, TWO STAGES OF AUDIO AND TWO DETECTOR TUBES. WORKS ON STANDARD 200-600 METER LOOP AERIAL, 24"-30" SQUARE.

J.B. RATHBUN
SH-55A

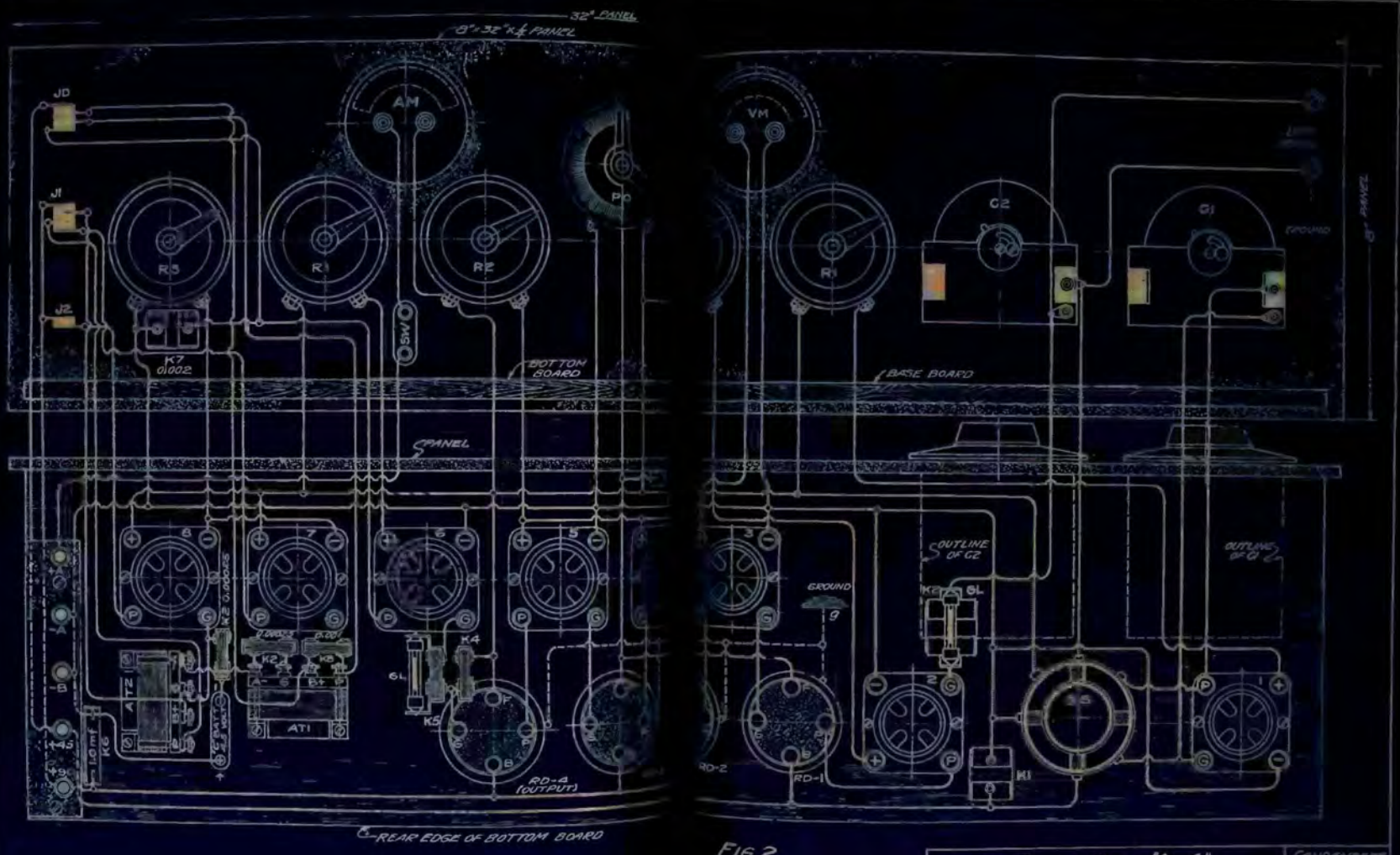


FIG. 2

THE EIGHT TUBE "A-4" SUPER-HETERODYNE

OSCILLATOR, THREE STAGES RADIO, TWO STAGES AUDIO AND TWO DETECTOR TUBES. ALL TUBES TO BE UV-201A, C-301A, OR OTHER "A" TYPES.

J.B. RATHBUN
SH-56-A

CONDENSERS

K1 - 0.005 mf
K2 - 0.0005 "
K3 - 0.5 "
K4 - 0.0005 "
K5 - 0.0005 "
K6 - 1.00 "
K7 - 0.02 "
K8 - 0.001 "

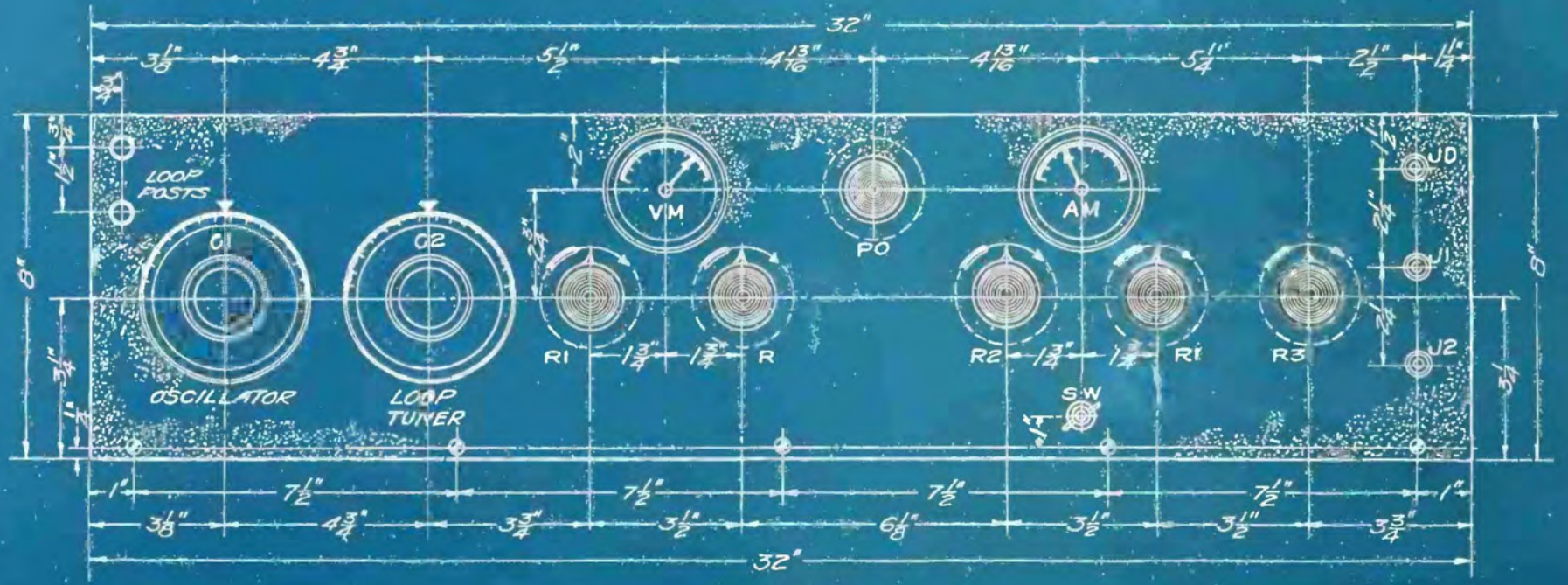


FIG. 3.

EIGHT TUBE SUPER-HETERODYNE

THE DRAWING ABOVE IS A DIMENSIONED PANEL LAYOUT (FRONT ELEVATION) SHOWING ARRANGEMENT OF APPARATUS ON FRONT FACE. USE ONLY HIGH GRADE PANELS, BAKELITE, HARD RUBBER, ETC. NO WOOD PANELS.

J. B. RATHBUN
SH-55A

WITH THE MANUFACTURERS

Silver Super Wins Grand Prize at Los Angeles Show

Against a field of more than 400 set-builders, including scores of radio experts and engineers, an 18-year-old builder of a Silver Super-Heterodyne carried away first honors in the Grand Sweepstake Contest conducted at the National Automotive School Radio Show in Los Angeles, June 7.

The prize was a $300 cash award, offered for the finest set in the entire contest, which was held in conjunction with the radio show. The youthful winner was Robert Haig, of 8123 Norton Ave., West Hollywood, Calif., and the super-heterodyne with which he won the grand prize was built from the circuit developed by McMurdo Silver, Assoc., I. R. E., whose work in super-heterodyne and transformer development is nationally known and recognized. Silver-Marshall super parts, also developed and designed by Mr. Silver, were used exclusively in Mr. Haig's prize receiver.

The award was judged on distance, quality of tone and selectivity, by three of the best informed radio engineers and editors in the industry. The set was a portable model Silver-Super, a seven-tube outfit on a 7" by 18" panel.

Of the total of 432 sets entered in the contest, eighty-three were super-heterodynes, built by some of the best known super-heterodyne experts in the country. More than 40,000 radio fans attended the exhibition.

In thanking the judges for the grand prize, young Haig said:

"I have built more than 10 supers, but I found the Silver-Super the very best I ever built and it is beating every set in town for reaching out and bringing in the distant and hard-to-get stations. It is easy to tune, selective, the locals never bother me, and it was easy to build. The parts and circuit are all Silver-Marshall, and I feel I have the best-performing set on the Pacific Coast. I had no trouble in building it. I simply followed the instructions with parts I had bought, and after hooking it up, it worked perfectly."

Fada Radio, Limited, Announcement

A Canadian Corporation has been formed under the name of Fada Radio Ltd., at 821-827 Queen Street, E. Toronto, Canada. The officers of this company are as follows: President and Treasurer, Frank A. D. Andrea; Vice-President, Concetta Andrea; Secretary, R. M. Klein; Manager, C. R. Fraser; Superintendent, T. M. Rozelle.

This Canadian Company is licensed under the Canadian Hazeltine patents in conjunction with F. A. D. Andrea, Inc., of New York City, to manufacture a complete line of Fada Neutrodyne Receivers.

Stemm Assumes New Duties

Royal A. Stemm, who has for the last two and a half years been the Illinois representative for the Crosley Radio Corp. has tendered his resignation to this company, effective June the first, and will immediately assume his duties as President of the Jackson Sales Company, 20 East Jackson Boulevard, Chicago.

Mr. Stemm has been intimately associated with radio in its various phases since its first inception as a commercial product and has always forcibly and effectively played his part along the tangents that are for the betterment of radio and its merchandising problems. "Royal", as he is known among his intimates, has by his energetic and pleasing personality won a large coterie of friends, both in the social and business world of radio.

The many messages of congratulations and good wishes already received, demonstrate his popularity in the trade and it is predicted that in his new and larger fields of activity, he will be much heard of throughout the middle west territory.

The Jackson Sales Company, which was organized over a year ago, are the exclusive Manufacturer's representative of the well known Air Way Receivers for the States of Illinois, Wisconsin, Minnesota, the Dakotas and the upper peninsula of Michigan. They also represent the Wireless Dry Cells Ltd., Niagara Falls, manufacturers of Maximite "A," "B," and "C" Batteries, and operators of Station CKCL Toronto; The Shamrock Manufacturing Company, Newark, N. J.; The Inter-Ocean Radio Corp., manufacturers of Woodehorn; Niles Manufacturing Company, manufacturers of the Niles chargers; and several other well known lines.

New "B" Battery Charger

The Apco Manufacturing Company, makers of the well known line of Apco Battery Chargers and other Radio products, announce a new "B" Battery Charger, that is a radical departure from anything heretofore manufactured.

It is a combination electric light bulb and vibrator type, which charges either a 24, 48 or 96 volt battery at from 1-10 to 1-4 of an ampere, depending on the size of the lamp used, which is an ordinary electric light bulb of 25 to 150 watt capacity.

The manufacturers claim that this is the only Battery Charger made that will charge 100 volts at one time in 10 hours, at a cost so insignificant that it is hardly measurable.

The device sells for $4.00, and complete data will be sent by the manufacturer on request.

Signal Holds Sales Conference

The annual sales conference of the Signal Electric Manufacturing Company, of Menominee, Michigan, was held May 18th-22nd. Twenty-one representatives from all over the United States and Canada were brought to the factory for five days of business and pleasure. Business in the morning, fishing, boating and dancing in afternoon and evening.

Before the conference opened the representatives took a tour through the factory, which covers 42,380 square feet of floor space, and were shown how Signal Quality Products were manufactured and each one assembled a Signal Jr. Fan, which has proved a big winner this year.

The conference was called to order at 10:00 a. m. by Charles E. Hammond, general manager, and first expressed his appreciation for the good work "The Boys" had done during the past year. He next introduced William E. Hopper, the newly appointed sales manager.

The present items of the line were first discussed and then the new ones were introduced. These newly introduced items were received with great enthusiasm and the unanimous opinion of sales force was that "Signal Would Enjoy Wonderful Business" on all its lines, but especially on the new items, which are "world beaters."

The new items introduced were: a new loop, variable condenser, a complete line of A. C. and D. C. bells, exhaust fans, new bell ringing transformer, factory siren Signal, and newly designed cabinets.

"Clearco Crystal" Ready

One of the most unusual endorsements ever given an accessory has just been put into practice by the Howe Auto Products Company, which now are including with each Howe Radio Receiver a special card relating to the Clearco Crystal, which has been adopted as standard for Howe Sets. The card states:

"This Howe Radio Receiver is equipped with a Clearco Crystal, adopted as standard for Howe Sets after exhaustic tests. It is highly sensitive and hot everywhere. We highly recommend this crystal. The continued use of Clearco Crystals in your Howe Set will give you the best possible reception. If your dealer does not handle Clearco Crystals, have him write direct to the Clearco Crystal Co., Idaho Springs, Colo."

The card shows upon its reverse side the towering peaks of the Rocky Mountains in the vicinity of Idaho Springs, Colorado, where the mineral which goes into the making of Clearco Crystals is mined. The spot, incidentally, is

(Turn to page 90)

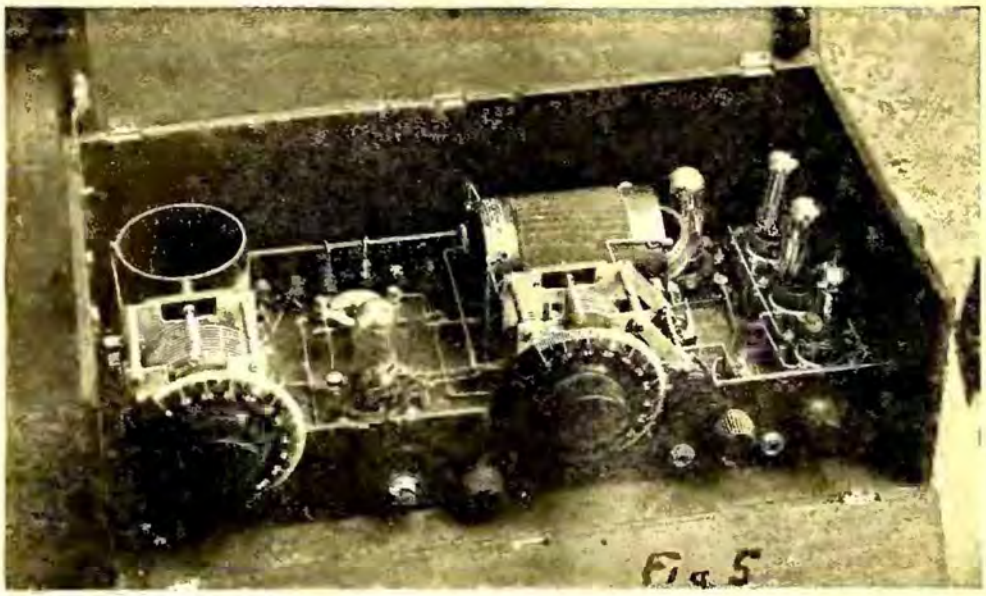


Fig. 5 (above) Browning Drake adaptation, using 4 UV199's, the fifth in parallel with the fourth tube.

Fig. 6 (at right). The veins on Mr. Cox's hand do not stand out unduly, so we assume the self-contained set must not weigh very much. And weight is something which a traveling man doesn't like plenty of.

(Continued from page 22)

fading and strength of signals on different wavelengths.

Edmund B. Redington, of Waverly, N. Y., a senior in the class of 1925 at Union College, has been awarded the Bailey Prize given each year for the senior who contributes most to the advancement of the college.

Redington's work was the operation of a radio transmitter on 3.8 meters. This was accomplished using standard equipment in the form of two fifty watt tubes. Previous oscillators had been made to operate on four or five meters, but it had been necessary to eliminate the tube sockets and remove the bases. It was also necessary to nullify the tube capacity. Redington's form of oscillator makes use of the internal capacity, and by the use of extremely short leads between the sockets, he was able to make the set oscillate at 3.8 meters.

¶ Write the Pickups and Hookups editor and tell him what you are doing to eliminate static.

