RADIO NEWS

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Over 200 Illustrations

BROADCAST WRNY STATION

Edited by HUGO GERNSBACK

Hearing Plants Grow By Radio

See Page 812

EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

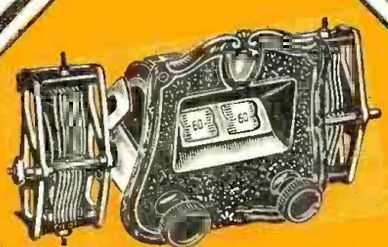
PILOT JUMBO DOUBLE CHOKE COIL UNIT

PILOT WORLD'S LARGEST RADIO PARTS PLANT

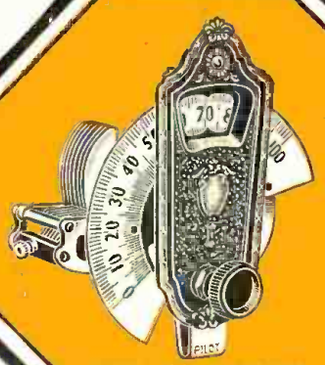
PILOT JUMBO FILTER CONDENSER BLOCK

RADIO MANUFACTURERS SINCE 1908

PILOT JUMBO POWER TRANSFORMER



PILOT ILLUMINATED DRUMS DOUBLE AND SINGLE DIALS



PILOT ILLUMINATED DIAL VERNIER TYPE

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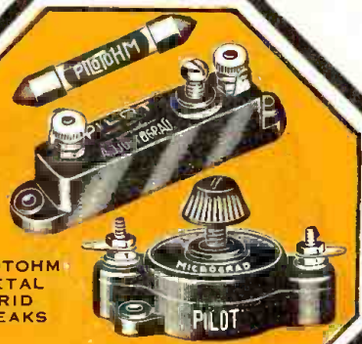
PILOT PERFECTED CONDENSERS WITH BUILT-IN COMPENSATORS TRIPLE, DOUBLE AND SINGLE TYPES

LOOK FOR THE PILOT

PILOT MOISTURE-PRUF TRANSFORMERS ALL TYPES

PILOT WORLD'S LARGEST RADIO PARTS PLANT



PILOTOHM METAL GRID LEAKS

PILOT ADJUSTOGRAD
PILOT MICROGRAD

TRADE MARK REGISTERED

FREQUENT TESTS AND INSPECTIONS CONSTANTLY MAINTAIN THE PRECISION WHICH CHARACTERIZES ALL PILOT RADIO PARTS.

PILOT ELECTRIC MF'G. CO

323 BERRY ST. BROOKLYN, N.Y. INC.

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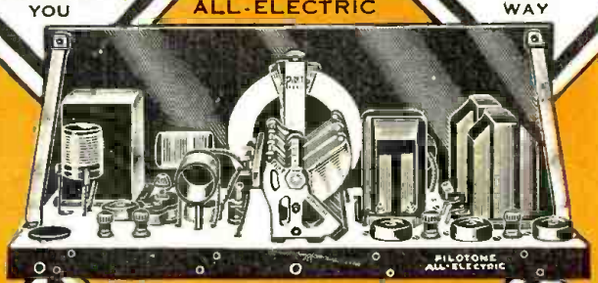
PILOT ENGINEERS ARE DEVELOPING A NEW SERIES OF RECEIVERS IN KIT FORM EMPLOYING TRIED AND TESTED CIRCUITS.

THE PILOT PROTECTS YOU

PILOTONE FRONT PANEL SIMPLE - BEAUTIFUL SIMPLY BEAUTIFUL!

PILOTONE ALL-ELECTRIC



ONE OF THE NEWLY DEVELOPED PILOT KITS. AN A-C JOB WITH PUSH-PULL AMPLIFICATION AND BUILT-IN "A" POWER

PILOT LEADS THE WAY

PILOTONE "B" ELIMINATOR DESIGNED ESPECIALLY FOR THE PILOTONE A-C RECEIVER

5 Easy Ways *to Make $3.00 an hour in Your Spare Time in* RADIO

Each of these plans, developed by the Radio Association of America, is a big money-maker. Set owners everywhere want to get rid of static, to have their sets operate from the electric light socket, the tone improved, and the volume increased, and transformed into single-dial controls. Phonograph owners want their machines electrified and radiofied. If you learn to render these services, you can easily make $3.00 an hour for your spare time, to say nothing of the money you can make installing, servicing, repairing, building radio sets, and selling supplies.

Over $600,000,000 is being spent yearly for sets, supplies, service. You can get your share of this business and, at the same time, fit yourself for the big-pay opportunities in Radio by joining the Association.

Join the Radio Association of America

A membership in the Association offers you the easiest way into Radio. It will enable you to earn $3.00 an hour upwards in your spare time—train you to install, repair and build all kinds of sets—start you in business without capital or finance an invention—train you for the $3,000 to $10,000 big-pay radio positions—help secure a better position at bigger pay for you.

A membership need not cost you a cent!

The Association will give you a comprehensive, practical, and theoretical training and the benefit of its Employment Service. You earn while you learn. Our cooperative plan will make it possible for you to establish a radio store. You have the privilege of buying radio supplies at wholesale from the very first.

Earned $500.00 Spare Time

Frank J. Deutsch, Penn.: "I have made over $500 out of Radio in my spare time."

Radio Engineer In One Year

Claude De Grave, Canada: "I knew nothing about Radio when I joined a year ago. I am now a member of a very exclusive organization of Radio Engineers, and my income is 225% greater than it was."

Doubles Income In 6 Months

W. E. Thon, Chicago: "Six months after I enrolled I secured the managership of large Radio Store and doubled my income."

ACT NOW—If You Wish the No-Cost Membership Plan

To a limited number of ambitious men, we will give Special Memberships that may not—need not—cost you a cent. To secure one, write today. We will send you details and also our Radio Handbook filled with dollars-and-cents radio ideas. It will open your eyes to the money-making possibilities of Radio.

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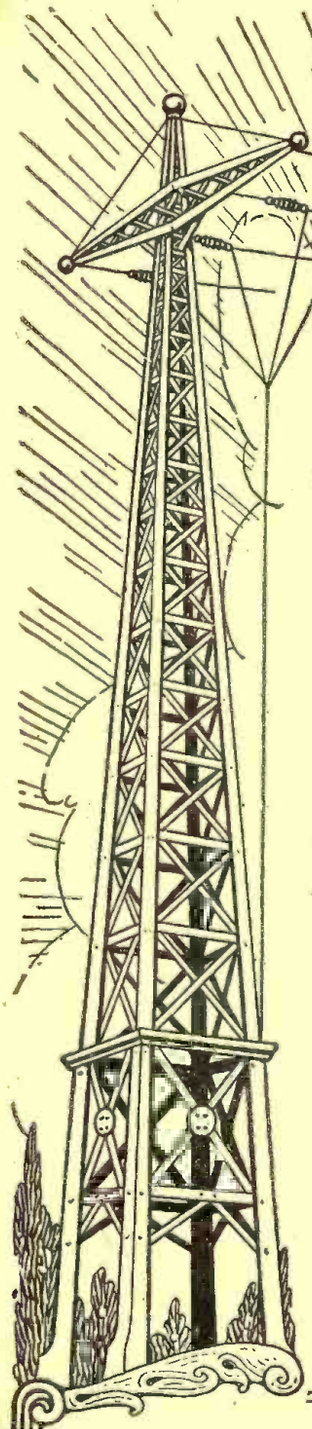
Dept. RN-3 4513 Ravenswood Ave., Chicago, Ill.