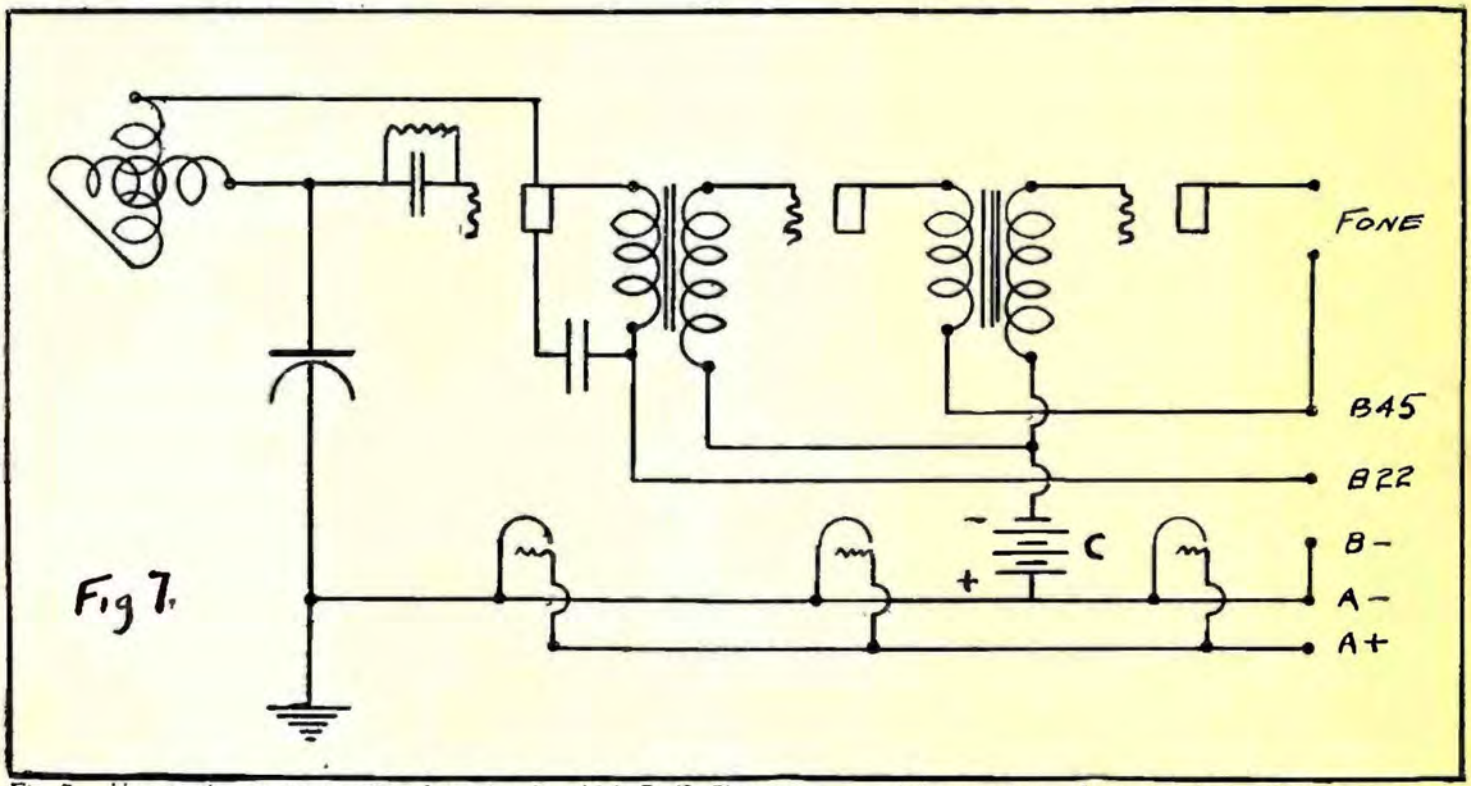


Fig. 7. Here is the set we mentioned previously which P. E. Chapman uses while canoeing. It is an ultra-audion arrangement with two stages of audio, using "199" tubes.

Standard Radio Receivers

Recently RADIO AGE inaugurated a new department called "Know Before You Buy," to serve as a guide to the prospective radio purchaser in deciding on the receiver best suited to his individual needs. Fans throughout the country have shown an instantaneous response to this new feature, and accordingly it is continued and will be a feature of all forthcoming numbers of RADIO AGE. Readers are invited to write us concerning the sets in which they are interested, and manufacturers also are asked to send us material describing their sets.

IN TESTING the Melco Supreme receiver we experienced a few new things, both in circuit design and use of radio apparatus. The Melco Supreme receiver is a tuned radio-frequency receiver using five tubes, and follows the usual design in such a circuit. The differences that exist are not in any way radical but they represent refinements in parts of the circuit that are important.

The engineers of the circuit have used a variable inductance in places of the customary variable capacity and fixed inductance combination that is used so much in this type of receiver. The advantage in substituting a variable inductance in place of the customary condenser and coil combination lies in the greater amplification of the radio-frequency energy given by the use of a large grid inductance. We have not seen much in the line of variable inductance tuned radio-frequency receivers because there are many peculiar obstacles that present themselves when a high inductance is used in the grid circuit. The most pronounced of the drawbacks is the straying of magnetic fields from one stage to another. A feature of the Melco Supreme inductances is the confinement of each field to its respective inductance.

"D" Shaped Coils Used.

This is accomplished by splitting the inductance in two D shaped coils, both mutually connected to form one continuous connection, but the magnetic lines of force so travel that they are attracted to one another and self-confined. The path presented between the two coils of each stage is of much less resistance than the path offered from stage to stage for promotion of magnetic straying from one stage to another.

The prevention of stray magnetic fields is highly desirable if reception is wanted, unaccompanied by whistles and howls. To prevent the impairing of reception by whistles and howls the Melco receiver has two auxiliary adjustments that are designed for the sole purpose of allowing maximum amplification of the received signal without interference by whistles and howls thru oscillation. Oscillation is generally experienced when the three main tuning dials are tuned to resonance with the frequency of an incoming signal. If the set is designed to give great amplification it often will burst into a shrill whistle as exact resonance is reached. It is both desirable to obtain great amplification of the signal and a resonant tuning condition but it is impracticable to receive a signal under such a condition without promoting the oscillation annoyance.

Oscillation Control.

The Melco Supreme receiver employs a method of controlling oscillation by allowing exact tuning to resonance and controlling the amplification of the signal to a point that lies just below the point where oscillation takes place. This is done thru the manipulation of two small dials that are situated a little above the center line axis of the three main wave length tuning controls.

Reception of distant stations is made more easy by the use of these dials by allowing the two oscillation controls to remain in an oscillatory condition. The incoming signal is noticed by the oscillation whistle. When once the station is located the two controls may be adjusted to a point below the oscillation point and the signal will be freed from any interference caused from the oscillation.

Spacing of Parts.

Maximum spacing of the sensitive parts of the circuit is obtained by constructing the set with the stage sockets in the following order: (1) Second audio stage; (2) First radio stage; (3) Second radio stage; (4) First audio stage; (5) Detector stage.

Spacing the first audio stage between the second radio and the detector stage keeps the detector stage sufficiently far away from the radio stages to minimize any tendencies for the detector tube to oscillate or regenerate. If this were not corrected in this manner it would probably be necessary to use an additional oscillation control to retard regeneration. By arranging the parts as specified regeneration is eliminated before it is created and the additional control is made unnecessary.

The Melco Supreme receiver is a handsome instrument possessing a most pleasing balance of operating controls

Earn $100 a Week In Radio

Easy to Learn at Home

Big money every week in fascinating easy work—wonderful future. Hundreds of big paying positions in this huge new industry!

More Money for YOU in Radio

THOUSANDS of Radio Experts are needed to design, repair, maintain, sell radio apparatus, to operate broadcasting stations, as ship and land operators, to go into business; to instruct, sell, demonstrate, superintend and for scores of other big paying radio jobs.

And now, you can easily become a Radio Expert. Studying at home in spare time, you can quickly qualify for a splendid Radio position. Astonishingly small cost. Famous radio instructors give you individual help by mail. Training Guaranteed.

Free Employment Service

Hardly a week goes by without our receiving urgent calls for our graduates. "We need a competent Radio Engineer"—"We want men with executive ability in addition to radio knowledge to become our local managers"—"We require the services of several resident demonstrators"—these are just a few small indications of the great variety of opportunities open to our graduates.

Receiving Set and Special Parts

Our course of practical instruction includes not only several of our own special patented instruments, but in addition we furnish material and diagrams for building receiving sets—all without additional cost. This is an absolutely complete course which qualifies you for the government first-class license and for the big-pay jobs in Radio.

We Help You to Big-Pay Positions

Scores of young men who have taken our course are already earning from $75 to over $200 a week. Merle Wetzel of Chicago Heights, Ill., advanced from lineman to Radio Engineer, increasing his salary 100% even while taking our course! Emmett Welsh, right after finishing his training started earning $300 a month and expenses. Another graduate is now an operator of a broadcasting station PWX of Havana, Cuba, and earns $250 a month. Still another graduate only 16 years old is averaging $70 a week in a radio store, and we help our graduates to positions like these.

Send for FREE BOOK

There's more money for You in Radio. Find out what this field has meant to hundreds of our graduates—and how you too can profit in it. "Rich Rewards in Radio" has just been printed. It is filled with the latest Radio facts, figures and illustrations of tremendous interest to you. Right now—if you are at all ambitious—send for this valuable free book. Write Now while our Special offer is still open. Fill out the coupon—and mail it now!
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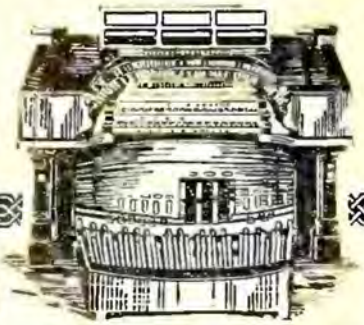
NATIONAL RADIO INSTITUTE, Dept. 53KB, Washington, D. C.

Without obligation send me your book "Rich Rewards in Radio," which tells all about the opportunities in Radio, how spare time study at home will qualify me quickly as a Certified Radiotrician so I can get one of these splendid positions, and how your Employment Service helps me to secure a big-pay job.

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

Street .....

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



Majestic Roll of the Mighty Organ

Mighty tones from the depths of the noblest of musical instruments do not tax the resources of Rauland-Lyric. Accurately designed for faultless amplification, this instrument faithfully transmits all organ tones—those of the piccolo stop as well as those of the open diapason.

Rauland-Lyric is a laboratory-grade audio transformer designed especially for music lovers. The price is nine dollars. Descriptive circular with amplification curve will be mailed on request. All-American Radio Corporation, 4201 Belmont Ave., Chicago.

Rauland-Lyric
AN
ALL-AMERICAN
TRADE MARK
TRANSFORMER
The Choice of Noted Music Critics

THE RADIO AGE BUYERS' SERVICE

What do you want to purchase in the radio line? Let the staff of RADIO AGE save you time and money by sending in the coupon below. Enter the number of the article you would like to know more about in the spaces provided in the coupon.

1 "A" Batteries
2 Aerial protectors
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5 Aerials, loop
6 Amplifiers
7 Amplifying units
8 Ammeters
9 "B" batteries
10 Batteries (state voltage)
11 Batteries, dry cell
12 Batteries, storage
13 Battery chargers
14 Battery clips
15 Battery plates
16 Battery substitutes
17 Bezels
18 Binding posts
19 Binding posts, insulated
20 Books
21 Boxes, battery
22 Boxes, grounding
23 Bridges, wheatstone
24 Broadcasting equipment
25 Bushings
26 Buzzers
27 Cabinets
28 Cabinets, battery
29 Cabinets, loud speaker
30 Carbons, battery
31 Cat whiskers
32 Code practisers
33 Coils
34 Coils, choke
35 Coils, coupling
36 Coils, filter
37 Coils, grid
38 Coils, honeycomb
39 Coils, inductance
40 Coils, Reinartz
41 Coils, stabilizer
42 Coils, tuning
43 Condenser parts
44 Condenser plates
45 Condensers, antenna coupling
46 Condensers, by-pass
47 Condensers, coupling
48 Condensers, filter
49 Condensers, fixed (paper, grid, or phone)
50 Condensers, variable grid
51 Condensers, variable mica
52 Condensers, vernier
53 Contact points
54 Contacts, switch
55 Cord tips
56 Cords, for head sets
57 Couplers, loose
58 Couplers, molded
59 Couplers, vario
60 Crystal alloy
61 Crystal holders
62 Crystals, rough
63 Crystals, mineral
64 Crystals, synthetic
65 Crystals, unmounted
66 Crystals, mounted
67 Desks, radio
68 Detector units
69 Detectors, crystal
70 Detectors, fixed crystal
71 Dial, adjusters
72 Dials, composition
73 Dials, hard rubber
74 Dials, rheostat
75 Dials, metal
76 Dials, vernier
77 Dials with knobs
78 Dies
79 Drills, electric
80 Dry cells
81 Earth grounds
82 Electrolyte
83 Enamels, battery
84 Enamels, metal
85 End stops
86 Eyelets
87 Experimental work
88 Fibre sheet, vulcanized
89 Filter reactors
90 Fixtures
91 Fuse cut outs
92 Fuses, tube
93 Generators, high frequency
94 Grid choppers, rotary
95 Grid leak holders
96 Grid, transmitting leaks
97 Grid leaks, tube
98 Grid leaks, variable
99 Grinders, electric
100 Ground clamps
101 Ground rods
102 Handles, switch
103 Head bands
104 Head phones
105 Head sets
106 Honeycomb coil adapters
107 Hook ups
108 Horns, composition
109 Horns, fibre
110 Horns, mache
111 Horns, metal
112 Horns, wooden
113 Hydrometers
114 Indicators, polarity
115 Inductances, C. W.
116 Insulation, molded
117 Insulation material
118 Insulators, aerial
119 Insulators, composition
120 Insulators, fibre
121 Insulators, high voltage
122 Insulators, cloth
123 Insulators, glass
124 Insulators, hard rubber
125 Insulators, porcelain
126 Irons, soldering
127 Jacks
128 Filament control
129 Jars, battery
130 Keys, transmitting
131 Knobs
132 Knock-down panel units
133 Laboratories, testing
134 Lever, switch
135 Lightning arresters
136 Loosecouplers
137 Loud speakers
138 Loud speaker units
139 Lugs, battery
140 Lugs, terminal
141 Measuring instruments
142 Megohmeters
143 Meters, A. C.
144 Meters, D. C.
145 Mica
146 Mica sheets
147 Milliammeters
148 Minerals
149 Molded insulation
150 Molybdenum
151 Mountings, coil
152 Mountings, condenser leak
153 Mountings, end
154 Mountings, grid leak
155 Mountings, honeycomb coil
156 Mountings, inductance switch
157 Name plates
158 Neutrodyne set parts
159 Nuts
160 Ohmeters
161 Oscillators
162 Panel cutting and drilling
163 Panels, drilled and undrilled
164 Panels, fibre
165 Panels, hard rubber
166 Parts
167 Paste, soldering
168 Patent attorneys
169 Phone connectors, multiple
170 Phonograph adapters
171 Plates, condenser
172 Plugs, coil
173 Plugs, telephone
174 Pointers, dial and knob
175 Poles, aerial
176 Potentiometers
177 Punching machines
178 Reinartz set parts
179 Regenerative set parts
180 Receiver caps
181 Rectifiers, battery
182 Resistance leaks
183 Resistance units
184 Rheostat bases
185 Rheostat strips
186 Rheostats, automatic
187 Rheostats, battery
188 Rheostats, dial
189 Rheostats, filament
190 Rheostats, potentiometer
191 Rheostats, power
192 Rheostats, vernier
193 Rods, ground
194 Rotors
195 Scrapers, wire
196 Screw drivers
197 Screws
198 Schools, radio
199 Sets, receiving—cabinet
200 Sets, receiving—crystal
201 Sets, receiving—knock-down
202 Sets, receiving—Neutrodyne
203 Sets, receiving—portable
204 Sets, receiving—radio frequency
205 Sets, receiving—reflex
206 Sets, receiving—regenerative
207 Sets, receiving—Reinartz
208 Sets, receiving—sectional
209 Sets, receiving—short wave
210 Sets, receiving—super-regenerative
211 Sets, transmitting
212 Slats
213 Shellac
214 Sliders
215 Socket adapters
216 Sockets
217 Solder
218 Soldering irons, electric
219 Soldering paste
220 Solder flux
221 Solder salts
222 Solder solution
223 Spaghetti tubing
224 Spark coils
225 Spark gaps
226 Stampings
227 Stators
228 Stop points
229 Switch arms
230 Switch levers
231 Switch points
232 Switch stops
233 Switches, aerial
234 Switches, battery
235 Switches, filament
236 Switches, ground
237 Switches, inductance
238 Switches, panel
239 Switches, single and double throw
240 Tone wheels
241 Towers, aerial
242 Transformers, audio frequency
243 Transformers, filament
244 Transformers, modulation
245 Transformers, power
246 Transformers, push-pull
247 Transformers, radio frequency
248 Transformers, variable
249 Transmitters
250 Tubes, vaccuum—peanut
251 Tubes, vacuum—two element
252 Tubes, vacuum—three element
253 Tuners
254 Variocouplers, hard rubber
255 Variocouplers, molded
256 Variocouplers, wooden
257 Variometers, hard rubber
258 Variometers, molded
259 Variometers, wooden
260 Varnish, insulating
261 Voltmeters
262 Washers
263 Wave meters
264 Wave traps
265 Wire, aerial
266 Wire, braided and stranded
267 Wire, copper
268 Wire, insulated
269 Wire, Litz
270 Wire, magnet
271 Wire, platinum
272 Wire, tungsten

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Please see that I am supplied with buying specifications and prices on the articles numbered herewith:

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* *Tested and Approved by* RADIO AGE *

Scientifically Designed I. F. Transformers

IT IS not the purpose of this paper, nor is it possible in the space available, to enter into a theoretical consideration of the ideal characteristics of intermediate frequency inter-stage transformers suitable for use in super-heterodyne receiving systems, but rather to explain the desirable characteristics of such transformers briefly, and to present some designs which have been found most satisfactory, yet simple enough to be constructed by the experimentally inclined radio enthusiast.

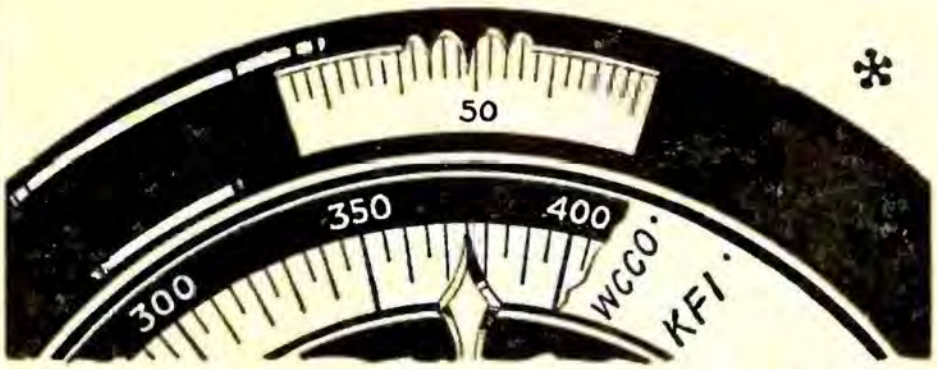
As is well known, a signal received upon a super-heterodyne system at a short wavelength is converted by means of an oscillator and first detector to some longer wavelength, then fed to a sharply tuned amplifier, amplified, and again detected, after which the audio frequency signal may be further amplified. The reason for this change in wavelength is two-fold: Direct radio frequency amplification at short wavelengths is not at all efficient, whereas it may be made extremely so at longer waves between two and ten thousand meters.

The second reason is that an efficient radio frequency amplifier operating at broadcasting wavelengths must have each stage tuned, which would involve from three to six adjustments for a really sensitive receiver (interstage coupling in the amplifier prevents practically building such a really sensitive system) each time it was desired to tune to a different signal. In the super, the amplifier, consisting of several stages, is permanently tuned to one wavelength, and the signal wavelength changed to that of the amplifier by means of but two adjustments—the oscillator and loop circuit controls, regardless of the amount of amplification obtained.

The Requirements

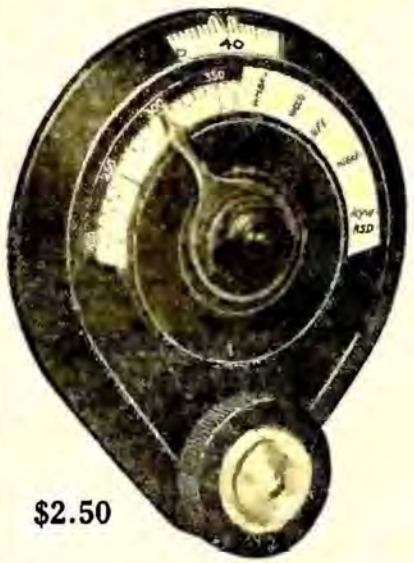
OBVIOUSLY, the ideal interstage transformer must operate at a wavelength long enough to get away from the drawbacks of shortwave amplification, but not long enough so that the amplifier will verge into the audio frequency range and be non-selective. The transformer must give the greatest possible again (amplification) so that a minimum number of stages may be used; it must be entirely stable, and preferably operate with a negative grid potential to be economical of plate current. In its ideal state, the transformer would give uniform amplification over a frequency range of 10,000 cycles (necessary for undistorted speech and music reproduction) yet no amplification of any frequencies outside this range. It must not be so selective as to cut frequencies within this range, and it should be so shielded either by a metal case or an iron core that it will not be affected by strays in the nature of long wave telegraph transmission, etc. This latter consideration necessitates the use of a wavelength not commonly used for telegraph transmission.

(*Turn to page 96*)



Over 500 Stations in U. S.— How Many Do You Get?

The air is fairly crowded with an infinite variety of programs. Yet most listeners rarely hear more than thirty or forty. A good set has the ability to bring in practically all of these stations, *but it takes fine tuning to get them.* Almost impossible with ordinary dials. Slipping, backlashing "Verniers" are little better.



$2.50

Patents Pending

The new "BETTER TUNING" Control, solves the problem. Smooth, easy action without the slightest backlash or lost motion. A vernier device for fractional readings. Turns quickly and easily to that last, fine hairline adjustment.

Works with either right or left turning instruments. Readings in dial numbers and wave lengths or call letters.

Not only makes your set work better but look better.

New B-T Products

The New B-T Inductance, the Toro-style Transformer practically eliminates pick-up, no intercoupling.

The B-T Socket, something new and different. Features you'll appreciate on sight. Write Dept. S for circulars.

BREMER - TULLY MFG. CO.

532 S. Canal St. Chicago, Ill.

MARVELOUS NEW AUDIO TRANSFORMER
adds a musical quality to any set far beyond anything you ever heard before.
KARAS HARMONIK
Amplifies low, middle and high tones—all to the same big volume, thus eliminating distortion. Brings out the vita harmonics and overtones of music. Price $7.00. Write
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WHERE AN AUDIO $3.50 *
Transformer Is Called for in the Blueprint Use
FLINT BEST VALUES GUARANTEED
Transformer
From Your Dealer or Direct.
FLINT RADIO CO.
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BAKELITE KNOBS
Permanently hold their color and finish. Write for Booklet 31. *
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CORRECTION
Our new address is 116-118 So. Wells Street, Chicago. Dealers will please note this change when writing for a copy of our "Salespeaker."
HUDSON-ROSS—116 S. Wells St. Chicago

* *Tested and Approved by* RADIO AGE *

LIFE, LIBERTY
and the Pursuit of
HAPPINESS!

You Won't Have to *Pursue* HAPPINESS

You can have it right at your elbow to while away the time 'til old Lady Static gets off the line!

You'll have no trouble getting station Z-I-F-F-S, because you'll find it is always tuned in to catch your funny bone's wavelength, and is more ticklish to your giggle box than the finest cat whisker!

ZIFFS, ***Badzib's Book of Art and Wit,*** is the only humorous monthly of its kind on the market, and is crammed full of the best artists and funsters in the world!

Exclusive Photo Section! Complete gallery of French-American Art Studies in color! Fifty pages of illustrations! Pep, Ginger, Punch!

ALL FOR TWO BITS!

Pick This Out On Your Piccolo!

Even tho' your set is growling
'Til you think a cat is howling
And the music comes in wailing, hissing sniffs.
You will giggle, grin and chuckle
'Til you hafta loose the buckle
On your belt, if you've the latest book of ***ZIFFS***

You wouldn't go fishing without bait, would you? Well, then, don't try to get Hong Kong on a stormy night with a crystal set, till you've put your John Henry on the tag below:

ZIFFS,
608 South Dearborn,
Chicago, Ill.

Dear Badzib:
I got a radio. I got Hawaii. I got drowned out. I got peeved.
I don't see nothin' to laugh at, you big bum! Here's two bits. Send me the July ZIFFS, and I *will!*

They Call Me.....

And I live at.....

With the Manufacturers

(Continued from page 85)

Brooklyn "Good Will" Trip a Success

Covering 9,021 miles by rail and 2,500 miles by automobile on their "good-will and industry" trip, the Brooklyn Chamber of Commerce made radio history as well as scored travel and industrial honors this year.

Their special train was radio-equipped and with the exception of one day, following the damaging of the apparatus, the members heard broadcasting, in many cases of programs welcoming them to various cities or given otherwise in their honor, throughout the United States and Canada.

The antenna was 60 feet long, on the roof of the observation car, serving a five tube neutrodyne set and an amplifier. In addition, a portable set was carried wherever the party went on auto trips to scenic points.

Eric H. Palmer, of the Freed-Eisemann Radio Corporation, member of the Chamber, made the entire trip, and reported excellent reception on the whole, considering the conditions, particularly of the high-power stations like KDKA, WHT, KGO, KOA, WGN, and WSAI, sometimes when the train was going a mile a minute, with occasional fading on sharp turns and marked fading in tunnels and when crossing steel bridges.

Palmer took his set into the Grand Canyon, to the top of Pike's Peak, into Yosemite Valley, besides Lake Louise and on the snow-covered mountains of the Canadian Rockies, among Indian pueblos of the Southwest, on the shores of the Pacific Ocean, and along the auto roads of California, never failing to receive music from the ether.

Double Service Tube on the Market

A tube with double service is announced by the Van Horne Co., at Franklin, Ohio, this concern being the manufacturers of the Van Horne Selected and Musselman Certified radio tubes.

The new tube is known as the 3V-A radio tube and is adaptable either to dry cell or storage battery operation. It has the same structural principle as the 5V-A, which is patterned after the conventional 201-A. It consumes one quarter of the current of a 201-A.

The 5V-A tube is of the 5 volt type with a current consumption of one quarter of an ampere, while the 3V-A takes three volts and consumes one tenth of an ampere. The mutual conductance on the 3V-A's is 500 micro-mhos; the plate flow 3.8 milliamperes to 5 milliamperes and the amplification 6.5.

With each of the certified tubes sold, Musselman furnishes a characteristic curve of the tube itself, a scheme which is rapidly finding favor with the radio public. Thus you have matched transformers and then matched tubes. The characteristic curve on each tube enables you to determine its ability to perform in different parts of the circuit, and saves the trouble of having to have a curve drawn on all your tubes.

Voices of the World to Be at "World's Fair"

NEW YORK—Plans now afoot by leading broadcasting interests in the United States, who will exhibit at the Fourth Annual National Radio Exposition, opening in Grand Central Palace, New York, September 12, will create in the Exposition auditorium a new tower of Babel in which the voices of the world will be received by radio, according to an announcement by Harold Bolster and J. C. Johnson, directors of the Exposition.

Through the broadcasting studios and receiving station to be set up in Grand Central Palace during Exposition Week, probably London, Paris and Berlin will be "plugged in," through high power transmission, and the first exchange of international concerts, it is expected, will take place on the opening night. Dispatches from Berlin, reflecting the great public interest created in Germany by the announcement that an agreement had been concluded between wireless interests in that country and America for an exchange of radio concerts, are confirmed by exhibitors at the Fourth Annual National Radio Exposition. Technical experiments, it is added, will begin almost immediately, and by September the regular exchange of concerts should be in force.

The present outlook is that the American radio fan will be greeted at the Exposition in at least four different languages from as many parts of the world. On the other hand, the messages delivered through the microphone in Grand Central Palace by leading figures in American public and industrial life, will be heard in millions of homes across the Atlantic.

Radio interests representing an annual business of over $300,000,000 will exhibit at the Fourth Annual National Radio Exhibition. So complete and elaborate are the exhibits to be offered this year to the radio trade and the radio public that the third floor of the Grand Central Palace has had to be opened for the Exposition, in addition to the ground and mezzanine floors. Nor is public interest less keen. Reservations already had been received for over 50,000 tickets from large industrial organizations, national institutions and dealers throughout the country.

An Antenna Support for City Dwellers

An attractive antenna support for the use of cliff dwellers in the city who desire that radio shall be as unobtrusive as possible, has been designed and marketed by the Jife Support Co., at 5568 West Van Buren St., Chicago, Ill.

The device consists of a wire spring clamp which encircles a small porcelain insulator. The clamp is slipped onto picture moulding; the wire which is to be strung up inside the house is passed through the insulator held by the spring and the job is complete.

* *Tested and Approved by* RADIO AGE *

James F. Kerr, Noted Showman, Dies

It is with profound regret that we announce to the radio industry the untimely death of James F. Kerr, general manager of the Radio World's Fair and nationally known showman.

Mr. Kerr's sudden demise will in no way alter the policy and activities of the Second Radio World's Fair and the Fourth Annual Chicago Radio Show, it has been announced. U. J. Herrmann, Managing Director of both shows, and closely identified in their management, welfare and success in the past, will continue to carry them on with the same degree of perfection as attained at previous shows.

Mr. Herrmann was to have sailed with the Donald B. McMillan Expedition from Boston on June 17th, but has now cut short his trip in order to devote his undivided attention to the direction of the forthcoming Second Radio World's Fair and the Fourth Annual Chicago Radio Show.

Brandes Broadens Line

Since 1908 Brandes have been specializing in radio acoustics and their laboratories have been constantly striving to improve the audio circuit of the radio receiving set because it, in the final analysis, determines the quality of the reception. This work has resulted in the following new additions to their line:

A new audio transformer which amplifies without distortion frequencies from 200 to 4000 cycles per second with the high voltage amplification ratio of 1 to 5. It is so designed that two stages of amplification may be employed without sacrificing quality of reproduction. It is provided with outside soldering terminal connections, screw mounting base, and is completely shielded.

Announced also is a new horn speaker (Type H), which is somewhat larger than their Table-Talker and gives much greater volume. This speaker has laminated pole pieces which increase its magnetic efficiency, and, in turn, increase its volume.

"THE TUBE WITH A PEDIGREE"

THERE is only one way to measure the value of a radio tube, regardless of who made it, and that is by the characteristic curve reading. In this way, and no other, can its value as a tube be determined in advance. All MUSSELMAN TUBES have a characteristic curve slip inclosed at the factory and certified when the readings are above the standard set by leading radio engineers as to what constitutes an unusually good tube.

Jobbers, manufacturers, and dealers are invited to write for details as to sales franchise.

Manufactured by
The Van Horne Co., Franklin, Ohio
SALES OFFICE
A. J. MUSSELMAN
601-C Machinery Hall - CHICAGO

French Battery Reorganized

A refinancing plan, whereby the French Battery Company at Madison, Wisconsin, will be able to greatly increase the output of that plant, has been announced by officials of the company. At a stockholders' meeting recently, it was decided to increase the preferred stock.

The reorganization plan which makes the Madison concern one of the largest manufacturers of dry batteries and flashlights in the United States does not involve any changes in personnel.

In view of the fact that the company has decided to intensify on the production of dry batteries and flashlights, the directors voted to drop the word "Carbon" from the name of the company, giving the firm the new title of "The French Battery Company."

"Arctic" to Pierce North for Canada

New Arctic radio transmission records undoubtedly will be established when the Canadian Government ship "Arctic" enters the polar regions on her annual trip this Summer. The vessel will be equipped with a transmitting set especially designed to keep the Canadian Government posted on her movements in the land of the midnight sun. The Arctic will leave Quebec about June 27.

The vessel holds the present record for receiving and transmitting radio messages from the point nearest the North Pole. The Canadian Government is preparing to start the ship off on her voyage somewhat earlier this year, in order to pierce farther into the Arctic ice field than it did in 1924. The staunch ship, built especially for Arctic travel, is being reinforced on bow and stern with heavy steel plates to fight its way through the ice to a point farther north than it has been able to penetrate most of the 20 years it has been making annual pilgrimages to the Arctic circle.

Last year the vessel continuously received messages from the Canadian government transmitted from Station KDKA, on the short wave, and established the "farthest north" reception record when a message from KDKA was received at Cape Sabine, north of Peary's winter base at Etah, and within 11 degrees of the north pole.

Not all the reply messages sent from the vessel to the Canadian government were received, however, and in order to insure uninterrupted two way transmission this year, Commander C. P. Edwards, director of radio service of the Canadian Department of Marine and fisheries, in collaboration with C. W. Horn, superintendent of radio operations of the Westinghouse Company and the KDKA engineers, is having a more powerful set built for the vessel this year.

William L. Sayre Joins H. H. Eby Co.

The H. H. Eby Manufacturing Company of Philadelphia, well known makers of quality binding posts, recently acquired the services of William L. Sayre, who has been identified with radio interests for the past fifteen years.

Mr. Sayre was made an associate of the Institute of Radio Engineers in 1914 and later of the American Institute of Electrical Engineers. His earlier training under able physicists, coupled with his later practical radio and merchandising experience, will enable the Eby organization to offer further aid to its many manufacturing and distributing customers upon whom Mr. Sayre will call after a time spent at the factory.

SM SUPER PARTS

Entirely silver-plated! And a new standard has been set for low-loss condensers! It is only logical that the new Silver-Marshall S-L-W Condensers should be the first to be so built. Their losses are lower than many laboratory standards—their mechanical design unique and original. The S-L-W plates mean *real* selectivity and station separation.

No. 305	.0005	$6.00
No. 306	.00035	5.75
No. 307	.00025	5.50

S-M Type 210 and 211 Transformers

S-M 210 and 211 transformers are known as the finest intermediate transformers ever made. They were an important feature of the receiver built entirely of S-M parts, that took the grand sweepstake prize at the recent Los Angeles Radio Show. Price, each.....$8.00

Send 4c in stamps for Free Circulars of S-M Products, and reprints of article from Radio Broadcast, describing the remarkable new Super-Autodyne Receiver.

Silver-Marshall, Inc.
114 S. Wabash Ave.
Chicago, Illinois

Burns *

Perfect Reproducer
Tone loud and pleasing.
Handsome material and design.
Black, $22.50 Shell, $25.00
Mother-of-Pearl.....$30.00
Makers
AMERICAN ELECTRIC COMPANY
State and 64th Sts., Chicago

Are you ready for the big season that starts in the Fall? Order your September RADIO AGE NOW!

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The Jewell Radio Test Set

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¶ Manufacturers, Experimenters, Jobbers and Dealers all over the world are using it. This set is Jewell's outstanding contribution to Radio.

Price $75.00

Send for Complete Circular

Order from Dealer

Jewell Electrical Instrument Co.

1650 Walnut St., - Chicago

"25 Years Making Good Instruments"

Brainard Foote Analyzes Tuning Tricks

(Continued from page 10)

tributed capacity. Then, to bring KSD near to 95 on the dial, it was necessary to remove five of the rotor plates. The condenser is then really only a 15 plate instrument, because the fixed plates corresponding to the removed rotor plates are "dead" too. Thus the capacity is reduced to about 7-12 of its former value, or about .0003 mfds. Two marked improvements result from this:

1. The inductance to capacity ratio is much higher than it was, meaning louder signals.

2. The tuning scale is evenly distributed over the entire scale, meaning just as good selectivity with much easier tuning.

Thus one of the chief gains made by using a coil having low distributed capacity, even with the basket-wound type, is the greater wavelength range possible with a given variable condenser. It must be understood that more wire is needed, and because of the fact that added wire means added resistance, some might think the spaced system a disadvantage. However, the use of a higher inductance - to - capacity - ratio throughout the scale more than offsets the slight increase in wire resistance.

A set adjusted to tune in this fashion, especially if the condenser be one of straight-line wavelength, as in Fig. 2, where each degree represents a certain number of meters (usually 3½ to 4½ meters) is a pleasure to operate. To keep it smooth-running, the antenna absorption must not interfere on short waves, on account of the natural period of the antenna system.