Gentlemen: Please send me by return mail full details of your Special Membership Plan, and also copy of your Radio Handbook,

*Name*_____

*Address*_____

*City*_____ *State*_____



RADIO NEWS

Volume 10 March, 1929 Number 9

Contents of This Issue

In Our Next Number

METHODS OF DETECTION: A simple and understandable explanation of the two main methods used in broadcast receivers: grid-condenser and leak, and plate rectification. The advantages and disadvantages of each will be listed, and some practical information on how the systems are best used will be given.

SHORT-WAVE AERIALS AND GROUNDS: What every short-wave enthusiast should know about the most important part of his installation—the pick-up system. Accompanying the theoretical discussion will be a section devoted to hints on actual antenna arrangements.

CONSTRUCTIONAL ARTICLES: Among the receivers to be the subjects of our blueprint articles are a fine seven-tube superheterodyne using screen-grid amplifier tubes, and an unusually compact screen-grid short-wave receiver. The "super" is as sensitive and selective a broadcast receiver as can be built to-day, and will appeal to constructors and custom radio builders who want the best.

Blueprint Notice—*see page* 837

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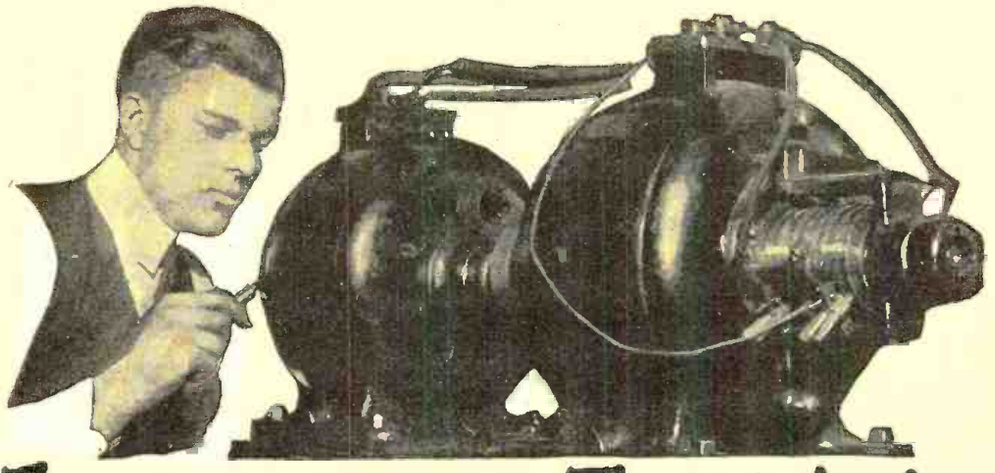

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INDEX TO ADVERTISERS

I will show you too how to start a spare time or full time Radio Business of Your Own without capital

Radio's amazing growth is making many big jobs. The world-wide use of receiving sets and the lack of trained men to sell, install and service them has opened many splendid chances for spare time and full time businesses.

Ever so often a new business is started in this country. We have seen how the growth of the automobile industry, electricity and others made men rich. Now Radio is doing the same thing. Its growth has already made many men rich and will make more wealthy in the future. Surely you are not going to pass up this wonderful chance for success.

Read what BIG money these fellows have made in the RADIO BUSINESS

$375 One Month Spare Time

"Recently I made $375 in one month in my spare time installing, servicing, selling Radio sets. And, not so long ago, I earned enough in one week to pay for my course."
EARLE CUMMINGS,
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$1597 In Five Months

"The N. R. I. is the best Radio school in the U. S. A. I have made $1597 in five months. I shall always tell my friends that I owe my success to you."
HENRY J. NICKS, Jr.,
302 Safford Ave.,
Tarpon Springs, Fla.

$1164 Spare Time Profits

"Look at what I have made since I enrolled, $1,164—money I would not have had otherwise. I am certainly glad I took up Radio with N. R. I. I am more than satisfied."
HENRY R. HEIKKINEN,
123 W. Erie St., Chicago, Ill.

Over $1000 In Four Months

"My opinion of the N. R. I. course is that it is the best to be had at any price. When I enrolled I didn't know a condenser from a transformer, but from December to April I made well over $1000 and I only worked in the mornings."
AL. JOHNSON,
2409 Shelby St., Sandusky, Ohio.

More Trained Radio Men Needed

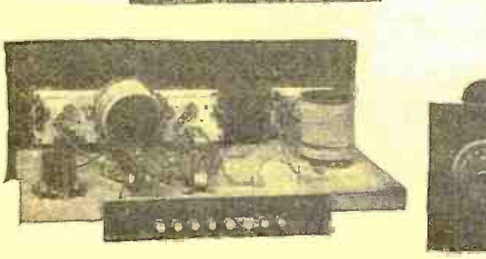
A famous Radio expert says there are four good jobs for every man trained to hold them. Radio has grown so fast that it simply has not got the number of trained men it needs. Every year there are hundreds of fine jobs among its many branches such as broadcasting stations, Radio factories, jobbers, dealers, on board ship, commercial land stations, and many others. Many of the six to ten million receiving sets now in use are only 25% to 40% efficient. This has made your big chance for a spare time or full time business of your own selling, installing, repairing sets.

So Many Opportunities You Can Make Extra Money While Learning

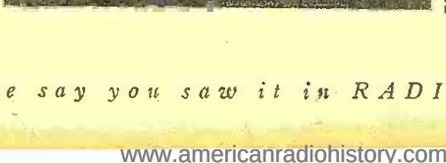
Many of our students make $10, $20, $30 a week extra while learning. I'll show you the plans and ideas that have proved successful for them—show you how to begin making extra money shortly after you enroll. G. W. Page, 1807-21st Ave., S., Nashville, Tenn., made $935 in his spare time while taking my course.

I Give You Practical Radio Experience With My Course

My course is not just theory. My method gives you practical Radio experience—you learn the "how" and "why" of practically every type of Radio set made. This gives you confidence to tackle any Radio problems and shows up in your pay envelope too.



You can build 100 circuits with the Six Big Outfits of Radio parts I give you. The pictures here show only three of them. My book explains my method of giving practical training at home. Get your copy!



I Will Train You At Home In Your Spare Time

I bring my training to you. Hold your job. Give me only part of your spare time. You don't have to be a college or high school graduate. Many of my graduates now making big money in Radio didn't even finish the grades. Boys 14, 15 years old and men up to 60 have finished my course successfully.

You Must Be Satisfied

I will give you a written agreement the day you enroll to refund your money if you are not satisfied with the lessons and instruction service when you complete the course. You are the only judge. The resources of the N. R. I. Pioneer and Largest Home-Study Radio school in the world stand back of this agreement.

Get My Book

Find out what Radio offers you. My 64-page book, "Rich Rewards in Radio" points out the money making opportunities the growth of Radio has made for you. Clip the coupon. Send it to me. You won't be obligated in the least.

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This coupon is good for a FREE copy of my Valuable Book. Mail it NOW!