Antenna Natural

IN THE case of a long and high aerial, the natural wavelength may lie near 200 meters or above it, including the antenna coupling coil of the set. Hence, the coupling coil should have a tap on it, so that only 4 or 5 turns are used for short wave coupling. The antenna natural interferes with regeneration and the set usually will not oscillate over 4 or 5 degrees near its lower scale in case the antenna natural is too high. When the natural can't be reduced by using fewer turns in the coupling coil, a small series condenser is advised, .00025 to .0005 mfds. capacity.

The circuit given in Fig. 3 shows how the regular three-circuit tuner outfit can be rearranged along the lines of this article. In addition, the method of regeneration does not interfere with the tuning to any noticeable extent, the two controls being independent of each other. The secondary is the space-wound coil about 4 inches in diameter and having about 60 turns, or any number necessary to place the shortest wavelength at 200 meters. The wire ought to be about No. 18 in size, although no smaller than No. 22. The tickler is a coil having about 15 turns wound on a 3-inch tubing and placed inside the secondary at the filament end. The primary is about ten turns, wound on the same tubing as the secondary and at the filament end.

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With Tone,

Clearness and Volume?

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ORIOLE

5-TUBE MODEL 7

Fills the Bill

Jobbers and Dealers Write for Exclusive Appointments

W-K ELECTRIC CO.

KENOSHA, WISCONSIN

The tickler, while fixed in position, must be tried reversed in case its direction is wrong for oscillation. If wound in the same direction as the secondary, the end away from the grid goes to the regeneration condenser.

The headphones or primary of the audio transformer act as a radio frequency choke coil, so that the R. F. choke coil often specified at point X isn't needed for broadcast waves. Care must be taken not to use a fixed condenser across the phones or transformer primary, however. There should be no more turns than necessary on the tickler to secure regeneration, for with too many turns the range of the regeneration condenser will be constricted and it will be hard to adjust the tube to the "edge" of oscillation, just as it is when the usual type of tickler is too big. If the tube oscillates with only 10 turns on it, so much the better.

Deciding on a Portable Super-Het

(Continued from page 14)

will be proportionately, due to the elimination of reaction, etc., which is bound to occur to a varying extent in every amplifier. With the transformers used in the portable super, two stages will get down to the noise level under average conditions. The question then arises as to why we whould use three stages when we obtain the same results with two, and save a tube and batteries. The average fan's answer is "greater sensitivity" but he forgets entirely the noise level and the fact that more than a given value of sensitivity, assuming for a moment that it would result from the use of a third stage, is worse than useless.

There is no question but that a novice can assembly a two-stage audio amplifier and make it work perfectly. Yet the same man will have great difficulty assembling a comparatively high frequency RF amplifier. The same conditions hold in an intermediate amplifier and the number of successful supers that have been built using iron-core transformers indicate they are far the easiest to build in actual practice. Where only two stages are used, the efficiency per stage is increased over a three-stage amplifier, the possibility of trouble in the amplifier decreases 25 per cent; and a tube, its socket, a transformer and some wiring are eliminated. This is a decided advantage.

From the foregoing it is evident that on the counts of amplification and current consumption, the iron-core transformer is far superior to the air-core system, even when the latter is built in the form of a tuned neutrodyned system. From the novice standpoint, the additional stability and ease of assembly put the iron-core system far ahead of the high frequency amplifier.

It will be seen, then, that the choice of transformers is important, affecting as it does the operation of the entire super. Transformers that are tested and matched as to curves and peaks, in careful laboratory tests, are the best for portable supers, for they eliminate all possibility

JEFFERSON TRANSFORMERS

Two Popular Types of Jefferson Transformers

Living tones of music and song, drawn into the "mikes" for your entertainment, get the reproduction they deserve with Jefferson Radio Transformers as part of your set. The extraordinarily accurate amplification afforded by Jefferson Transformers brings in to you the music from the air as you would hear it in the studio. Jefferson Transformers give their best, just as the artist does.

It takes pains—and brains—to make fine transformers. Our recipe for leadership in the field is simple: We devote all our time and manufacturing experience to transformers and coils.

A good set demands Jefferson Transformers to make it better. Good dealers sell them.

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Makers of Radio Tube Rejuvenators, Radio Transformers, Bell-Ringing Transformers, Sign-Lighting Transformers, Automobile Ignition Coils, Jump Spark — Make and Break Coils, Auto Transformers, Testing Instruments, Toy Transformers, Furnace and Oil Burner Transformers, Oil Burner Ignition Coils.

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Select Station at Will Cut out interference and undesired stations. Tune in loud and clear. Results amazing with any make tube or crystal set using any kind of aerial except loop antenna.

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Better reception or your money refunded. Bank guarantee. Assembled complete; attach to aerial in two minutes. No tools. Doesn't disturb present log. No additional tubes or batteries. and enjoy "Summer time" reception—get the station you want—do away with interference. Complete Radio literature FREE.

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DEALERS—JOBBERS. Write for discriptive literature and prices Steinite Nationally known popular price Radio Sets.

Plenty of Surprises in the September Radio Age!

of guesswork and danger of poor operation after you have transported your set a few hundred miles from civilization and radio stores.

A fan who takes a portable super on his vacation does not want to fuss with several imposing controls before he finally "lands" a station. Sometimes, under the screen of night and in the absence of suitable illumination, he will find it impossible to be aware of what he is doing if he has to tinker with six or eight adjustments before actually beginning to perceive results. If a portable super is to be efficient, it must be easy to tune. Two tuning controls, one for each hand, and not more than two other adjustments for filament and volume control, are easy to remember and easy to handle. The day of the complicated super is over, and a portable super that is not easy to operate had better be left at home for the expert to experiment with.

In installing a portable super in a traveling cabinet or suitcase, many fans become obsessed by a desire to either put too much into the set or to so crowd the parts in a "freakish" way that the set should be relegated to a museum as an oddity and not assumed to be an assembly of efficient apparatus that will really produce coast-to-coast results.

For portable use, the type "199" tubes are acknowledged the most convenient, and their difference in volume and battery drain as compared with the larger tubes is negligible. Small tubes can be so mounted in a portable super, on a 7 inch by 18 inch panel, that transformers and other parts can be mounted underneath the tube sockets and put out of the way. For general compactness, it has been found that seven tubes fit most satisfactorily in a 7 inch x 18 inch layout, as well as being the best from a strictly mechanical standpoint.

The parts used must also be durable. Many fragile radio parts are now on the market, and they are suitable for the elaborate home models for which they were constructed. But for outdoor use they will not stand up under the ravages of the weather. Carefully covered parts that will withstand inclement conditions, as well as the corroding elements of the atmosphere, should be used. Not all the burden should be put on the parts, however; the outer case or cabinet must be covered with a weatherproof paint or leather covering, or a like material, that will thrive under Nature's punishment. A portable set cannot be expected to be kept indoors during its actual use, so its construction should be carried out with a view to making it durable against weather as well as the hardships of walking or automobile travel.

The accompanying photograph shows how a cabinet can be utilized to hold the receiver itself, the lower part of the case being used for the batteries, all of which are of the dry cell type. The "A" batteries, placed in the order shown, stop the "B" and "C" batteries, take up the least possible room and take the curse from the load usually caused by the current supply. Such an outfit will weigh about 30 pounds, which is about as light as can be expected of a complete portable set.

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While Big Local Stations Are Broadcasting, The New York Evening World got 46 stations in *One Evening* including Dallas, Los Angeles, and Porto Rico; while testing the wonderful sensitivity of the

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parts and sets are always featured in our Salespeaker. If you are a live-wire dealer, write for your copy, now.

HUDSON-ROSS—116 S. Wells St.
Chicago

Causes of Variation in DX Results

(Continued from page 16)

causing a maximum disturbance at that time.

Lightning discharges also cause a great amount of noise in a receiving set, especially during the summer, when electric storms are frequent and most severe. It is surprising to many when they learn that these disturbances are not usually heard over distances greater than 100 miles. These disturbances cause sharp clicks of considerable intensity in the receiver.

Another condition which is often found to be very annoying is fading. Many theories have been advanced regarding the causes of fading, but the latest information upon the subject seems to indicate that it is largely a matter of interference between direct waves and waves that have been reflected from the Heaviside layer, which is a layer of ionised air in the upper strata of the earth's atmosphere. This ionised air has the peculiar property of reflecting radio waves in a manner which might be compared to a mirror reflecting a beam of light.

Sketch 3 illustrates how both the direct and reflected waves travel from the transmitter to the receiver. It is evident that the reflected wave travels much farther than the direct wave and is therefore subject to being out of phase with the latter wave. As the height of the Heaviside layer varies, the phase relation will change, thereby changing the extent to which the two waves aid or oppose each other. It is possible for the two waves to entirely neutralize each other, causing the signal to disappear entirely, or they may aid each other and cause an abnormally loud signal in the receiver. Exhaustive tests have proven that barometric pressures also affect signal intensity and sometimes cause fading.

MARVELOUS NEW AUDIO TRANSFORMER
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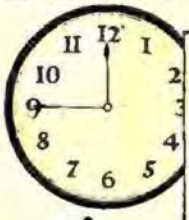
REBUILD YOUR NEUT—Use same panel, same parts. No neutralization. 22 feet gold wire, only extra part, circuit and complete, simple instructions—$5.00 prepaid. Hundreds of Neut owners use this kit. Details—10c. 48 page catalog parts—10c. Stamps accepted. KLADAG RADIO LABORATORIES, KENT, O.

In our July issue, in reporting tests on the Wet "B" batteries furnished the RADIO AGE Institute by the Kelman Electric Co., at Rochester, N. Y., inadvertently it was stated the jars were housed in a wood container. RADIO AGE is glad at this time to learn its error and to state the container is made of solid rubber, since obviously wood would not last long as a container for lead plate batteries.

Build this phenomenal new radio *in 45 minutes*



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Price $49.50

This new type kit is factory assembled. Ready cut, flexible, solderless leads make it ridiculously easy to wire. Amazing new inductance principle brings results hardly thought possible. Send for book, *Better Radio Reception.*

NOW anyone can build the finest of receivers in only a few minutes. No more wire bending or soldering. Merely attach a few ready cut, flexible eyeletted leads and the job is done. The finished set is unsurpassed even by the costliest factory-built receiver.

But most amazing is the new inductance principle incorporated in this last word in kits—called the Erla Circloid principle of amplification.

Four vital improvements result from this great discovery, which are not found in ordinary sets.

1. ***Greater Distance:*** Erla *Balloon *Circloids have no external field, consequently do not affect adjacent coils or wiring circuits. This enables concentration of proportionately higher amplification in each stage, with materially increased sensitivity and range.

2. ***More Volume:*** Increased radio frequency amplification made possible by Erla Balloon Circloids gives concert volume to distant signals inaudible with receivers of conventional type.

3. ***Increased Selectivity:*** Erla Balloon Circloids have no pick-up quality of their own. Hence only signals flowing in the antenna circuit are amplified. Static is greatly reduced for this reason.

4. ***Improved Tone Quality:*** The self-enclosed field of Erla Balloon Circloids eliminates stray feed-backs between coils and consequently does away with mushing of signals and distortion. Tone is crystal clear and perfectly lifelike.

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COMING IN SEPTEMBER—

—An unusual bunch of surprises that the Editors of RADIO AGE have been saving for you all Summer. First, John B. Rathbun, the "Man Who Makes the Blueprints," will have an exhaustive article on "Thirty-Two Ways to Prevent Oscillations." That in itself ought to hold you for a while. Then such radio experts as Roscoe Bundy, H. Frank Hopkins, Frank D. Pearne, Armstrong Perry and Brainard Foote will reveal their new developments for the coming season. Are you ready? September issue out August 15!

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And in addition it will help increase selectivity, tune out local stations, sharpen signals, remove noises, lessen interference and prevent re-radiation!

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Our offer of the Telmaco P-1 Receiver in kit form has met with enthusiastic reception. This contains all parts, as built by us, including case, drilled and engraved panel, and illustrated instructions. $80.00
Complete kit . . . .
Ask your dealer or write us. Descriptive folder free.

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Lakeside Supply Co.
73 W. Van Buren St., Chicago

Solving the Question of I. F. Transformers

(*Continued from page 89*)

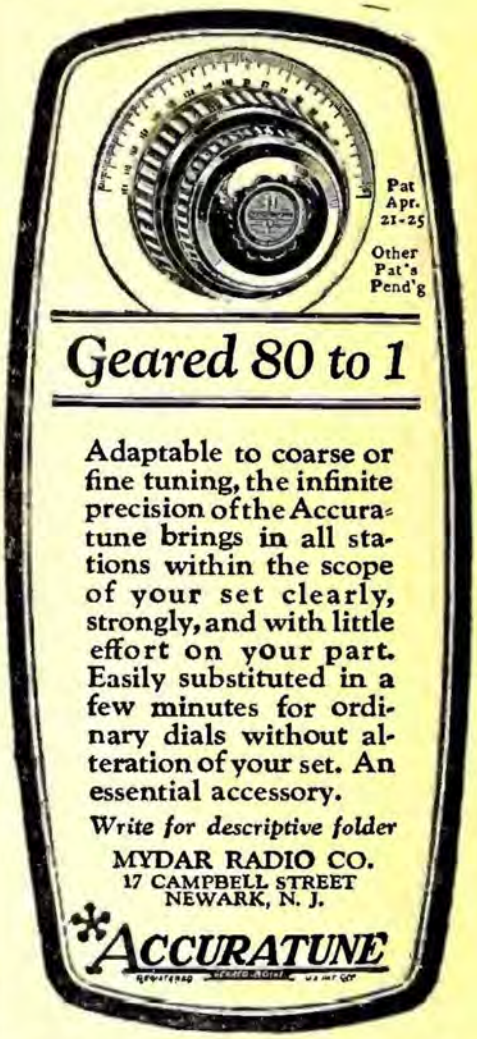
It is commonly accepted that a wavelength in the neighborhood of five to seven thousand meters is most satisfactory, preference being given to 5,000 meters, since transformers may be made more selective at this wave than at the longer ones. Obviously, a transformer wound with a large low-loss air-core coils, tuned by a low-loss condenser, would give maximum gain. Actually, it would be so sharp as to cut side-bands, and would have a terrific field, resulting in instability and inability to use more than one or two such coils. The next step is an air core transformer with smaller coils of higher resistance. However, the same troubles prevail in a lesser degree until we resort to an iron core, which limits the transformer field, broadens the curve to the desired width, and reduces amplification. If we go further, and use a large iron core, we get a nice flat curve, wonderful reproduction, no selectivity, and no gain. It is obvious again that we must resort to a compromise, and if this paper has brought out this single point, the writer feels amply repaid, for it may be said that the necessity for compromise between desirable theoretical extremes is an axiom of radio equipment engineers.

Looking at the curves of Figure 1, we see A, B, C and D. "A" represents the ideal transformer, giving infinite amplification over a 10,000 cycle band, yet at no other frequencies. "B" is an air-core transformer giving the highest possible amplification. It is useless, since it will not pass music and speech, and is subject to the physical limitations previously set forth. "C" is the practical ideal transformer, passing the desired frequency band with a gain variation insufficient to cause distortion, yet with a limited field and good stability. "D" is the extreme for perfect reproduction—but gives no selectivity and no amplification to speak of.

Construction Details

SUPPOSE we wish to construct "C", which is the best transformer we can build practically. We will require a bobbin turned out of wood or built up of fibre, together with two pieces of core iron as shown in Figure 2. This bobbin is wound with 1,400 turns of No. 36 SSE in the smaller slot for the primary, and 3300 turns of the same wire in the larger slot for the secondary. The core is put in so that the air-gap comes under the larger or secondary coil, and the ends of the laminations are bent over each other to hold them together. This transformer may be placed in a small metal can, with leads brought out as desired. It should first be boiled in a resin-bees-wax compound, with which the can should be filled.

This transformer, while selective, may best be used in conjunction with another type, which would be a compromise between "B" and "C".



Geared 80 to 1

Adaptable to coarse or fine tuning, the infinite precision of the Accuratune brings in all stations within the scope of your set clearly, strongly, and with little effort on your part. Easily substituted in a few minutes for ordinary dials without alteration of your set. An essential accessory.

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6Volt, 13 Plate,	11.50	6Volt, 120 Amp.	11.50
12Volt, 7 Plate,	13.00	6Volt, 140 Amp.	13.00

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HUDSON-ROSS—116 S. Wells St.
Chicago

This latter transformer may be built by turning out a wood spool. In the bottom of the slot are wound 250 turns of No. 30 DSC wire. On top are wound 1,500 turns of No. 36 DSC wire, forming the secondary. This coil has an air core, and cuts side bands slightly. Using but one, this is not noticeable, but the use of two or three would be out of the question for reasons outlined above, in addition to this latter one.

Now that we have these transformers, we cannot use them unless they are properly matched. Such a step will insure co-ordinate operation at all times.

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Radio Age,
500 N. Dearborn St., Chicago, Ill.