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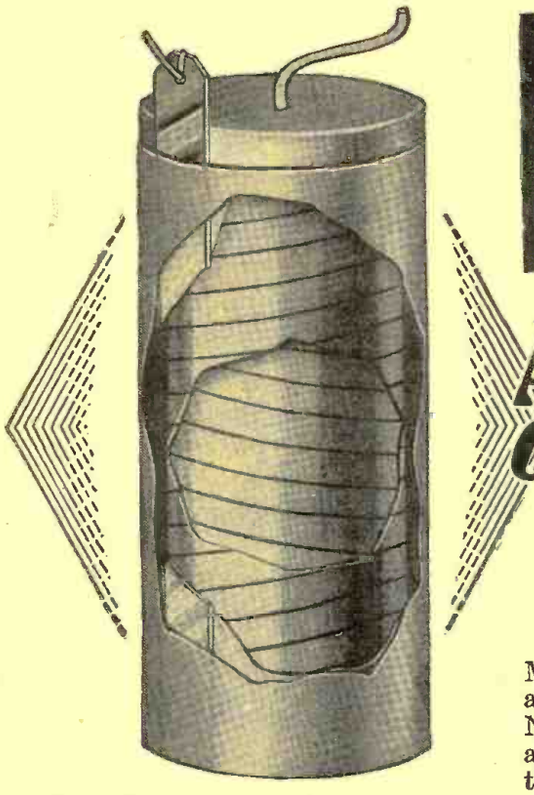
Dept., 9-PT
National Radio Institute, Washington, D. C.

Dear Mr. Smith: Send me your book. I want to know more about the opportunities in Radio and your practical method of teaching at home in spare time. This request does not obligate me to enroll and I understand no agent will call on me.

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

Address.....

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



NEW

ANTENNA and GROUND

Combined in one convenient Unit

A wonderful thing has happened in radio! Convenience never before dreamed of! Clearer, sweeter-toned reception! Radio pleasure with less interruption! These things are brought to you by the amazing, tested, approved, EARTHANTENNA.

Many set owners have come to realize the importance of using a dependable antenna, also the value of perfect grounding in getting good reception. Now science has gone a step further; it says that the LOCATION of the antenna is an equally important factor in getting best results. Because the radio wave goes right into the earth—where obviously there is less atmospheric disturbance and interference—it is claimed the logical place for the antenna should be the EARTH, not the air. This important conclusion allowed Radio Engineers to work out the EARTHANTENNA.

Reduces Static—

Gets Clearer, Sweeter Tone

Have you ever listened to reception that almost took your breath away with its faultless reproduction, its pure melodious tone? And then gone home and compared its haunting beauty to YOUR receiver's often unsatisfactory, static-ridden performance? Probably nine out of ten set owners who formerly thought they were getting "pretty good" reception have had this experience.

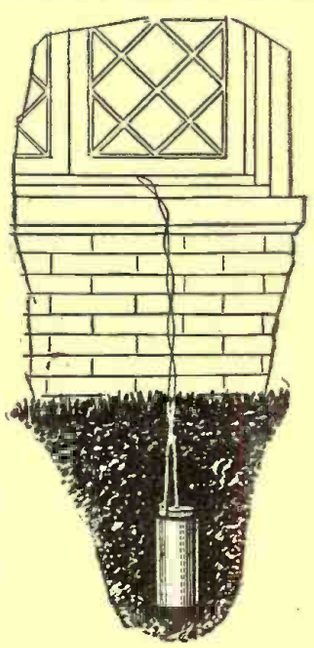
They accepted the shrieks, whistles, knocking and howls due to atmospheric conditions—the weak, faulty results of sagging, broken, or soot-laden aerial wires—the interference of other aerials or power line noises—the fading often caused by corrosion or imperfect contact in an unscientific ground—all as necessary evils.

Progressive radio refused to stop there. The new scientific, successful EARTHANTENNA is designed to give you clearer, better, more dependable reception—and it costs no more than the old inefficient aerial—in fact less than many.

EARTHANTENNA is so easy to install that soon people will wonder how they ever put up with the old, dangerous, slow methods. You simply dig a small hole only two feet below the surface of the ground, drop the EARTHANTENNA into it and attach the lead-in wires to your set. Now you are ready to listen to earth-clarified, sweeter-toned ground-wave reception. You never need to touch the EARTHANTENNA again.

Shielded Antenna Gets Better Reception

The antenna is insulated or "shielded" against electro-static disturbances as are the most advanced, expensive receivers and their various parts. Science declares that the earth itself "shorts" the electro-static capacity before it reaches the Antenna. This acts as another shield. The ground element is constructed of copper, undisputed as the most effective material for obtaining a perfect ground connection. This section of the unit is separated from the Antenna by the insulation which shields the Antenna. So in the EARTHANTENNA you have a scientific ground and an antenna of modern shielded construction combined in one compact unit. You can test it yourself right now at our risk. Hear the wonderful results!



Test EARTHANTENNA at OUR Risk

Let EARTHANTENNA prove its own value without your risking one cent. Don't remove your old aerial and ground until you've compared the old and modern methods and hear the vast improvement with the new. If possible pick a time when static is bad. Then if you are not convinced that EARTHANTENNA is the greatest discovery you've ever found for your radio—if you are not enthused over the improvement—you don't pay us a cent. The thrilling details of this important development—illustrated—will be sent immediately on receipt of this coupon. Mail it NOW!

The Modern Antenna Company

Dept. 827CE St. Clair Bldg., cor. St. Clair and Erie Streets
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THE MODERN
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Address.....

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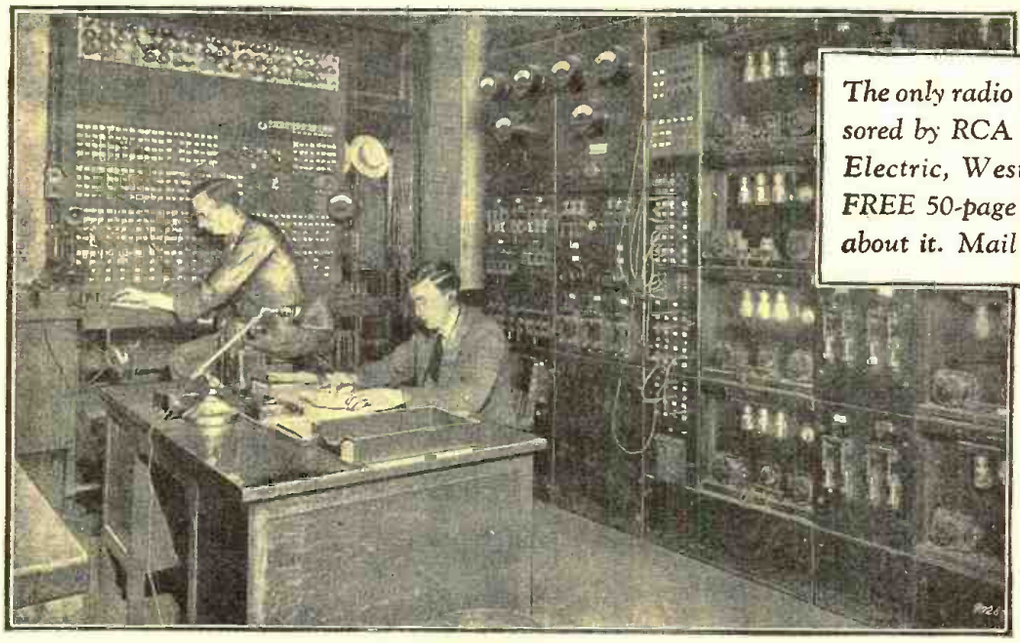
"I Found the Short Cut to Success in Radio

through this amazing home laboratory method!"



The only radio training sponsored by RCA . . . General Electric, Westinghouse . . . FREE 50-page book tells all about it. Mail coupon.

By Frank Halloran

I GOT hungry to get into Radio when I learned about the big money it was bringing my next door neighbor.

He was only twenty-eight years old, but his income was over four times as much as I was getting. He owned a fine car, dressed in expensive clothes, took week-ends off to go hunting and fishing, and was one of the most popular fellows in town.

"Charlie," I asked him one day, "how did you become a radio expert?"

"A cinch," he smiled. "I took it up in my spare time at home."

"What?" I asked in surprise, "you actually took a radio course by mail?"

"No," he shot back. "Not just a mail order course, but the only technical home-laboratory training conducted under the auspices of RCA, Westinghouse and General Electric! Believe me, these 'big-league' organizations not only know what's what in radio, but they know how to teach it!"

A Great Piece of Luck

Taking Charlie's advice was the luckiest thing I've ever done. It's bringing me more money in a week than I've often earned in a month!

I never dreamed that learning radio at home was so easy and so fascinating. From the very first lesson to the last I was thrilled! Each subject was explained in simple word and picture form . . . . and written in such an interesting style that I was carried along like a novel!

I didn't know the first thing about radio when I started, yet before many months were over I was able to solve many of the problems which now help me command big money. The lessons took me step by step through trouble-finding and repairing . . . . through ship and shore and broadcasting apparatus operation and construction . . . . through photoradiograms, television and beam transmission . . . . through radio salesmanship, store operation and executive work.

Success—In Spare Time!

I didn't have to give up my regular job. I learned at home during my spare time. And I actually learned by doing! With the course, I received an outlay of the finest standard apparatus with which I was able to build radio circuits and sets of almost every description . . . . yet this expensive apparatus cost me absolutely nothing extra!

Even before I had completed the course I was able to earn good money doing odd radio jobs. And it wasn't long after that I was able to give up my regular work and branch out for myself as a full-fledged expert in work that is fun and extremely profitable!

Today, my income is more than doubled . . . . and I've only just started! I'm certainly happy that I found this short cut to success!"

Read This Thrilling FREE Book

Frank Halloran's wonderful success is just another typical example of the success which the Radio Institute is bringing to hundreds of men everywhere through its wonderful Home-laboratory training . . . the only official radio training based on the inside knowledge of radio developed in the great experimental laboratories of RCA, General Electric and Westinghouse!

There is an amazing opportunity for you in Radio. Manufacturers, dealers, broadcasting stations, ships . . . all are calling for trained radio experts. The pay is big—the opportunities are limitless—the work is thrilling! Find out all about it. The Institute has prepared an interesting, illustrated booklet telling you all you want to know about this vast industry and about the remarkable home study-course that can fit you for a brilliant radio career. Just mail the coupon below and claim your copy of this valuable booklet . . . *it's absolutely free!* Radio Institute of America, Dept. R. N. 3, 326 Broadway, New York

Mail this coupon

Radio Institute of America
Dept. R. N. 3, 326 Broadway, New York, N.Y.

Gentlemen: Please send me your FREE 50-page book which tells all about the great opportunities in Radio and about your famous home-laboratory method of guaranteed radio instruction sponsored by RCA, General Electric and Westinghouse.

Name.....

Address.....

SM On Top of the World— S-M Screen Grid Six and Sargent-Rayment Seven

(All testimonials here quoted were entirely unsolicited)

"Just to say that I have one of your 720 Screen-Grid Six's with 670B power unit . . . Picked up Japan, 1:00 A. M.—came in strong—four stations in Chicago and everything up and down the coast . . . "
—F. A. Forbes, Oakland, Calif.

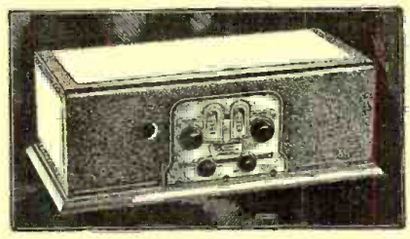
"Think of the thrill of getting your dinner concert from KFI on a 6-tube receiver away up here in Northern Wisconsin . . . At the end of the dial twisting session I had 28 stations over 1000 miles away, from 21 states and 3 provinces of Canada, and WKAQ, Porto Rico . . . "
—Clinton B. DeSoto, Withee, Wis.

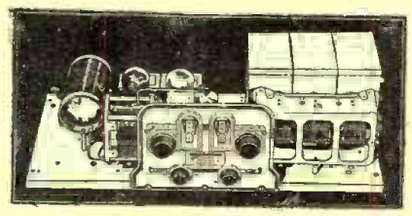
"I am writing to tell you about the results I am getting from the 720 Screen Grid Six. I have brought in stations from New York to Japan with good volume on the speaker and the tone quality is very natural . . . The following are some of the stations I have received: JOIK, Sapporo, Japan, WHAM, Rochester, N. Y. . . . I had two other Japanese and some other foreign stations, but I haven't the call letters yet. WLW, WGN, KWKH come in good almost every night."
—Alonzo Henderson, Mossy Rock, Washington.

"I am having great success with the 720 and 740 sets. Only today, I received 3 orders for 720s and one for a 730. In all my experience of building kits for fans, I have never had the feeling of really giving value till I took up your line. I think it is the best that money can buy in its class and my long list of satisfied customers surely is the proof that their sets are wonderful."
—Howard Brett, New York City.

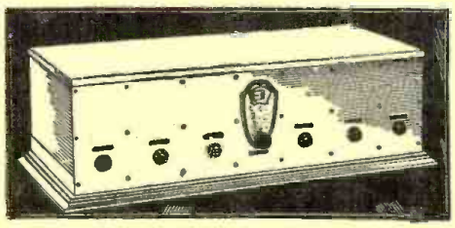
"Last night picked up Halifax, Nova Scotia with such volume that I had to turn the volume control half off. We then proceeded to pick distance to the satisfaction of the prospect . . . I got his order then and there.
—L. Frank Miller, Brooklyn, N. Y.

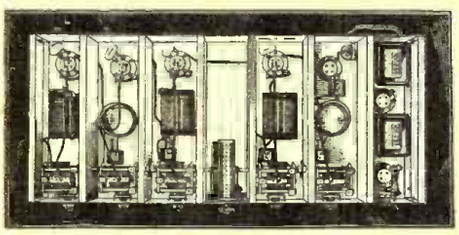
The plain cold facts are simple. The Silver-Marshall 720 is a six-tube t.r.f. set using three screen-grid tubes, a detector, and two stages of S-M Clough audio amplification. It's an all-metal, shielded assembly, just like the finest ready-made sets, with its own attractive two tone brown metal shielding cabinet, its antique brass escutcheon plate with two dials, volume knob, and a small selectivity knob. Yet this set with its three stages of screen grid r.f. amplification, and its audio system that money can't buy in a ready-made set, costs you but $72.50 for the S-M packed kit, or $102.00 for an S-M custom-built wired receiver, complete with cabinet.