Corrected List of Broadcasting Stations

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh, Pa.	309
KDLR	Radio Electric Co.	Devils Lake, N. D.	231
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDYL	Newhouse Hotel	Salt Lake City, Utah	250
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZI	Electric Supply Co.	Wenatchee, Wash.	380
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	273
KFAE	State College of Washington	Pullman, Wash.	348
KFAF	Western Radio Corporation	Denver, Colo.	278
KFAJ	University of Colorado	Boulder, Colo.	360
KFAN	University of Idaho	Moscow, Idaho	230
KFAU	Boise High School	Boise, Idaho	271
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Aebill	San Diego, Calif.	278
KFBG	First Presbyterian Church	Tacoma, Wash.	250
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Lease Bros.	Everett, Wash.	224
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCF	Frank A. Moore	Walla Walla, Wash.	258
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tucson, Ariz.	388
KFDJ	Oregon Agricultural College	Corvallis, Ores.	254
KFDM	Magnolia Petroleum Co.	Beaumont, Texas	318
KFDX	First Baptist Church	Shreveport, La.	380
KFDY	South Dakota State College	Brookings, S. Dak.	380
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank Co.	Portland, Ores.	248
KFEK	Augsbury Seminary	Minneapolis, Minn.	281
KFEL	Winner Radio Corp.	Denver, Colo.	254
KFEQ	J. L. Scroggin	Oak, Nebr.	288
KFER	Auto Electric Service Co.	Fort Dodge, Iowa	231
KFEY	Bunker Hill & Sullivan Mining and Concentrating Co.	Kellogg, Idaho	233
KFFP	First Baptist Church	Moberly, Mo.	28
KFFV	Graceland College	Lamoni, Iowa	280
KFGB	Heldbreder Radio Supply Co.	Utica, Neb.	224
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	273
KFGQ	Crary Hardware Co.	Boone, Iowa	228
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHH	Ambrose A. McCue	Neah Bay, Wash.	281
KFHL	Penn College	Oskaloosa, Iowa	240
KFI	E. C. Anthony, Inc.	Los Angeles, Calif.	468
KFIF	Benson Polytechnic Institute	Portland, Ores.	248
KFIO	North Central High School	Spokane, Wash.	252
KFIQ	First Methodist Church	Yakima, Wash.	242
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	228
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huseman	Fond du Lac, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	R. B. Fegan (Episcopal Church)	Junction City, Kansas	219
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Ores.	252
KFJL	Hardsaeg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	280
KFJR	Ashley C. Dixon & Son	Stevensville, Mont.	258
KFJX	Iowa State Teacher's College	Cedar Falls, Iowa	280
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	248
KFJZ	W. E. Branch	Fort Worth, Texas	254
KFKA	Colorado State Teachers College	Greeley, Colo.	273
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	250
KFKU	The University of Kansas	Lawrence, Kans.	275
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	288
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLP	Everett M. Foster	Cedar Rapids, Ia.	258
KFLR	University of New Mexico	Albuquerque, New Mexico	254
KFLU	Rio Grande Radio Supply House	San Benito, Texas	238
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLX	George Roy Clough	Galveston, Texas	240
KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273
KFMB	Christian Churches	Little Rock, Ark.	254
KFMQ	University of Akransas	Fayetteville, Ark.	299
KFMR	Morningside College	Sioux City, Iowa	261
KFMT	Dr. George W. Young	Minneapolis, Minn.	231
KFMW	M. O. Sateren	Houghton, Mich.	288
KFMX	Carleton College	Northfield, Minn.	338
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	268
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
KFNV	L. A. Drake Battery and Radio Supply Shop	Santa Rosa, Calif.	234
KFOA	Rhodes Department Store	Seattle, Wash.	454
KFOC	First Christian Church	Whittier, Calif.	238
KFOJ	Moberly High School Radio Club	Moberly, Missouri	248
KFOL	Lealle M. Schafhuth	Marengo, Iowa	234
KFON	Echophone Radio Shop	Long Beach, Calif.	234
KFOO	Latter Day Saints University	Salt Lake City, Utah	261
KFOP	Rohrer Elec. Co.	Marshfield, Ore.	240
KFOR	David City Tire & Electric Co.	David City, Nebraska	228
KFOT	College Hill Radio Club	Wichita, Kansas	231
KFOX	Board of Education, Technical High School	Omaha, Nebraska	248
KFOY	Beacon Radio Service	St. Paul, Minn.	228
KFPG	Garretson and Dennis	Los Angeles, Calif.	238
KFPL	C. C. Baxter	Dublin, Texas	242
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPR	Los Angeles Co. Forestry Dept.	Los Angeles, Calif.	231
KFPT	Cane & Johnson	Salt Lake City, Utah	288
KFPV	Heints & Kohlmoos, Inc.	San Francisco, Calif.	238
KFPW	St. Johns M. E. Church	Carterville, Mo.	288
KFPY	Symons Investment Co.	Spokane, Wash.	283
KFQA	The Principia	St. Louis, Mo.	284
KFQB	The Searchlight Publishing Co.	Fort Worth, Texas	221
KFQC	Kidd Brothers Radio Shop	Taft, Calif.	258
KFQH	Radio Service Co.	Burlingame, Calif.	231
KFQP	G. S. Carson, Jr.	Iowa City, Ia.	284
KFQR	Walter LaFayette Ellis	Oklahoma City, Okla.	220
KFQT	Texas National Guard	Denison, Texas	252
KFQU	W. Riker	Holy City, Calif.	253
KFQW	C. F. Knierim	North Bend, Wash.	248
KFQY	Farmers State Bank	Belden, Neb.	273
KFQZ	Taft Radio Co.	Hollywood, Calif.	240
KFRC	City of Paris Dry Goods Co.	San Francisco, Calif.	268
KFRM	James F. Boland	Fort Sill, Okla.	283
KFRU	Ethereal Radio Co.	Bristow, Okla.	394
KFRW	United Churches of Olympia	Olympia, Wash.	220
KFRX	J. Gordon Klemgard	Pullman, Wash.	217
KFRZ	The Electric Shop	Hartington, Neb.	222
KFSG	Angelus Temple	Los Angeles, Calif.	272
KFSY	The Van Blaricom Co.	Helena, Mont.	281
KFUJ	Hopper Plumbing and Heating Co.	Breckenridge, Minn.	242
KFUL	Thomas Goggan & Bros. Music Co.	Galveston, Texas	258
KFUM	W. D. Corley	Colorado Springs, Colo.	242
KFUO	Concordia Seminary	St. Louis, Mo.	549
KFUP	Fitzsimmons General Hospital	Denver, Colo.	234
KFUQ	Julius Brunton and Sons Co.	San Francisco, Calif.	234
KFUR	H. W. Peery and C. Redfield	Ogden, Utah	224
KFUS	Louis L. Sherman	Oakland, Calif.	233
KFUT	University of Utah	Salt Lake City, Utah	271
KFUU	Coburn Radio Labs.	San Leandro, Calif.	231
KFUY	Irvine M. Bouchard	Butte, Mont.	284
KFUZ	Y. M. C. A.	Virginia, Minn.	244
KFVC	Bansberg's Music Co.	Camden, Arkansas	248
KFVD	McWhinnie Electric Co.	San Pedro, Calif.	202
KFVE	Film Corporation of America	St. Louis, Mo.	245
KFVF	Clarence B. Juneau	Hollywood, Calif.	208
KFVG	First M. E. Church	Independence, Kansas	238
KFVH	Whan Radio Shop (Herbert Whan)	Manhattan, Kansas	218
KFVI	Headquarters Troop, 56th Cavalry	Houston, Texas	248
KFVJ	First Baptist Church	San Jose, Calif.	228
KFVK	Sacramento Chamber of Commerce	Sacramento, Calif.	248
KFVL	Lt. Richard F. Lussier, 5th Inf. U. S. A.,	Vancouver Barracks, Vancouver, Wash.	231
KFVN	Carl E. Bagley	Welcome, Minn.	227
KFVG	F. M. Henry	Kirksville, Mo.	228
KFVR	Moonlight Ranch	Route 6, Denver, Colo.	248
KFVS	Cape Girardeau Battery Station	Cape Girardeau, Mo.	224
KFVY	Radio Supply Co.	Albuquerque, N. M.	250
KFVZ	Glad Tidings Tabernacle	San Francisco, Calif.	234
KFWA	Browning Bros. Co.	Ogden, Utah	214
KFWB	Warner Bros.	Hollywood, Calif.	252
KFWD	Arkansas Light & Power Co.	Arkadelphia, Arkansas	288
KFWH	F. Wellington Morse, Jr.	Chico, Calif.	254
KFWI	Radio Entertainments, Inc.,	South San Francisco, Calif.	220
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGG	General Electric Co.	Oakland, Calif.	381
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach	370
KGW	Portland Morning Oregonian	Portland, Oreg.	491
KGY	St. Martins College (Reb. Sebastian Ruth)	Lacy, Wash.	253
KHJ	Times-Mirror Co.	Los Angeles, Calif.	405
KHQ	Louis Wasmer	Seattle, Wash.	273
KJR	Northwest Radio Service Co.	Seattle, Wash.	384
KJS	Bible Institute of Los Angeles, Inc.	Los Angeles, Calif.	293
KLDS	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	441
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	242
KLX	Tribune Publishing Co.	Oakland, Calif.	508
KLZ	Reynolds Radio Co.	Denver, Colo.	283
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	243
KMO	Love Electric Co.	Tacoma, Wash.	250
KNX	Los Angeles Evening Express	Los Angeles, Calif.	337
KOA	General Electric Co.	Denver, Colo.	323
KOB	New Mexico College of Agriculture & Mechanic Arts,	State College, N. Mex.	348
KOP	Detroit Police Department	Detroit, Mich.	286
KPG	Hale Bros.	San Francisco, Calif.	428
KPPC	Pasadena Presbyterian Church	Pasadena, Calif.	229
KPRC	Houston Post-Dispatch	Houston, Texas	270
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	270
KQW	Charles D. Herrold	San Jose, Calif.	228
KRE	V. C. Battery & Electric Co.	Berkeley, Calif.	275
KSAC	Kansas State Agricultural College	Manhattan, Kans.	341
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo.	545
KSL	Radio Service Corp. of Utah	Salt Lake City, Utah	299
KTCL	American Radio Telephone Co., Inc.	Seattle, Wash.	308
KTHS	New Arlington Hotel Co.	Hot Springs, Ark.	375
KTW	First Presbyterian Church	Seattle, Wash.	455
KUG	Examiner Printing Co.	San Francisco, Calif.	248
KUGM	State University of Montana	Missoula, Montana	244
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	248
KWKC	Wilson Duncan Studios	Kansas City, Mo.	238
KWWG	City of Brownsville	Brownsville, Texas	278
KYO	Electric Shop	Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	535
KZM	Preston D. Allen	Oakland, Calif.	242
WAAB	Valdemar Jeosen	New Orleans, La.	283
WAAC	Tulane University	New Orleans La.	278
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	248
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	288
WAAM	I. R. Nelson Co.	Newark, N. J.	283
WAAW	Omaha Grain Exchange	Omaha, Nebr.	285
WABA	Lake Forest University	Lake Forest, Ill.,	227
WABB	Harrisburg Sporting Goods Co.	Harrisburg, Pa.	288
WABC	Asheville Battery Co., Inc.	Asheville, N. C.	254
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WARN	Ott Radio, Inc.	LaCrosse, Wis.	244
WABG	Lake Avenue Baptist Church	Rochester, N. Y.	283
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WABU	Victor Talking Machine Co.	Camden, N. J.	224
WABW	College of Wooster	Wooster, Ohio	234
WBAX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	283
WADC	Allen T. Simmons (Allen Theatre)	Akron, Ohio	258
WAFD	Albert B. Parlet Co.	Port Huron, Mich.	233
WAHG	A. H. Grebe & Co.	Richmond Hill, N. Y.	315
WAMD	Hubbard and Co.	Minneapolis, Minn.	244
WBAA	Purdue University	W. Lafayette, Ind.	283
WBAC	Clemson Agric. College	Clemson College, S. C.	331
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAK	Pennsylvania State Police	Harrisburg, Pa.	275
WBAG	James Millikan University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Texas	476
WBAV	Exner & Hopkins Co.	Columbus, Ohio	292
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	254
WBAY	Western Electric Co.	New York, N.Y.	492
WBBG	Irving Vermilya	Mattapoisett, Mass.	249
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	283
WBBM	Atlass Investment Co.	Chicago, Ill.	226
WBBN	Blake, A. B.	Wilmington, N. C.	278
WBBP	Petoskey High School	Petoskey, Mich.	248
WBBR	Peoples Pulpit Asso.	Rossville, N. Y.	273
WBBS	First Baptist Church	New Orleans, La.	252
WBBU	Jenks Motor Sales Co.	Monmouth, Ill.	224
WBBV	Johnstown Radio Co.	Johnstown, Pa.	245
WBBX	Ruffner Junior High School	Norfolk, Va.	322
WBBY	Washington Light Infantry Co. "B" 118th Inf.	Charleston, S. C.	288
WBCN	Foster & McDoland	Chicago, Ill.	288
WBDC	Barter Laundry Co.	Grand Rapids, Mich.	358
WBES	Bliss Electrical School	Takoma Park Md.	232
WBGA	Jones Elec. & Radio Mfg. Co.	Baltimore Md.	354
WBOQ	A. H. Grebe & Co., Inc.	Richmond Hill, N. Y.	236
WBR	Pennsylvania State Police	Butler, Pa.	286
WBRC	Bell Radio Corporation	Birmingham, Ala.	248
WBRE	Baltimore Radio Exchange	Wilkes-Barre, Pa.	231
WBS	D. W. May, Inc.	Newark N. J.	252
WBT	Southern Radio Corp.	Charlotte, N. C.	278
WBZ	Westinghouse E. & M. Co.	Springfield, Mass.	333
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co. and The Pittsburgh Pres.	Pittsburgh, Pa.	461
WCAG	Clyde R. Randall	New Orleans, La.	282
WCAH	Entrekin Electric Co.	Columbus, Ohio	258
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	283
WCAL	St. Olaf College	Northfield, Minn.	338
WCAO	Sanders & Stayman Co.	Baltimore Md.	278
WCAP	Chesapeake & Potoma Telephone Co.	Washington, D. C.	468
WCAR	Alamo Radio Electric Co.	San Antonio, Texas	263
WCAS	W. H. Dunwoody Industrial Institute	Minneapolis, Minn.	280
WCAT	State College of Mines	Rapid City, S. Dak.	340
WCAU	Durham & Co.	Philadelphia, Pa.	278
WCAX	University of Vermont	Burlington, Vt.	250
WCAZ	Carthage College	Carthage, Ill.	248
WCBA	Charles W. Heibachm	Allentown, Pa.	280
WCBC	University of Michigan	Ann Arbor, Mich.	280
WGBD	Wilbur C. Voliva	Zion, Ill.	344
WCBE	Uhalt Radio Co.	New Orleans, La.	283
WCBF	Paul J. Miller	Pittsburgh, Pa.	338
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss.	288
WCBH	University of Miss.	Oxford, Miss.	242
WCBM	Charles Sware	Baltimore, Md.	229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind.	280
WCBQ	First Baptist Church	Nashville, Tenn.	238
WCBR	C. H. Meester	Providence, R. I.	244
WCBT	Clark University, Collegiate Dept.	Worcester, Mass.	238

Radio Test Trip To Begin in August

While other radio engineers are exploring and testing atmospheric conditions in the Arctic and in the tropics, H. Frank Hopkins and Harvey T. Kelley, Assoc., I. R. E., plan to make an extensive survey of transmitting and receiving conditions in America's own front yard. They will leave Chicago some time during August on a trip through the territory west of the Mississippi River in an effort to trace the causes of difficult Summer reception and discover remedies for existing conditions.

Their trip will first take a northerly direction, and will gradually return south and west to Colorado and Utah. From there the two engineers will head Northwest to the state of Washington, down the coast through Oregon and California, and eastward through Arizona New Mexico, Texas and so on until they again arrive in Chicago about six months later.

Their findings will be revealed regularly throughout the long journey, and it is expected they will be of great value to the radio public throughout the country.

The largest mobile broadcasting set ever transported in such a manner will be part of the radio equipment to be carried on this trip, in order to test radio transmission in so-called "dead spots" and in places where static disturbances and other natural interference prevail. Under these extremely adverse conditions an attempt will be made to determine just what kind of radio receiving circuit performs the best. Several types of circuits will be taken on the trip and tested under varying atmospheric and geographic conditions.

Findings to be Broadcast

Communication with Eastern and Pacific broadcasting stations will be maintained throughout the long trek, which is to be made by automobile. Several radio stations have expressed a desire to broadcast the findings of the expedition to guide them in reaching listeners in isolated districts of the country, where difficulty is experienced in maintaining consistent touch with broadcasters throughout the year, and especially in Summer-time.

Mr. Hopkins and Mr. Kelley intend to devise several new types of radio apparatus to meet the difficulties they expect will confront them. This new apparatus will include both transmitting and receiving equipment. This information will also be given to the radio public through RADIO AGE, to guide the fans who desire improved reception or who are far from strong stations and are troubled with such disturbances as fading, static and other radio phenomena.

Mr. Hopkins and Mr. Kelley have long been identified in radio circles, ever since the days of the old spark transmitter and before vacuum tubes were used for receiving purposes. They have done considerable research work and development and as a result the findings of their trip should be of interest to all persons connected with radio and its allied sciences.

THE NEW RADIO TUBE

Designed Especially For Resistance

COUPLED AMPLIFIERS

Tested and Approved by RADIO AGE

HI-CONSTRON

Type C. T. 101A

You can't loose, for Cleartron is backed with ironclad guarantee to make good.

Another Cleartron product—the tube that gives greater volume, better quality at one-third the plate voltage. Designed for Resistance, also Intermediate steps of Superhetrodyne and in Radio frequency receivers.