"Boss of the Air"—Doubt It?—Read These:





The Sargent-Rayment Seven is the first and only set to offer four stages of screen-grid tuned r.f. amplification, and the unsurpassed tone quality of the S-M Clough audio system—the first and only set to give one-dial control, yet at the same time individual stage trimmers that mean the last drop of sensitivity when you want it. And its seven tubes, with 171, 210, or 250 power tube, give fine tone or hair-splitting selectivity, super-distance or local programs with thrilling quality. Shipped from stock: KIT $130.00—or FACTORY-WIRED $175.00. Both complete with handsome satin aluminum shielding cabinet.

THE MUNICIPAL COURT OF CHICAGO
Samuel H. Trude, Judge

"I am very much pleased with the custom-built 710 Sargent-Rayment receiver. . . which I have been using in connection with a cone-type loud speaker at the South Shore Country Club, Chicago.

"This is a remarkably good receiver for all kinds of radio reception. I have found that distant broadcasting stations can be tuned in on all wave channels over the entire broadcasting band—one and only one at a time with the single tuning drum."
—Samuel H. Trude

"It may interest you to know that the first station I tuned in was KOA (1500 miles away) and that last Saturday morning from 3 to 4 A.M. we listened to three stations in Japan—JOAK, JOGK, and JOAH."
—Walter A. Reeves, Seattle, Wash.

"Some time ago I bought a 710 Sargent-Rayment set from Mr. Toolan of Lansing, Michigan. . . It has marvelous tone, volume, sensitiveness, and selectivity. I am right across the street from WTAM and can tune them out. . .in a few points."
—J. W. Carvey, Cleveland, Ohio.

"I have just finished building one of your 710 Sargent-Rayment kits. I am delighted with its performance. It is the only set that I know of that will bring in stations here in the day time. . . It does it with good volume.
—Claude H. Matthews Roswell, N. M.

"The most I can say is—it was worth waiting for—the Sargent-Rayment 710. The most wonderful set I ever had anything to do with—goes together beautifully and makes a handsome job in its silvery-white finish."
—The Radio Shoppe, H. O. Hornbake, South Brownsville, Pa.

OTHER S-M KITS

Besides the 720 Screen-Grid Six and the 710 Sargent-Rayment Seven, S-M manufactures two other thoroughly modern receiver kits. The "Coast-to-Coast Four" (for D.C. or A.C. tubes) employs the popular four-tube circuit (1 screen-grid r.f. stage, regenerative detector, 2 stages Clough system audio).

The "Round-the-World Four" short-wave kits are highly successful either for code and phone reception or for re-broadcasting.

HIGH POWER AMPLIFICATION

The new two-stage S-M 678PD Phonograph Amplifier provides full 250-tube volume from any phonograph or radio receiver. For use with any 110-volt D.C. dynamic speaker; all power comes from 110-volt A.C. house-lighting mains. Price, less tubes, WIRED $73.00, KIT $65.00.

You can install a 250 power tube and adapter in your present set with no changes whatever, by using the S-M 675ABC high-voltage power supply. KIT, $54. WIRED, with adapter $58.

NEW PUSH-PULL APPARATUS

Built on the Clough system, with curves flat from below 50 cycles to well above 5,000, these transformers include all necessary types—input, output, and interstage (between two push-pull stages).

The new 690 double push-pull theatre amplifier, with undistorted power output of 15 to 16 watts, employs these new transformers to give power sufficient to cover large theatres, or stadiums, with such tone quality as only the S-M Clough audio system can produce.

Silver-Marshall, Inc.
848 W. Jackson Blvd., Chicago, U. S. A.

....Please send me, free, the complete S-M Catalog; also sample copy of The Radiobuilder.

For enclosed.....in stamps, send me the following:

.... 50c Next 12 issues of The Radiobuilder
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....No. 1. 670B, 670ABC Reservoir Power Units
....No. 2. 685 Public Address Unipac
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....No. 4. 223, 225, 226, 256, 251 Audio Transformers
....No. 5. 720 Screen Grid Six Receiver
....No. 6. 740 "Coast-to-Coast" Screen Grid Four
....No. 7. 675ABC High-Voltage Power Supply and 676 Dynamic Speaker Amplifier
....No. 8. Sargent-Rayment Seven
....No. 9. 678PD Phonograph Amplifier

.....Name
.....Address

Are you getting The RADIOBUILDER regularly? No. 9 (Jan. 1929) describes these new push-pull transformers, and the 690 Amplifier, as well as the new (and different!) S-M Dynamic Speakers. No. 7 (Nov. 1928) described in detail, with complete circuits, a 750-volt rectifying system. Sample copies may be had without charge as long as they last; use the coupon.

If you build professionally, by all means ask for information on the S-M Authorized Service Station proposition; its money-making opportunities are greater than ever.

SILVER-MARSHALL, Inc.

848 West Jackson Blvd., Chicago, U. S. A.

Radio News

Hugo Gernsback Editor & Publisher

Editorial and General Offices, 230 Fifth Avenue, New York

Vol. 10 MARCH, 1929 No. 9

Whither Radio?

By HUGO GERNSBACK

THE remarkable thing about radio is not this new art itself, but rather the human element connected with it. Strange to say, those who are intimately associated with it seem to be least certain whither radio is drifting and what is in store for it during the years to come. There is nothing new in this condition, because it has ever been thus with radio since the days of Heinrich Hertz.

Indeed, when Hertz first discovered "wireless waves," no one took the new discovery very seriously; not even the scientists themselves, who thought of it as only a pretty lot of laboratory experiments, to which there could not be attached any practical future. It took almost two decades to yank Hertz's experiments out of the laboratory and, even after Marconi brought "wireless" out into the open, there was another long period of development when few took the new art seriously, and even the most far-sighted scientists could not see much of a future for it.

When the first book devoted to this subject, one entitled "The Wireless Telephone," was written by me in 1910, there was no such thing as practical radio telephony. Though, by that time, it was conceded that "wireless telegraphy," at some time in the future, would have an adjunct in the form of radio telephony, no one dreamt of such a thing as radio broadcasting. Indeed, even at that time, in the preface to that book, I ventured the opinion that within ten years everyone (particularly farmers) would have a "wireless" telephone whereby they could communicate with each other, instead of using the wire telephone. The prophecy was to some extent fulfilled in time, but not at all in the way I had imagined. Everyone now has his "wireless telephone"; but it is not used to talk to the neighbors. It is only a *one-way* instrument, whereby we now receive what is put out by the broadcast stations; but we do not use it to talk with our friends.

In view of the past history of the radio art, he would be a rash prophet who undertook to foretell just what is in store for radio itself.

Thus, for instance, we are now talking glibly about radio television, radiovision and the like; but, at this time, most of us imagine that television will parallel broadcasting. It is freely predicted by everyone who is seemingly "in the know," that the large broadcast stations will sooner or later put on television broadcasts; so that anyone who has a set can see what is going on in the distant studio or at a remote point where the television program would be picked up—at the night club, or on the Metropolitan Opera stage, or at a baseball game, or a prize fight, or any other scene of visual broadcasting. Other wiseacres say that nothing of the kind will happen and that what we really will get will be "radio movies" broadcast from some studio; in other words, the latest Hollywood production will be run through a projecting machine at the transmitting station and the result will appear on the screen in your own home.

But it is quite possible that both these schools of prophets are wrong, and that television will play an entirely different part, which we do not even dimly discern today. One thing is sure; that the young art of television will take on a most surprising form, once it becomes established. How television and "aural" broadcasting will finally be amalgamated, even the most daring prophet does not venture to say.

The art of broadcasting as we have it today is yet in its first stage. In Europe it is thought necessary to tax listeners with a definite fee every month, in order that the stations may derive sufficient revenue to keep going. In this country, such an idea seems un-American, and a proposal to tax the public directly would excite their violent opposition; therefore the taxation is *indirectly* maintained, through the advertising appropriations for programs put on the air by big corporations who thus seek publicity.

No one can foretell, at the present time, whether the "advertising tie-up" broadcasting scheme of today is the final one, or that something entirely new may not be evolved in the future.

The entire broadcasting industry is in constant flux and there is really nothing very much settled about it today; it is too young and too new for that. It is also to be doubted that, ten years from now, broadcasting will be done in the channels between 200 to 545 meters now used. It is frequently predicted that, sooner or later, there will be a stampede down to the lower wavelengths, where there are more channels and other advantages, as well as certain disadvantages.

So far, large radio manufacturers have turned out no radio set, which can be sold to the public, capable of being tuned as readily on the short waves as it can be on the high waves. But it is safe to say, that most of the large manufacturers are keeping a weather eye on the short-wave situation and, if one or more break the ice and a good set that makes tuning on the short waves easy is developed, we will have another silent revolution in radio. Then the old prevailing sets will be scrapped in favor of new models, just as the battery sets are now being scrapped for A.C. electric sets.

The good thing about all of these radio revolutions is that they are orderly and that they do not come over night. Indeed, it has been found that sets built even as far back as 1923 still give good service in 1928. The same will probably be found the case with the present-day alternating-current sets, when the broadcast stations take to lower wavelengths. Most probably, in that case, attachments for present-day sets will be available to make possible tuning them to the short-wave bands.

The objection has been frequently raised, what will happen when all the stations abandon the present wave channels and move downwards? It is well known that, because of the "skip-distance" effect, a local short-wave station will, in most cases, become almost inaudible at a short distance; in other words, it will be found that a broadcast station located in New York or Chicago cannot be heard at all or, at best, poorly in the very city where the broadcasting is done; though strong enough further away.

This, however, will not frighten the broadcast engineers, and it will be found that this will work out to the advantage of the chain stations. Suppose that all of the stations were to move tomorrow to the lower waveband; and suppose that you live in Chicago and find yourself unable to tune in your local station. The easy thing to do will then be to tune in the same program from a New York station which, it will probably be found, though 800 miles away, comes in just as a local station does today. Thus—unless some new scheme is developed whereby it will be possible to get short-wave stations just as well locally as you get the high-wave stations now—we will then listen, not to our local stations at all, but to DX stations exclusively in their stead.

Mr. Hugo Gernsback speaks every Tuesday at 9.30 P. M. from Stations WRNY (297 meters) and W2XAL (30.91 meters) on various radio and scientific subjects.

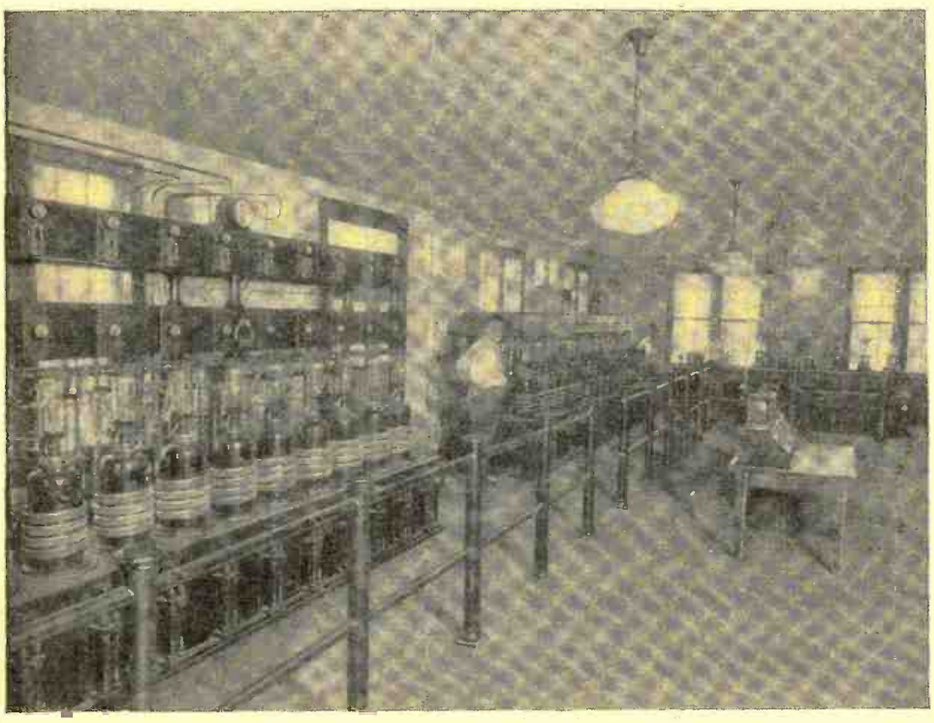
Radio cannot be Heard or Felt

It has no Physical Effects

Beneath the aerial of a 50-kilowatt station which is transmitting, a piece of insulated metal (like an automobile body) quickly gathers an electric charge out of the magnetic field. But a human body does not; nor can the man in the midst of this field tell when it is turned off.

"COMMON SENSE" is a much-abused term; its original meaning is an appeal to the basis of all science, as well as of all human actions. It is the "common sense," or unanimous agreement of mankind, that iron is heavier than wood, that the sky appears blue, that ice is cold, that the rose smells sweet, that vinegar tastes sour, that the notes of a fife are shrill; in other words, that the same things produce similar results on the senses of any human being.

There are differences of opinion as to the aesthetic values or pleasure produced by certain impulses on our senses; there are slight variations in the sensibility of individuals. Some men cannot distinguish the color red, others cannot hear certain sounds, and some are poisoned by other men's meat. But, speaking generally, the person whose judgments of the outside world differ too widely from the rest of the human race is held to be lacking in "common sense."



Operators of a 50-kilowatt station like WEAF, exposed to magnetic radiation of high intensity day in and day out, feel no physical effects from this source; and the only thing about a transmitter that is dangerous is a live wire or part, as in any power plant.

DISCOVERY OR DELUSION

When, therefore, a startling discovery is made by anyone, the practical test of its truth is his ability to show the same thing to others, or to account satisfactorily for their inability to perceive it. If a person claims to see the invisible, he must at least be prepared to show to the skeptical that the "something" invisible to them *is really there.*

It is, therefore, in the original meaning of the words, that we confidently assert that "common sense" shows us that radio waves cannot be seen, heard, felt, "hefted," smelt or tasted by human beings. It is only by indirect means, and the interposition of materials which radio *perceptibly* affects, that its presence can be discovered.