AMPLIFICATION CONSTANT 20

(Almost 3 times that of 201A)

5 VOLTS **Price $3.00** ¼ AMP.

Manufactured by

CLEARTRON

GUARANTEED RADIO TUBES

28 WEST 44th ST. NEW YORK

The Great Manufacturers' Exposition

Attended by Leading Jobbers and Dealers

The Official 1925 R.M.A. *Show*

THE SECOND

RADIO WORLD'S FAIR

NEW YORK CITY

U. J. HERRMANN, MANAGING DIRECTOR

SEPTEMBER 14th to 19th

MONDAY NOON TO SATURDAY MIDNIGHT

ENTIRE EXHIBITION ON GROUND FLOOR IN THE LARGEST HALL IN THE WORLD

258th Field Artillery Armory

NEW YORK OFFICES
1500 TIMES BLDG.
NEW YORK CITY

* *Tested and Approved by* RADIO AGE *

WCBU	Arnold Wireless Supply Co.	Arnold, Pa.	254
WCBX	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WCCO	Washburn-Crosby Co.	Twin Cities, Minn.	416
WCEE	Charles E. Erbstein, Villa Olivia	near Elgin, Ill.	278
WCK	Stix-Baer-Fuller D. G. Co.	St. Louis, Mo.	275
WCTS	C. T. Scherer Co.	Worcester, Mass.	268
WCX	Free Press	Detroit, Mich.	516
WDAE	Tampa Daily Times	Tampa, Fla.	365
WDAF	Kansas City Star	Kansas City, Mo.	365
WDAG	J. Laurence Martin	Amarillo, Texas	263
WDAH	Trinity Methodist Church (South)	El Paso, Texas	268
WDAR	Lit Brothers	Philadelphia, Pa.	394
WDAY	Radio Equipmeot Corp.	Fargo, N. Dak.	244
WDBA	Fred Ray	Columbus, Ga.	236
WDBB	A. H. Waite & Co., Inc.	Taunton, Mass.	229
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDBD	Herman Edwin Burns	Martinsburg, W. Va.	268
WDBE	Gilham-Schoen Elec. Co.	Atlantic, Ga.	278
WDBJ	Richardson Wayland Electric Corp.	Roanoke, Va.	229
WDBK	M. F. Broz	Cleveland, Ohio	227
WDBL	Wisc. Dept. of Markets	Stevens Point, Wis.	278
WDBN	Electric Light & Power Co.	Bangor, Me.	252
WDBO	Rollins College Inc.	Winter Park, Fla.	240
WDBQ	Morton Rado Supply Co.	Salem, N. J.	234
WDBR	Tremont Temple Baptist Church	Boston, Mass.	256
WDBV	The Strand Theatre	Fort Wayne, Ind.	258
WDBX	Otto Baur	New York, N. Y.	233
WDBY	North Shore Congregational Church	Chicago, Ill.	258
WDBZ	Boy Scouts, City Hall	Kingstown, N. Y.	233
WDM	Church of the Covenant	Washington, D. C.	234
WDOD	Chattanooga Radio Co., Inc.	Chattanooga, Tenn.	256
WDWF	Dutee Wilcox Flint, Inc.	Cranston, R. I.	441
WDZ	J. L. Bush	Tuscola, Ill.	278
WEAA	F. D. Fallain	Flint, Mich.	250
WEAF	American Telephone & Telegraph Co.	New York, N.Y.	485
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 (W. Gibson Buttfield)	North Plainfield, N. J.	286
WEAN	Shepard Co.	Providence, R. I.	273
WEAO	Ohio State University	Columbus, Ohio	293
WEAR	Goodyear Tire and Rubber Co.	Cleveland, Ohio	389
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Texas	270
WEB	Beowood Co.	St. Louis, Mo.	273
WEBA	Electric Shop	Highland Park, N. J.	233
WEBC	Walter Cecil Bridges	Superior, Wis.	242
WEBD	Electrical Equipment and Service Co.	Anderson, Ind.	246
WEBE	Roy W. Walker	Cambridge, Ohio	248
WEBH	Edgewater Beach Hotel, Chicago Evening Post Station	Chicago, Ill.	370
WEBJ	Third Avenue Railway Co.	New York, N. Y.	273
WEBM	Radio Corporation of America	Portable	226
WEBP	E. B. Pedicord	New Orleans, La.	280
WEBT	The Dayton Coop. Industrial High School	Dayton, Ohio	270
WEBW	Beloit College	Beloit Wis.	283
WEEI	The Edison Electric Illuminating Co.	Boston, Mass.	475
WEHS	Robert E. Hughes	Evanston, Ill.	205
WEMC		Barrien Springs, Mich.	285
WENR	All-American Radio Corporation	Chicago, Illinois	266
WEW	St. Louis University	St. Louis, Mo.	280
WFAA	Dallas News & Dallas Journal	Dalles, Tex.	472
WFAM	Times Publishing Co.	St. Cloud, Minn.	273
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFBC	First Baptist Church	Knoxville, Tenn.	250
WFBD	Gethsemane Baptist Church	Philadelphia, Pa.	234
WFBE	John Van De Walle	Seymour, Ind.	226
WFBG	The Wm. F. Cable Co.	Altoona, Pa.	261
WFBH	Concourse Radio Coporation	New York, N. Y.	273
WFBJ	St John's University	Collegeville, Minn.	236
WFBQ	Wynne Radio Co.	Raleigh, N. C.	255
WFBR	Fifth Inf. Md. Nat'l Guard, 5th Reg. Armory	Baltimore, Md.	452
WFBW	Ainsworth-Gates Radio Co.	Cincinnati, Ohio	309
WFBY	Signal Officer	Ft. Ben Harrison, Ind.	258
WFBZ	Knox College	Galesburg, Ill.	254
WFI	Strawbridge and Clothier	Philadelphia, Pa.	394
WFKB	Francis K. Bridgman	Chicago, Ill.	217
WFUV	G. Pearson Ward	Springfield, Mo.	252
WFUW	Earl William Lewis	Moberly, Mo.	233
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	248
WGAQ	YoureeHotel	Shreveport, La.	252
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGBB	Harry H. Carman, 217 Bedell St.	Freeport, N. Y.	244
WGBC	First Baptist Church	Memphis, Tenn.	266
WGBF	Fink Furniture Co.	Evansville, Ind.	217
WGBG	Brietenbach's Radio Shop	Thrifton, Va.	226
WGBH	Fall River Herald Pub. Co. (Portable)	Fall River, Mass.	209
WGBI	Frank S. Megargee	Scranton, Pa.	240
WGBK	Lawrence Campbell	Johnstown, Pa.	248
WGBM	Theodore N. Sasty	Providence, R. I.	234
WGBL	Elyria Radio Asso. (Albert H. Ernst)	Elyria, Ohio	227
WGBQ	Stout Institute	Menominee, Wis.	234
WGBR	Marshfield Broadcasting Assn.	Marshfield, Wis.	229
WGBS	Gimbel Brothers	New York, N. Y.	315
WGBT	Furman University	Greenville, S. C.	236
WGBX	University of Maine	Orono, Me.	252
WGBY	Progress Sales Co.	R. R. No. 2	218
WGES	Coyne Electrical School	Oak Park, Ill.	250
WGI	American R. & R. Co.	Medford Hillside, Mass.	261
WGMU	A. H. Grebe & Co., Inc., Portable	Richmond Hill, N. Y.	236
WGN	The Tribune Co.	Chicago, Ill.	370
WGR	Federal T. and T. Co.	Buffalo, N. Y.	319
WGY	General Elec. Co.	Schenectady N. Y.	379
WHA	University of Wisconsin	Madison, Wis.	535
WHAD	Marquette University	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	278
WHAP	H. Alvin Simmons, 290 Flatbush Ave.	Brooklyn, N. Y.	240
WHAR	Seaside House	Atlantic City, N. J.	275
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	399
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	385
WHB	Sweeney School Co.	Kansas City, Mo.	365
WHBA	C. C. Shaffer	Oil City, Pa.	250
WHBB	Hobel's Store	Stevens Point, Wis.	240
WHBC	Rev. E. P. Graham	Canton, Ohio	245
WHBD	Chas. W. Howard	Bellefontaine, Ohio	222
WHBF	Beardsley Specialty Company	Rock Island, Illinois	222
WHBG	John S. Skane	Harrisburg, Pa.	231
WHBH	Culver Military Academy	Culver, Ind.	222
WHBJ	Lauer Auto Co.	Ft. Wayne, Ind.	234
WHBK	Franklin St. Garage, Inc.	Ellsworth, Maine	231
WHBL	James H. Slusser	Logansport, Ind.	220
WHBM	C. L. Carroll, Portable Station	Chicago, Ill.	233
WHBN	First Ave. Methodist Church	St. Petersburg, Florida	258
WHBO	Y. M. C. A., Summer Street	Pawtucket, Rhode Island	231
WHBP	Johnstown Automobile Co.	Johnstown, Pennsylvania	256
WHBQ	St. John's M. E. Church South	Memphis, Tenn.	233
WHBR	Scientific Electric & Mfg. Co., 3664 Vine St.	Cincinnati, Ohio	216
WHBS	Edward Wm. Locke	Mechanicsburg, Ohio	208
WHBU	B. L. Bing's Sons	Anderson, Ind.	218
WHBV	Fred Ray's Radio Shop	Columbus, Ga.	244
WHBW	D. R. Kienzle	Philadelphia, Pa.	215
WHBX	J. W. Bowser	Punxsutawney, Pa.	213
WHBY	St. Norbert's College	West De Pere, Wis.	250
WHEC	Hickson Electric Co., Inc.	Rochester, N. Y.	258
WHK	Radiovox Company	Cleveland, Ohio	273
WHN	George Schubert	New York, N. Y.	360
WHO	Bankers' Life Co.	Des Moines, Ia.	526
WHT	Radiophone Broadcasting Corporation	Deerfield, Ill.	238
WIAD	Howard R. Miller	Philadelphia, Pa.	254
WIAK	Journal-Stockman Co.	Omaha, Nebr.	273
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAS	Home Electric Co.	Burlington, Iowa	283
WIBA	The Capital-Times Studio	Madison, Wis.	236
WIBC	L. M. Tate Post, No. 39, Veterans of Foreign Wars	St. Petersburg, Florida	222
WIBD	X-L Radio Service	Joliet, Illinois	200
WIBE	Martinsburg Radio Broadcasting Co.	Martinsburg, W. Va	210
WIBF	S. P. Miller Dance Activities	Wheatland, Wisc.	231
WIBG	St. Paul's Protestant Episcopal Church	Elkins Park, Pa.	222
WIBO	Nelson Brothers	Chicago, Ill.	226
WIBH	Elite Radio Stores	New Bedford, Mass.	209
WIBI	Frederick B. Zittell, Jr.	Flushing, N. Y.	219
WIBJ	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBK	University of Toledo	Toledo, Ohio	205
WIBL	McDonald Radio Co., Portable Station	Joliet, Ill.	2157
WIBP	First Presbyterian Church	Meridian, Miss.	210
WIBR	Thurman A. Owings	Weirton, W. Va.	246
WIBS	New Jersey National Guard, Hdqrs. Co. 57th Inf. Brig., 921 Edgewood Road	Elizabeth, N. J.	202.6
WIBQ	F. M. Schmidt	Farina, Ill.	205
WIL	Continental Electric Supply Co.	Washington, D. C.	360
WIP	Gimbel Bros.	Philadelphia, Pa.	509
WJAB	American Electric Co.	Lincoln, Nebr.	229
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	352
WJAG	Norfolk Daily News	Norfolk, Nebr.	283
WJAK	Clifford L. White	Greentown, Iowa	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	306
WJAS	Pittsburgh Radio Supply Honse	Pittsburgh, Pa.	286
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	268
WJBA	D. H. Lentz, Jr.	Joliet, Ill.	207
WJBB	L. W. McClurg	St. Petersburg, Fla.	207
WJBC	Hummer Furniture Co.	LaSalle, Ill.	234
WJBD	Ashland Broadcasting Committee	Ashland, Wisc.	233
WJBI	H. M. Couch	Joliet, Ill.	2142
WJD	Denison University	Granville, Ohio	229
WJJD	Supreme Lodge, Loyal Order of Moose	Mooseheart, Ill.	303
WJY	Radio Corp. of Ama	New York, N. Y.	455
WJZ	Radio Corp. of Ama	New York, N. Y.	455
WKAA	H. F. Paar	Cedar Rapids, Iowa	278
WKAD	Ches. Looff (Crescent Park)	East Providence, R. I.	240
WKAP	Dutee W. Flint	Cranston, R. I.	234
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	340
WKAR	Michigan Agriculture College	East Lansing, Mich.	285
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKBE	K. & B. Electric Co.	Webstar, Massachusetts	231
WKBF	Dutee Wilcox Flint	Cranston, Rhode Island	286
WKBG	C. L. Carrel, Portable	Chicago, Ill.	216
WKY	Wky Radio shop	Okla. City, Okla.	275
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAL	First Christian Church	Tulsa, Okla.	250
WLAP	Wm. V. Jordan	Louisville, Ky.	288
WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
WLAX	Putnam Electric Co.	Greencastle, Ind.	231
WLB	University of Minnesota	Minneapolis, Minn.	278
WLBL	Wisconsin State Dept. of Markets	Stevenspoint, Wis.	278
WLS	Sears Roebuck & Co.	Chicago, Ill.	344
WLTS	Lane Technical High School, 1225 Sedgwick Road	Chicago, Ill.	258
WLW	Crosley Mfg. Co.	Cincinnati, Ohio	422
WMAC	J. Edw. Page (Olive B. Meredith	Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	360
WMAK	Norton Laboratories	Lockport, N. Y.	273
WMAL	Trenton Hardware Co.	Trenton, N. J.	256
WMAN	First Baptist Church	Columbus, Ohio	286
WMAQ	Chicago Daily News	Chicago, Ill.	447
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	261
WMBB	Trianon Ball Room	Chicago, Ill.	250
WMBF		Miami Beach, Fla.	384
WMC	Commercial Appeal	Memphis, Tenn.	503
WMCA	Hotel McAlpin (Greeley Square Hotel Co.)	New York City	341
WMH	Ainsworth-Gates Radio Co.	Cincinnati, O.	321
WNAB	The Shepard Stores	Boston, Mass.	250
WNAC	Shepard Stores	Boston, Mass.	284
WNAD	University of Oklahoma	Norman, Okla.	258
WNAL	Omaha Central High School	Omaha, Nebr.	255
WNAP	Wittenberg College	Springfield, Ohio	271
WNAR	First Christian Church	Butler, Mo.	230
WNAT	Lannig Brothers Co. (Frederick Lannig)	Philadelphia, Pa.	254
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	248
WNYC	Dept. of Plant and Structures	New York, N. Y.	526
WOAC	Page Organ Co.	Lima, Ohio	260
WOAE	Midland College	Fremont, Nebr.	280
WOAG	Apollo Theater (Belvidere Amusement Co.)	Belvidere, Ill.	274
WOAI	Southern Equipment Co.	San Antonio, Texas	392
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	280
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	369
WOAR	Lundskow, Henry P.	Kenosha, Wis.	225
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebraska	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOCL	Hotel Jamestown, Inc.	Jamestown, N. Y.	275
WODA	James K. O'Dea	Paterson, New Jersey	203
WOI	Iowa State College	Ames, Ia.	207
WOO	John Wanamaker	Philadelphia, Pa.	509
WOR	L. Bamberger and Co.	Newark, N. J.	405
WORD	Peoples Pulpit Assn.	Batavia, Ill.	276
WOS	State Marketing Bureau	Jefferson City, Mo.	440
WOWL	Owl Battery Company	New Orleans, La.	270
WOWO	Main Auto Supply Co.	Ft. Wayne, Ind.	227
WPAB	Pennsylvania State College	State College, Pa.	283
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. D.	283
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio	286
WPAZ	John R. Koch (Dr.)	Charleston, W. Va.	273
WPG	The Municipality of Atlantic City	Atlantic City, N. J.	300
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	270
WQAC	E. B. Gish	Amarillo, Texas	234
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAM	Electrical Equipment Co.	Miami, Fla.	283
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQJ	Calumet Rainbo Broadcasting Co.	Chicago, Ill.	447
WRAA	The Rice Institute	Houston, Texas	256
WRAF	The Radio Club (Inc.)	Laporte, Ind.	224
WRAK	Economy Light Co.	Escanaba, Mich	256
WRAM	Lombard College	Galesburg, Ill.	244
WRAQ	St. Louis Radio Service Co.	St. Louis, Mo.	263
WRAV	Antioch College	Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRBC	Imanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corp. of Ama.	Washington, D. C.	468
WREO	Rao Motor Car Co.	Lansing, Mich.	286
WRHF	Washington Radio Hospital Fund	Washington, D. C.	256
WRNY	Experimenter Publishing Co.	New York, N. Y.	258
WRK	Doron Bros.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	270
WRM	University of Illinois	Urbana, Ill.	273
WRR	Police and Fire Signal Department	Dallas, Texas	261
WRW	Tarrytown Radio Res. Labs.	Tarrytown, N. Y.	273
WSAC	Clemson Agricultural College	Clemson College, S. C	336
WSAG	Loran Vanderbeck Davis	St. Petersburg, Fla.	264
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	325
WSAJ	Grove City College	Grove City, Pa.	258
WSAN	Allentown Call Publishing Co.	Allentown, Pa.	229
WSAP	Seventh Day Adventist Church	New York, N. Y.	263
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WSAV	C. W. Vick Radio Construction Co.	Houston, Texas	360
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233

Standard Radio Receivers

(Continued from page 87)

The Anylite King Cole Receivers

Anylite King Cole radio sets will be made for external batteries and may be used with any standard tubes. The cabinet is brown mahogany and the panel black formica with gold trimmings.

An outstanding feature is simplicity of control by means of two vernier dials. All reception is possible on a loud speaker. Selectivity is unsurpassed by any set, and coast to coast reception is possible under favorable weather conditions.

The small amount of B battery current, as low as .002 amperes, assures long life of batteries and low upkeep expense.

The set is non-radiating and all parts are extremely efficient. The coils are by far the most efficient we have been able to secure.

King Cole sets are guaranteed against defective material and workmanship, and when used with any good loud speaker will give ample volume and excellent tones.

Anylite King Cole audio frequency transformers are designed to give strong amplification and faithful reproduction over the entire musical range. These transformers may be used with all standard tubes and large, plainly marked terminals provide for secure connections. The cases are handsomely finished in black enamel and serve as a shield for the coil.

King Cole Transformers have been developed after exhaustive research on the part of the Anylite Engineers and will give complete satisfaction.

The Blair Receiver

Employing Resistance-Coupled Audio Amplification and Tuned Radio Frequency

The Blair Six Tube Receiver, employing two stages of tuned radio frequency, a detector and three stages of resistance-coupled audio amplification, is now available to the American market.

The Blair Receiver is the result of years of experimentation in both British and American laboratories and represents the perfected combination of these two highly efficient methods of amplification; namely, tuned radio frequency for distance and selectivity, and resistance-coupled audio for tone quality.

The result is the surpassing clarity of delivery for which resistance-coupled amplification is noted, together with distance and volume in any quantity desired.

Heretofore, the manufacturers of the Blair Receiver have confined their sales efforts to the British market, and they are now one of the largest exporters of radio receiving sets in this country.

In choosing a receiving set for his Majesty King George V, the British engineers chose resistance-coupled amplification.