Yet, with considerable frequency, RADIO NEWS receives letters such as that reproduced here. This letter is somewhat different from the usual run; the writing shows that it is from the pen of an educated man, even though his use of radio terms is a bit uncertain. We have received a letter from one unfortunate who had issued a handbill, "Murdered by Radio," to proclaim that he was being persecuted by unknown enemies, and who implored instructions how to shield himself against radio waves.

These are delusions!

If any man feels sensations for which he cannot account—mysterious sights, sounds, "hot flashes"—which are not shared by those about him, let him consult a capable physician. The faults are in his eyes, ears, "sensory" nerves, or over-strong imagination. Such "hallucinations" were known thousands of years before radio was thought of. *They do not necessarily mean insanity in the sense of mental derangement or lack of reasoning power;* but they do usually mean a state of ill-health that imperatively commands attention.

YEARS' EXPOSURE PRODUCES NO SIGNS

And, to physicians as well as to the laity, it may be timely to say that radio *as radio*

does not produce effects of sight and sound. We know that people occasionally hear strange sounds coming from unexpected sources and recognize bits of a radio program, as in the cases described in the article below. But, whenever this has happened, there has been *metal* nearby to pick up and carry radio. A man does not walk through the woods and hear the branches of the trees reproducing radio music. Nor, even though he stands within arm's reach of a high-power transmitter, does he hear, see

Do not be alarmed if the stove starts to sing, as it did in Santa Barbara. (*See page* 854.) *Call the neighbors to hear it.*

or feel in any way radio waves. If it were so—if it were possible that even the most intense concentration of radio could in course of time break down the system like X-rays or burn like sunlight—the operators at the big stations such as that pictured here would years ago have felt the effects. But, neither for sickness nor for health, does radio affect the system.

SHORT-WAVE SYSTEMS

We now touch on the point which our correspondent misinterprets, that of ultra-short-wave stations. It is true that around a five- or six-meter wavelength, and perhaps below, *with very high power,* a transmitter will cause a slight heating of bodies very close to it. That effect is manifested only by the conversion of this electrical energy into *heat;* and a very much smaller amount of electricity in a reflecting heater would produce sensible effects on those around it much quicker. Furthermore, for only a few feet away from a very powerful (and expensive) transmitter can this effect be detected by a human being.

The experiments described in the article, "Everyone His Own Aerial," do not produce the slightest sensation in the participants while they are vibrating with and reflecting the waves of a moderate-powered transmitter. A man may touch the aerial post of his set and serve as an antenna to bring in a broadcast signal out of the ether; but, so far as his own bodily organs are concerned, there will never be any way by which he can tell that there are radio waves around him—any more than he can see the ultra-violet and the infra-red rays of which he has been told.

If we could conceive of intelligent beings composed of a magnetic substance, such as iron (as in a recent piece of very striking scientifiction, "The Metal Emperor," which appeared as a serial recently in the pages of SCIENCE AND INVENTION) they would be able to feel the action of radio waves, as we do those of heat and light; and to receive from them, no doubt, sensations of pleasure and pain proportioned to their intensity. We cannot, of course, imagine what such a sensation would be like; for, while ability to feel the presence of a magnetic field might be a boon to mankind—and it might be a curse—it has not been bestowed upon them. A man can put his hand, without feeling

If your radiator starts playing the piano, quietly investigate, like Dr. Summy (*Page* 858).

anything different about the air or the space, into a magnetic field in which iron would melt.

Therefore, not only to those who believe they are hearing radio or feeling it, but to those in authority and in the medical, legal and clerical professions to whom such sufferers come with their stories, we have only to say that the belief has no foundation in fact; and that, if it had, the matter could and would be demonstrated openly to all within hearing. We have further to say that, while delusions of persecution caused by imaginary, invisible voices drove many to madness before the days of radio, in this age of better understanding a correct diagnosis should in every possible case be given, to guard the sanity and to promote the physical healing of the sufferers, if possible.

A Recent Letter

Editor, RADIO NEWS:

Reading the January number, I note that you have published an article on human radio reflectors and also on "mysteries" of radio. I believe that I am in possession of a real mystery that will startle you and also seem at first impossible until you give the matter consideration.

The fact is that some criminals have set up in this city and nearby two powerful stations operating on human frequency. I myself have experienced an oscillator fever from same. They apparently do not care one iota for human life or property. I have even difficulty in driving my machine, due to the fact that they are evidently using an etherical (sic) *form of transmission on a powered beam and I believe is brought about by the use of photo cell lamps and a television system. They are also capable of establishing vocal communication on same and I have heard them talk and know for a fact that they are our first real air criminals, and believe that they are really insane. So severe has been their activity, power and directional capability that I was able to plot on a map and trace the definite location of one of these stations to the exact block* (location described).

The aerial he was using was of the one-pole form, tripod style, a series of very short wires about 10 feet from insulator to insulator, of the counterpoise system; that is, a wire under each system of direction. I suspect that the article you published on the use of tuning on human frequency as used at the University of California is where they procured their idea, and that one or more men are from the east. I will appreciate your help on this matter and will furnish any information possible. I have also taken the matter up with the ——— detectives. You know absolutely that this is new and they may be skeptical in the matter and work slow, and the result, this bunch of criminals get away and operate again. So please give me every possible assistance.

(Signed) ———

Real Radio Mysteries Reported by Our Readers

WHY radio music and speech bursts forth in the most unexpected places, without the intervention of any apparent means of picking up, detecting or reproducing the signals, is still among the "'Mysteries' of Radio" described in the leading editorial on page 619 of the January issue of RADIO NEWS. But the fact is a source of scientific curiosity, rather than of awe. A public which has become used to the miracle of radio is not impressed with any impossibilities in the matter of its exemplification—like the prairie Indians who set down the telegrapher's climbing spurs and his hundred-mile reach alike as "medicine!" (magic) and dismissed all further inquiry into the methods used.

The radio experimenter, however, who has to work hard for his results, feels a greater interest in the matter. Many odd things have been noted from time to time, but uncertainty as to the exact conditions prevailing (electrically) at any given instant have prevented an attempt to reproduce the demonstrations; particularly when they seem to be structural freaks.

One thing, however, is generally to be noticed; they occur in close connection with some system of piping, wiring, or other metallic assembly of large extent. The analyses of the phenomena contained in press reports are often those of laymen.

For instance, the Associated Press carried some weeks ago the dispatch reproduced in facsimile in the continuation of this article; and, of course, the same story appeared in the same words in many papers; many of whose readers, on that day, accordingly,

(*Continued on page* 854)

Hearing Plants Grow by Radio

Imperceptible Movements of Plants Affect Sensitive Oscillators and Produce "Beat" Notes, Which are Broadcast by Austrian Scientist, Prof. Richtera

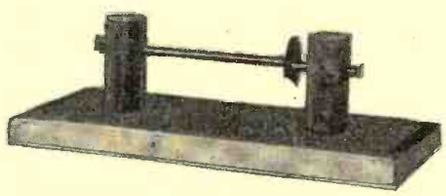
By Ashur van A. Sommers

IN their efforts to present radio programs of a "different" kind, broadcast stations here and abroad have taken their microphones into strange places and have picked up with them many strange and unusual sounds. Deep-sea divers have dragged "mikes" down into the green waters of the sea; aviators have taken them aloft in the clouds; surgeons have admitted them to their operating rooms. In New York the sound of goldfish swimming in a bowl was successfully broadcast in a most interesting manner from Station WRNY; in Iowa the sounds of human nerve currents, and in Japan the heartbeats of a maternity patient have been "put upon the air" for the edification of local listeners. The explosions of shattered atoms have crackled in the ears of a distant audience.