The Blair Receiver comes in mahogany or walnut cabinets with sloping panels and three dials. The list price is $75.00.

This set is being manufactured by the Blair Radio Laboratories, 23rd Street & 6th Avenue, New York City.

Foreign Visitors at N. Y. Radio Show

The undoubted leadership which the radio industry of the United States maintains over those of other nations is reflected by the many foreign visitors who are planning to come to this country for the Exposition to be held in Grand Central Palace during September.

A radio Festa, in which the leading stars of the microphone will participate, is planned for the Fourth Annual National Radio Exposition by S. L. Rothafel, ("Roxy,") who will have charge of the entertainment program to be broadcast from Grand Central Palace during Exposition Week.

Obsolete

Take the "GUESS" Out of Tube Control with $1.10 Everywhere

Amperite automatically controls tube current, eliminates hand rheostats, filament meters, guessing and all tube worry.
Simplifies wiring, tuning and operation.
Permits the use of any type of tube or any combination of tubes.
Tested and used by more than 50 set manufacturers and in every popular construction set

RADIALL COMPANY *
Dept. R.A.-8, 50 Franklin St., New York City

Write for FREE Hook-ups

AMPERITE
REG. U.S. PAT. OFF.
The "SELF-ADJUSTING" Rheostat

Sales Distributor Wanted

to start now in the fastest growing business the world ever knew—Three Million radio sets were sold last year—22 Million will be sold in the U. S. A.

THE *

MUSIC BOX RADIO RECEIVER

is the peerless seller of them all. Think! Only two orders weekly means $600 per month. Four orders $1200 per month. The Set with the Marvelous Tone and Volume Supreme, the Distance getter of them all. Write now, today, for our liberal 15-day trial offer and protected territory.

THIELEN, Manufacturer
1207 North Shore Ave., Chicago,

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* The Five Tube Set which startled the World!

FRESHMAN MASTERPIECE

The Greatest Value Ever Offered in A Radio Receiving Set

At Authorized Dealers

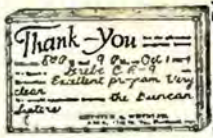
The Traffic Cop of the Air

FERBEND Wave Trap

Add a Ferbend Wave Trap to your Radio Set and "Police" your reception. Regulate traffic. Guaranteed to tune out any interfering station. Widely imitated but never equalled. The *original* and only successful WAVE TRAP. Now in its third year. Sent Postpaid upon receipt of $8.50 or C. O. D. plus postage. *Send for Free Booklet*

FERBEND ELECTRIC CO.
1 E. So. Water St. Chicago

SEND NO MONEY!



YOUR OWN Name and Address Printed Free on Thank You Cards
Hear what YOU like. Stations gladly put on numbers at your request. Thank your favorite stations. Special cards that get ATTENTION. All the RAGE. 100—$1.60; 200—$1.60; 500—$2.00; 500—$3.00; 1000—$5.00. Postpaid if pay with order.
MONEY REFUNDED If Not Delighted
Quality cards. High grade printing.

FREE LOG With 1st order. Shows call, city, wave length, 4 dial settings, etc. Station list by wave length. Distance map. Ripple cover. *Send no money—pay postman when you get cards etc. Order NOW*
RADIO PRINTERS, Dept. C202, Marengo, Ill.

"Get Away From Me Boys, You Bother Me"

is a favorite of ours. Our Salespeaker will be a favorite of yours. Dealers write for it.

HUDSON-ROSS—116 S. Wells St.
Chicago

* *Tested and Approved by* RADIO AGE *

WSAZ	Chas. Electric Shop	Pomeroy, Ohio	258
WSB	Atlanta Journal	Atlanta, Ga.	428
WSBC	World Battery Co., 1219 S. Wabash Ave.	Chicago., Ill.	209.7
WSKC	World's Star Knitting Co.	Bay City, Mich.	261
WSMB	Saenger Amusement Co. and Maison Blanche Co.	New Orleans, La.	319
WSMH	Shattuck Music House	Owosso, Mich.	240
WSMK	S. M. K. Radio Corp.	Dayton, Ohio	275
WSOE	School of Engineering	Milwaukee, Wis.	246
WSRF	Hardem Sales and Service	Broadlands, Ill.	233
WSTA	Camp Marlenfeld	Chesham, N. H.	229
WSUI	State University of Iowa	Iowa City, Iowa	498
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wis.	220
WTAR	Reliance Electric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	202
WTAT	Edison Electric Illuminating Co.	(portable) Boston, Mass.	244
WTAW	Agricultural & Mechanical College of Texas	College Station, Texas	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTHS	Flint Senior High School	Flint, Mich.	218
WTG	Kansas State Agricultural College	Manhattan, Kans.	273
WTIC	Travelers Insurance Co.	Hartford, Conn.	323
WTX	H. O. Seal Co.	Chicago, Ill.	268
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	The Alamo Ball Room	Joliet, Ill.	242
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	352
WWL	Loyola University	New Orleans, La.	269
WWOA	Michigan College of Mines	Houghton, Mich.	244

Canadian Stations

CFAC	Calgary Herald	Calgary, Alberta	430
CFCA	Star Pub. & Prtg. Co.	Toronto, Ontario	400
CFCF	Marconi Wireless Teleg. Co. Canada	Montreal, Quebec	440
CFCH	Abitibi Power & Paper Co.	Iroquois Falls, Ont.	400
CFCJ	La Cie de L'Evenement	Quebec, Quebec	410
FCKC	Radio Supply Co.	Edmonton, Alberta	410
CFCN	W. W. Grant Radio (Ltd.)	Calgary, Alberta	440
CFCQ	Radio Specialties (Ltd.)	Vancouver, B. C.	450
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCT	Victoria City Temple	Victoria, B. C.	410
CFCU	The Jack Elliott Radio Limited	Hamilton, Ont.	410
CFCW	The Radio Shop	London, Ont.	420
CFDC	Sparks Co.	Nanaimo, B. C.	430
CFHC	Henry Birks & Sons	Calgary, Alta.	440
CFLC	Chas. Guy Hunter	551 Adelaide St., London, Ont.	410
CFQC	The Electric Shop (Ltd.)	Saskatoon, Saskatchewan	400
CFRC	Queens University	Kingston, Ontario	450
CFUC	University of Montreal	Montreal, Quebec	400
CFXC	Westminster Trust Co.	New Westminster, B. C.	440
CFYC	Victor Wentworth Odlum	Vancouver, B. C.	400
CHAC	Radio Engineers	Halifax, Nova Scotia	400
CHBC	Albertan Publishing Co.	Calgary, Alberta	410
CHCB	Marconi Company	Toronto, Ont.	410
CHCD	Canadian Wireless & Elec. Co.	Quebec, Quebec	410
CHCE	Western Canada Radio Sup. (Ltd.)	Victoria, B. C.	400
CHCL	Vancouver Merchants Exchange	Vancouver, B. C.	440
CHCM	Riley & McCormack	Calgary, Alberta	415
CHCS	The Hamilton Spectator	Hamilton, Ont.	420
CHIC	Northern Electric Co.	Toronto, Ont.	356
CHNC	Toronto Radio Research	Toronto, Ont.	350
CHXC	J. R. Booth	Ottawa, Ont.	435
CHYC	Northern Electric Co.	Montreal, Quebec	410
CJBC	Jarvis Baptist Church	Toronto, Ont.	312
CJCA	Edmonton Journal	Edmonton, Alberta	455
CJGC	London Free Press Prtg. Co.	London, Ont.	430
CJCD	T. Eaton Co.	Toronto, Ont.	410
CJCE	Sprott-Shaw Radio Co.	Vancouver, B. C.	420
CJCF	The News Record	Kitchener, Ont.	295
CJCI	Maritime Radio Corp.	St. John, New Brunswick	400
CJCK	Radio Corp. of Calgary	Calgary, Alta.	316
CJCM	J. L. Phillips	Mont Joli, Quebec	430
CJCN	Simons Agnew & Co.	Toronto, Ont.	410
CJSC	Evening Telegram	Toronto, Ont.	430
CKAC	La Presse Pub. Co.	Montreal, Quebec	430
CKCD	Vancouver Daily Province	Vancouver, B. C.	410
CKCE	Canadian Independ. Telephone Co.	Toronto, Ont.	450
CKCK	Leader Pub. Co.	Regina, Saskatchewan	420
CKCO	Ottawa Radio Association	Ottawa, Ont.	440
CKCX	P. Burns & Co.	Calgary, Alberta	440
CKLC	Wilkinson Electric Company	Calgary, Alberta	400
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CNRA	Canadian National Railways	Moncton, N. B.	313
CNRC	Canadian National Railways	Calgary, Canada	357
CNRE	Canadian National Railways	Edmonton, Alta.	455
CNRM	Canadian National Railways	Montreal, P. Q.	410
CNRO	Canadian National Railways	Ottawa, Ont.	430
CNRR	Canadian National Railways	Regina, Sask.	312
CNRS	Canadian National Railways	Saskatoon, Sask.	329
CNRT	Canadian National Railways	Toronto, Ont.	357
CNRW	Canadian National Railways	Winnipeg, Man.	384

Cuban Stations

PWX	Cuban Telephon Co.	Habana	400
2DW	Pedro Zayas	Habana	300
2AB	Alberto S. de Bustamante	Habana	240
2OK	Mario Garcia Veles	Habana	360
2BY	Frederick W. Borton	Habana	260
2CX	Frederick W. Borton	Habana	320
2EV	Westinghouse Elec. Co.	Habana	220
2TW	Roberto E. Ramires	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. Salsa	Habana	280
2JD	Raul Pares Falcon	Habana	150
2K	Alvera Daze	Habana	200
2HS	Julio Power	Habana	180
2OL	Oscar Collado	Habana	290
2WW	Amadeo Saenz	Habana	210
5EV	Leopoldo E. Figueroa	Colon	360
6KW	Frank H. Jones	Tuinuou	340
6KJ	Frank H. Hones	Tuinucu	275
6CX	Antonio T. Figueroa	Cienfuegos	170
6DW	Eduardo Terry	Cienfuegos	225
6BY	Jose Gandara	Cienfuegos	300
6AZ	Valentin Ullivarri	Cienfuegos	200
8BY	Alberto Ravelo	Stgo. de Cuba	250
8FU	Andres Vinnet	Stgo. de Cuba	225
8DW	Pedro C. Andue	Stgo. de Cuba	275

European Broadcasting Stations

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	492	
6SL	Sheffield (relay station)	303	

French Stations

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

End your Radio Troubles for 30c in Stamps

We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed hookups to be found in these volumes. Select the ones you want and enclose 30c in stamps for each desired. The supply is limited, so enrich your store of radio knowledge by laying in an ample stock of copies NOW!

January, 1924
—Tuning Out Interference—Wave Traps—Eliminators
—Filters.
—A Junior Super-Heterodyne.
—Push-Pull Amplifier.
—Rosenbloom Circuit.

March, 1924
—An Eight-Tube Super-Heterodyne.
—A simple, low loss tuner.
—A Tuned Radio Frequency Amplifier.
—Simple Reflex Set.

April, 1924
—An Efficient Super-Heterodyne (fully illustrated).
—A Ten-Dollar Receiver.
—Anti-Body Capacity Hookups.
—Reflexing the Three-Circuit Tuner.
—Index and first two installments of Radio Age Data Sheets.

May, 1924
—Construction of a Simple Portable Set.
—Radio Panels.
—Third Installment of Radio Age Data Sheets.

June, 1924
—Important Factors in Constructing a Super-Heterodyne.
—A Universal Amplifier.
—A Sure Fire Reflex Set.
—Adding Radio and Audio to Baby Heterodyne.
—Radio Age Data Sheets.

July, 1924
—A Portable Tuned Impedance Reflex.
—Operating Detector Tube by Grid Bias.
—A Three-Tube Wizard Circuit.
—Data Sheets.

August, 1924
—Breaking Into Radio Without a Diagram.
—The English 4-Element Tube.
—Filtered Heterodyne Audio Stages.
—An Audio Amplifier Without an "A" Battery.
—Data Sheets.

September, 1924
—How Careful Mounting Will Improve Reception.
—One Tuning Control for Hair's Breadth Selectivity.
—Four Pages of Real Blueprints of a New Baby Heterodyne and an Aperiodic Variometer Set.
—Data Sheets.

October, 1924
—An Easily Made Super-Het.
—Two Radio and Two Audio for Clear Tone.
—A Simple Regenerative Set.
—The Ultradyne for Real DX.
—Real Blueprints of a 3-Tube Neutrodyne and a Midget Reflex Set.

November, 1924
—Blueprints of a Single Tube Loop Set and a Capacity Feedback Receiver.
—How to Make a Receiver that Minimizes Static.
—A Trans-Atlantic DX Receiver.
—How to Make a Home Made Battery Charger and a Loud Speaker at a Small Cost.

December, 1924
—Blueprints of a New 8-Tube Super-Heterodyne.
—How to Make a Receiver that Minimizes Static.
—A Trans-Atlantic DX Receiver.
—How to Make a Home Made Battery Charger and a Loud Speaker at a Small Cost.

January, 1925
—A Reflexed Neutrodyne
—A Six Tube Super-Het.
—An Efficient Portable Set.
—A Tuned Plate Regenerator.
—Making a Station-Finder.

February, 1925
—A Sure Shot Super-Het.
—A Three Circuit Regenerator.
—A Real, Low Loss Set.
—Blueprints of a 3-tube Reflex

March, 1925
—A Permanent Super-Het.
—A 5-Tube R. F. Receiver.
—How to Wind Low Loss Coils.
—A Short Wave Receiver
—Blue Prints of a Two-Tube Ultra Audion and a Regenerative Reflex.

April, 1925
—A 3-Tube Portable Set
—"B" Voltage from the A. C. Socket
—An Amplifier for the 3-Circuit Tuner
—Blueprints of a Five-Tube Radio Frequency Receiver

May, 1925
—A "Quiet" Regenerator.
—A Power Supply Receiver.
—How to Make a Tube-Tester.
—A Unique Super-Het and an Improved Reinartz.
—A Six Tube Portable Receiver Illustrated with Blueprints.

June, 1925
—Reducing Static Disturbances
—A Seven-Tube Super-Heterodyne
—The Double Grid Tube in Ordinary Sets
—Browning-Drake Receiver
—Overcoming Oscillations in the Roberts Receiver
—An Ideal Set in Practical Form
—Soldering Secrets

RADIO AGE, INC., 500 N. DEARBORN ST., CHICAGO

CLASSIFIED ADVERTISEMENTS

If you have anything to buy or sell, don't overlook the value of RADIO AGE'S classified advertisements. Many such messages have paved the way to independent incomes.

The classified advertising rates are but ten cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve-time insertions, of five, fifteen and thirty per cent respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates and no advertisement of less than ten words will be accepted.

All classified ads for the September issue must be sent in by August 1.

AGENTS WANTED

FORDS. 60 miles on one gallon of Gas. It has been proven such mileage can be made. AIRLOCK guarantees to increase gas mileage; also prevents radiator boiling in summer or freezing in winter. Cools, Fuels, Decarbonizes the Ford motor. Splendid territory open. AIRLOCK PRODUCTS, Box 703G, Willow Street, Long Beach, Calif.

RADIO—Join our sales organization and make big money. We want a man in every county to sell well advertised sets and parts made by the leading manufacturers. Widener of Kansas City makes $150.00 weekly. You can do as well or better. Write today for catalog, and discounts. Name your county. Waveland Radio Company, Div. 52, 1027 No. State St., Chicago, Ill.

MANUFACTURER'S AGENT calling on Radio-Electrical Jobbers, Chicago and vicinity, has opening for 3 additional lines carrying volume business, as we cater to large jobbers. Edelstein, 1804 McCormick Bld., Chicago.

AGENTS—WRITE FOR FREE SAMPLES. Sell Madison "Better-Made" Shirts for large manufacturer direct to wearer. No capital or experience required. Many earn $100 weekly and bonus. MADISON MFGRS., 501 Broadway, New York.

90c an hour to advertise and distribute samples to consumer. Write quick for territory and particulars. American Products Co., 2130 American Building, Cincinnati, Ohio.

Man wanted for this territory to sell wonderful value men's, women's, Children's shoes direct, saving consumer over 40%. Experience unnecessary. Samples supplied. Big weekly permanent income. Write today Tanners Mfg. Co., 1334C. St., Boston, Mass.

"B" BATTERIES

100 VOLT EDISON TYPE "B" BATTERY, knocked down. Parts and plans—complete, $12.50. Lane Mfg. 2937 W. Lake, Chicago.

BATTERIES FOR SALE—Four 24-volt "Main" Storage "B" Batteries, never used, shipped and ready to wire for $38.00. First order gets the batteries. Address Box B, Radio Age, 500 N. Dearborn St., Chicago, Ill.

BUSINESS OPPORTUNITY

MR. MANUFACTURER: Would you be interested in a national advertising campaign to reach more than two million prospective buyers of quality radio products —each week? Do you want to establish agencies in new territory and create national interest in your product—at a very conservative cost? It can be done. Let us explain our system without obligation to you. Drop a card to Radiograph Laboratories, 1234 Rosemont Ave., Chicago, Ill., Box 6.

CRYSTALS

TESTED GALENA CRYSTALS, 50c pound bulk. Buskett, Geologist, Joplin, Mo.

HELP WANTED

RADIO SALESMEN and SET BUILDERS—We need you and you need us. If you are reliable and well known in your community, we will appoint you our representative and furnish you with standard well advertised sets and parts at prices that will enable you to sell at a handsome profit. Write at once for catalog and sales plan. Waveland Radio Co., Div. 53, 1027 N. State St., Chicago, Ill.

MEN wanting forest ranger, railway clerk and other government positions, write for free particulars of exams. Mokane, Dept. B-33, Denver, Colo.

Classified ad. copy for the September RADIO AGE must be sent in by August 1, 1925.

INVENTIONS

NEW IDEAS WANTED—Well known Radio Manufacturer whose products are nationally advertised and sold everywhere wants new Radio device to sell. Will pay outright or royalty for idea or invention which is really new and saleable. Address: Mr. R. F. Devine, Room 1101, 116 West 32nd St., New York, N. Y.

MAGAZINES

DREAMS. A magazine for all who dream. If you are interested in the subjects of science, sex, psychology, health, love and romance, you cannot afford to be without this magazine. Three dollars will bring this most fascinating monthly publication to your home for one year. M. B. Smith Publishing Co., 508 N. Dearborn St., Chicago, Ill.

MANUFACTURING FACILITIES

AN OLD AND WELL ESTABLISHED MANUFACTURING COMPANY IN THE MIDDLE WEST WITH LARGE WELL EQUIPPED PLANTS AND UNUSUAL FINANCIAL RESOURCES, DESIRING TO ENTER THE RADIO FIELD WILL CONSIDER THE MANUFACTURE AND SALE OF RADIO SETS OR DEVICES OF OUTSTANDING AND UNUSUAL MERIT ON A ROYALTY BASIS. ADDRESS BOX 1A, RADIO AGE.

PATENTS

FOR SALE: U. S. and Canadian Patent on an Attachment for Phonographs is the most beautiful invention of the age. Address Chas. F. Smith, Huff, N. Dak.

PERSONAL

LONELY HEARTS: Exchange letters; make interesting new friends in our jolly club. Eva Moore, Box 908, Jacksonville, Florida. Enclose stamp.

Look! You Radio Bugs! Join Radio Correspondence Club. Entirely new. Broaden your acquaintance, exchange ideas. Membership open to LADY BUGS also. Dime stamp brings pamphlet and Radio Novelty Cards. Radio Rose, Box 662, Cleveland, Ohio.

PRINTING

WE print Stationery, Booklets, Catalogs, Circulars. Samples. Commercial Press, Batavia, Ohio.

RADIO

A PRACTICAL TUBE RECEIVING SET FOR $10, Postpaid, less phones and tube. Complete with phones, tube and battery, $18.00. J. B. RATHBUN, 1067 Winona St., Chicago, Ill.

Standard soderless radio Jacks. Binding post attachments. Double circuit. One dollar bill. Postpaid. Clinton Seward, Jr., New Paltz, New York, N. Y.

Three Cosmopolitan Phusiformers, each $5.50, book of instructions included. F. A. Mall, Triopli, Iowa.

15 to 25 per cent discount on nationally advertised sets and parts. Every item guaranteed. Tell us your needs. IMPERIAL RADIO COMPANY, Delaware, Ohio.

RADIO SETS. Our prices save you money. Lists free. The Radio Shoppe, Box 645, East Liverpool, Ohio.

AT LAST The Radco Static Eliminator. Eliminates 50 to 90% Static. Many satisfied users. Write for particulars. Radio Specialties Company, Sioux Falls, South Dakota.

NOTICE TO READERS!

Up to and including August 15, 1925, the August number of RADIO AGE will sell for the customary price of 25c per copy, but after that date the price will be 50c per copy. If you wish for additional copies, or know of friends who might want this August issue, BUY NOW before the price goes up!

RADIO CIRCUITS

SPECIAL FOR JULY

The Reinartz Radio Booklet, by Frank D. Pearne, fully illustrated, and RADIO AGE, for $2.50. Price of Booklet alone is 50c. Send check, currency or money order to RADIO AGE, 500 N. Dearborn Street, Chicago.

RADIO DEALERS

DEALERS—Write for our illustrated catalog of reliable Radio Merchandise. Rossiter-Manning Corporation, Dept. D, 1830 Wilson Ave., Chicago, Ill.

RADIO SUPPLIES

Ten per cent discount on all standard radio parts, from condensers to transformers to tubes, etc. Send for our latest price list, with special bargains on Static-eliminators, portable loud speakers, Radiotrons, German silver wire, etc. RADIOGRAPH LABORATORIES. 1234 Rosemont Ave., Dept. 4, Chicago, Ill.

STAMPS AND COINS

158 Genuine Foreign Stamps. Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc., only 5c. Finest approval sheets, 50 to 60 per cent. Agents Wanted. Big 72-p. Lists Free. We Buy Stamps. Established 20 Years. Hussman Stamp Co., Dept. 152, St. Louis, Mo.

STAMPS, 50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., 10c. 50 different U. S., 25c; 1,000 mixed, 40c; 1,000 hinges, 10c. List free. C. Stegman, 5950 Cote Brilliante, St. Louis, Missouri.

VOCATIONS

Make Big Money. Safe and Lock Expert. Wayne Strong, 3800 San Franco St., Los Angeles, Calif.

WANTED

WANTED—To complete my set RADIO AGE need August, September, October, November, 1923, issues, bound or unbound. Advise price. Lloyd C. Henning, Hellbrook, Arizona.

WIRELESS

WANT TO MEMORIZE THE WIRELESS CODE? The Coryden Snyder Code Method. Patented, is quickest. Send 50c coin, stamps or M. O. to C. G. Snyder, 1423 Elmdale Ave., Chicago, Ill.

TELEGRAPHY—Morse and Wireless—taught at home in half usual time and at trifling cost. Omnigraph Automatic Transmitter will send, on Sounder or Buzzer, unlimited messages, any speed, just as expert operator would. Adopted by U. S. Govt. and used by leading Universities, Colleges, Technical and Telegraph Schools throughout U. S. Catalog free. Omnigraph Mfg. Co., 13 F Hudson St., New York.

WRITERS

NEW WRITERS WANTED—Articles, stories, poems, scenarios, etc. $13,500 just paid to unknown writer. Entirely new field. (No. bunk.) NOT A CORRESPONDENCE COURSE. Moving picture industry and publishers crying for new original material. YOU CAN DO IT. We buy manuscripts for books and magazines. Send self addressed envelope for list of 100 subjects. CALIFORNIA STUDIOS, P. O. Box 697, Los Angeles, Calif.

WRITERS—Cash in on your knowledge of radio by writing for Radio Magazines and Newspaper Supplements. Write up your radio experiences, your new hook-up, your knowledge of broadcasting stations and artists. Experienced authors will correct and improve your manuscripts—make them typically professional work. FREE Criticism and Advisory Service until your manuscript is sold! ALL Magazines and Papers demanding fiction and articles dealing with radio. Here is YOUR OPPORTUNITY to profit! Send for FREE booklet, "How You Can Sell Your Manuscripts." Willis Arnold and Associates, 210 East Ohio St. Chicago, Ill.

Make big money writing Movie Plays. Circulars free. W. C. Krug, Ashton, Illinois.

Have you ordered your September Radio Age?

POLK'S REFERENCE BOOK
FOR DIRECT MAIL ADVERTISERS

Shows how to increase your business by the use of Direct Mail Advertising. 60 pages full of vital business facts and figures. Who, where and how many prospects you have. Over 8,000 lines of business covered.

Write for your FREE copy.

R. L. POLK & CO., Detroit, Mich.
599 POLK DIRECTORY BUILDING
Branches in principal cities of U. S.

$3.25 COD

RADIO
Storage "B" Battery
12 Cells 24 Volts *Lasts Indefinitely—Pays for Itself*

Economy and performance unheard of before. Recharged at a negligible cost. Approved and listed as Standard by leading Radio Authorities, including Pop. Radio Laboratories, Pop. Sci. Inst. Standards, Radio News Lab., Lefax, Inc., and other important institutions. Equipped with *Solid Rubber Case*, an insurance against acid and leakage. Extra heavy glass jars. Heavy, rugged plates. Order yours today!

SEND NO MONEY Just state number of batteries wanted and we will ship day order is received. Extra Offer: 4 batteries in series (96 volts), $12.75. Pay expressman after examining batteries. 5 per cent discount for cash with order. Mail your order now!

WORLD BATTERY COMPANY
1219 So. Wabash Ave., Dept. 81, Chicago, Ill.
Makers of the Famous World Radio "A" Storage Battery
Prices: 6-volt, 100 Amp. $12.25; 120 Amp. $14.25; 140 Amp. $15.00. All equipped with Solid Rubber Case.

World FOR RADIO **STORAGE BATTERIES**

KDKA WEAF WGN WJZ KHJ KGO KFAF WJY KOB

Radio Dealers HEADQUARTERS

Dealers—if you want the best products, the fastest shipments and the most liberal discounts, write on your letterhead for our catalog L1003.

WAKEM & McLAUGHLIN
225 E. ILLINOIS ST. — CHICAGO

RAULF RADIO CONSOLE
MFG. CO. 562 VEDDER ST.
CHICAGO. WRITE FOR CIRCULAR

Radio Age Institute

Manufacturers' Testing Service

MEMBERS of the staff of RADIO AGE will be pleased to test devices and materials for radio manufacturers with the object of determining their efficiency and worth. All apparatus which meets with the approval of various tests imposed by members of the technical staff of RADIO AGE will be awarded our endorsement, and the Institute seal will be furnished free of charge. Materials for testing should be sent to

RADIO AGE INSTITUTE
504 N. Dearborn Street, Chicago, Ill.

DEVICES displaying this seal have been tested and approved by the RADIO AGE INSTITUTE.

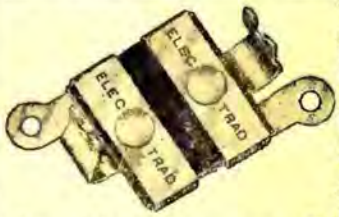
Apparatus illustrated and described below has successfully passed our tests for August, 1925.

Test No. 79 consists of a grid condenser made in circular form with conventional lugs for making connections. A cut-away section shows the plates made of thin brass leaves with ample dielectric, the whole mounted securely in a metal housing. The capacity is stamped on the back of the housing. Submitted by the A. E. Hill Manufacturing Co., of Atlanta, Ga. Tested and approved by the RADIO AGE Institute.

Test No. 80. A compensated multiple variable condenser which the manufacturers claim to be the only practical single dial control unit on the market. Submitted by the United Scientific Laboratories, Inc., 80 Fourth Avenue, New York City. It can be built into any tuned radio frequency circuit; is compact and space saving and reduces panel requirements. This new multiple is a straight-line, low-loss condenser making the sharpest tuning, quick and easy. The manufacturers claim that dozens of stations can be brought in instantly. Capacity .00035 mfd. per unit. Tested and approved by RADIO AGE Institute.

Test No. 81. Submitted by the Anylite Electric Co., at Ft. Wayne, Ind. The sample consists of an audio frequency transformer, well built and shielded, designed for use in any audio amplifier where clearness of speech and volume is desired. *Tested and approved* by RADIO AGE Institute.

Test No. 82. SILVER "TWO-TENS" and "TWO-ELEVENS." Long wave transformers. New style Bakelite Cases, replacing the old type aluminum case, and far more efficient. Supplied in sets of 2 or 3 210's (iron core interstage and one 211, (filter for input or out-put) with identical peaks and separate curves. The feature of these transformers lies in the fact that the makers plot the curve in their own laboratory and record them directly on a tag attached to each transformer before it is placed on sale. Tests to determine the accuracy of these charted and matched transformers were conducted in this magazine's laboratory and in every instance the tag attached to each transformer was found to have the correct curve. Manufactured and submitted by Silver-Marshall, Inc., 105 S. Wabash Ave., Chicago. Satisfactorily passed the tests and requirements of the RADIO AGE Institute.



Test No. 83 submitted by the Electrad, Inc., 428 Broadway, New York. Sample consists of a grid condenser type G-S equipped with punched connecting lugs by means of which the condenser may be mounted directly to the socket. There are two prongs for the use of a cartridge resistance of a grid leak. The capacity of each condenser is stamped on the prongs. Tested and approved by the RADIO AGE Institute.

Test No. 84. Sample submitted by the Walbert Mfg. Co., 925 Wrightwood Ave, Chicago, Ill. This socket of bakelite with a safety top rim has both side and bottom contacts for the prongs of a vacuum tube. With both types of friction contact there should be no difficulty with loose connections. Tested and approved by RADIO AGE Institute.

Test No. 85. Submitted by Dongan Electric Manufacturing Co., 2983 Franklin St., Detroit, Mich. This unit is designed for delivery from 110 volts, a.c. of the necessary voltage for the new McCullough a. c. tubes. Equipped with lever switch for various voltage taps. Tested and approved by RADIO AGE Institute.

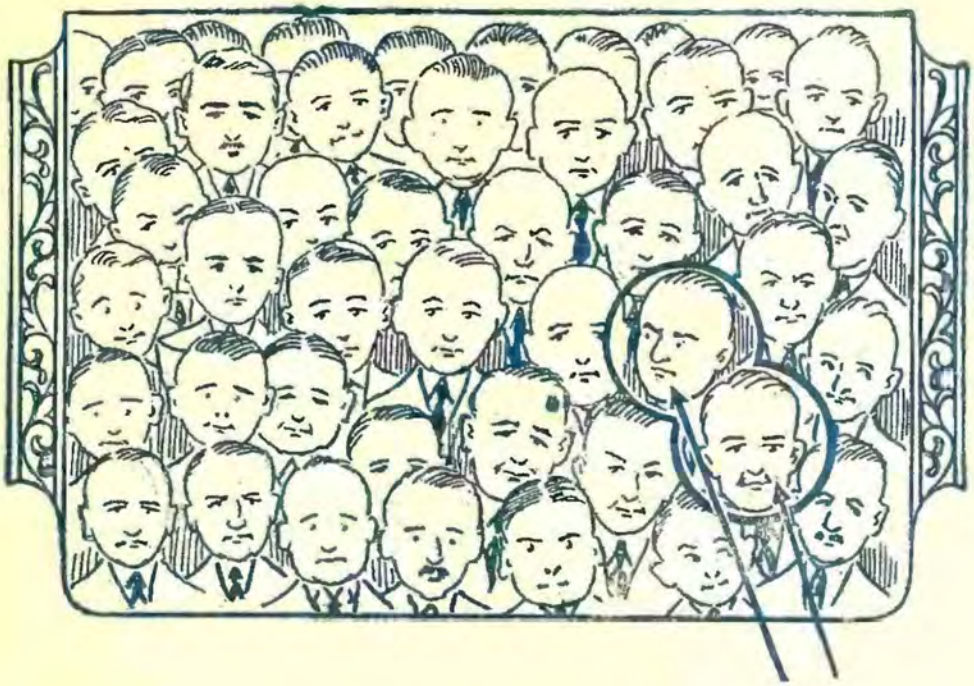
MARSHALL Radio Frequency Receivers

Embodying a marvelous New Non-Oscillating Principle

Sold Direct on Free Trial and Easy Terms

Write for catalog and Special Offer

Marshall Radio Products, Inc.
Dept. B-589 Marshall Blvd. & 19th St., Chicago



Mr. Manufacturer

Would you write 100 letters to 100 people to reach just two men?

Then, before you invest your advertising dollars—THINK!

This Association is comprised of the leading Radio Magazines.

An analysis shows that publications of general circulation, newspapers and magazines, devote less than 2% of their reading columns to Radio—proving that in the opinion of their own Editors less than 2% of their readers are interested in Radio. In fact, many general publications carry no Radio editorial matter. Therefore—98% of your investment is lost!

On the contrary, the Radio magazine offers 100% Radio editorial—attracts 100% potential buyers.

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Radio Magazine Publishers' Association, Inc.

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ZENITH

TRADE MARK REG.

→LONG DISTANCE← RADIO

TRADE MARK REG.

Arctic Explorers Stake Their Lives on Zenith Radio—

Costs More
But Does More

Super-Zenith IX

It is one thing to select a radio set for pleasure only—it is quite another to select a set which may be called upon most unexpectedly to save your life.

Alone in the Arctic—cut off from the nearest rescue post by hundreds of miles of ice and open water—men cannot run to the nearest radio shop for repairs. If transportation fails, ***and radio does not work,*** they are in the gravest peril.

This summer—across the million square miles of unexplored territory stretching between Alaska and the North Pole—MacMillan and his party of explorers will fly in three great navy planes. Each of these cruising airplanes is equipped with Zenith radio, as are the ***Bowdoin*** and the ***Peary,*** which will locate at Etah as their base. Between ships and airplanes messages will be sent and received.

When Arctic explorers of MacMillan's calibre stake their lives—repeatedly—on Zenith performance, one reason only can explain their choice—***Zenith has proved to be the best obtainable, at any price.***

Call this evening at your nearest Zenith dealer and let him prove it to you by a demonstration.

ZENITH RADIO CORPORATION
310 South Michigan Avenue, Chicago

THE complete Zenith line ranges in price from $100 to $475.

With either Zenith 3R or Zenith 4R, satisfactory reception over distances of 2,000 to 3,000 miles is readily accomplished, ***using any ordinary loud speaker.*** Models 3R and 4R licensed under Armstrong U. S. Patent No. 1,113,149. They are NON-RADIATING.

Zenith 4R - $100
Zenith 3R - $175

The new Super-Zenith is a six-tube set with a new, unique, and really different patented circuit, controlled exclusively by the Zenith Radio Corporation. It is NOT regenerative.

SUPER-ZENITH VII—Six tubes—2 stages tuned frequency amplification—detector and 3 stages audio frequency amplification. Installed in a beautifully finished cabinet of solid mahogany—44⅞ inches long, 16¾ inches wide, 10⅝ inches high. Compartments at either end for dry batteries. Price (exclusive of tubes and batteries)..... **$240**

SUPER-ZENITH VIII—Same as VII except—console type. Price (exclusive of tubes and batteries)..... **$260**

SUPER-ZENITH IX—Console model with additional compartments containing built-in Zenith loud speaker and generous storage battery space. Price (exclusive of tubes and batteries)..... **$355**

SUPER-ZENITH X—Contains built-in, patented, Super-Zenith Duo-Loud Speakers (harmonically synchronized *twin* speakers and horns), designed to reproduce both high and low pitch tones otherwise impossible with single-unit speakers. Price (exclusive of tubes and batteries) **$475**

All Prices F. O. B. Factory

Zenith Radio Corporation
Dept. C-8
310 S. Michigan Avenue, Chicago, Illinois

Gentlemen:
Please send me illustrated literature about Zenith Radio.

Name.....

Address.....

.....

* *Tested and Approved by* RADIO AGE *

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