It has remained for an Austrian scientist, gifted with a sense of publicity values, to go even closer to Nature and to reveal her own voice over a radio broadcast station. He took a pot of flowers from his living-room window, placed it in the company of a lot of complicated electrical apparatus, and then actually broadcast the sounds made by the blossoms as they grew imperceptibly before his eyes! Needless to say, the radio listeners who were permitted to eavesdrop on the novel experiment obtained quite a thrill out of it.

As the instruments which made the stunt possible may easily be obtained and put into operation by any capable radio engineer, we may now expect that ringside descriptions of championship prize fights will be enhanced by noises indicating the growth of bumps on the protagonists' heads; so that grandmother's appreciation of the gory battle will be complete except for the odor of the blood on the canvas. Many other uses for the apparatus will suggest themselves to enterprising station managers.

The principles of operation of the electric *ultra-micrometer*, which is the name given to this remarkable instrument, will be understood readily by the radio fan, and a description of them may be of interest. *No constructional data or constants are given, as the apparatus can be duplicated only by an engineer having laboratory equipment at his disposal.* The original apparatus used for the Vienna broadcasts was designed by Prof. Richtera, director of the "Ravag" station in that city.



A simple form of electric ultra-micrometer, consisting merely of two metal plates fastened to adjusting rods.

HOW IT WORKS

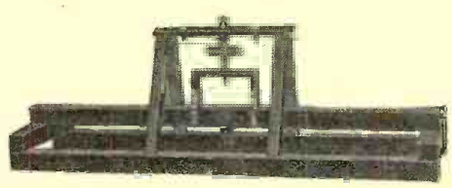
Briefly, the idea is to arrange a delicate system of levers in such a manner that the upward movement of the plant as it grows moves one plate of a tiny condenser. This condenser is connected across the tuning condenser of a high-frequency oscillator, which is tuned to exactly the same frequency as a second oscillator of identical construction. While the lever remains stationary, the two locally-generated currents do not produce any "beats" because they are tuned alike. However, the very slightest movement of the lever, which will be caused by even an infinitesimal growth of the plant or flower, alters the capacity of the midget condenser and throws one oscillator off tune. Since the oscillations generated by this unit are now slightly different from those of the other, they will heterodyne or "beat," and a third frequency will be generated, equal numerically to the difference between the two original oscillations. If the values are properly selected, the beat signal can be made to fall in the audible band, between 16 and about 10,000 cycles.

BROADCASTING A PLANT'S PULSE

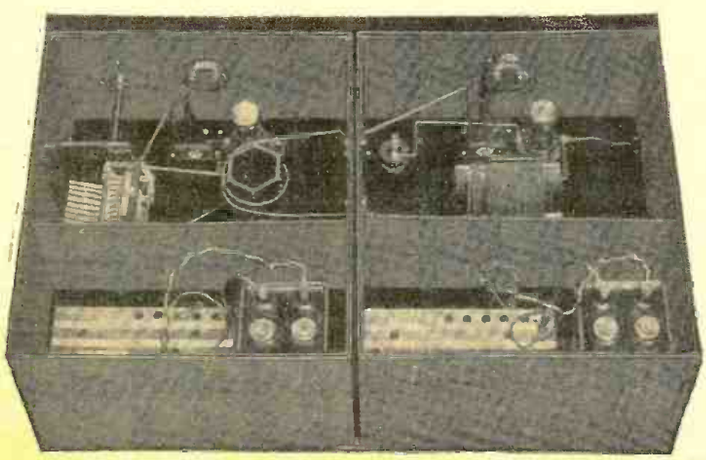
The beat note is then led directly to the modulator circuit of the broadcast transmitter, and will go over the air as a peculiar squeal. Another possible arrangement is to reproduce the noise first through a loud speaker, and to pick up the sound waves with the usual studio microphone. This scheme allows the operators to listen to the apparatus directly and to determine whether it is working properly.

In the actual oscillators used in the experiments by the Vienna broadcast station, "Ravag," which are pictured on this page, the circuits were adjusted to a frequency of 1,500,000 cycles (200 meters). The plates of the condenser whose capacity is affected by the growth of the plant are very thin aluminum discs about two inches in diameter. The top plate is attached to one arm of the lever, while the bottom one is fastened to an upright rod. The position of the latter is adjustable, and is determined by experiment with the particular plant being used.

The growth of mushrooms has been observed with the aid of this apparatus. One end of the lever is simply rested on the top of the mushroom; as the latter rises, it pushes the other end of the lever downward, increasing the capacity of the midget condenser and, consequently, decreasing the frequency of the oscillator in whose circuit it is connected. It is interesting to know that the movements of plant growth are not steady, but pulsating—like the strokes of a pump.

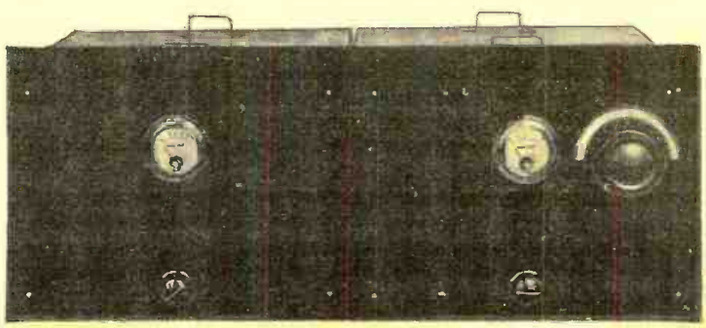


A more advanced form of electric micrometer, with which distances of a fraction of a millionth of an inch can be measured.



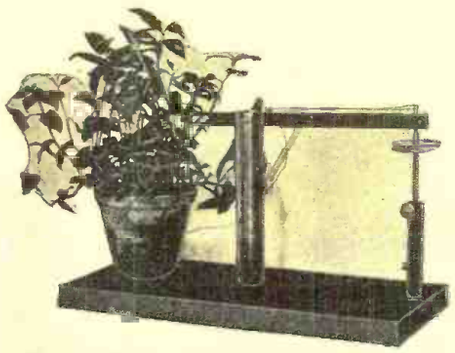
Left: Inside view of the two oscillators, showing the complete shielding between the parts.

Below: Front panel view of the oscillator unit, completely enclosed. The dial at the right adjusts one of the oscillator circuits.



MEASURING INVISIBLE DISTANCES

The electric ultra-micrometer has a practical use in the measurement of extremely small distances, since variations in the length of an object to an extent as small as 1/250,000,000th of an inch can be detected. This movement is so much smaller than a wavelength of light that it is necessarily forever invisible. Very slight changes of temperature, which affect the length of pieces of metal, can be measured with precision to 1/5500th of a degree, Fahrenheit. In fact, when a person enters the room in which the electric ultra-micrometer is located, the rise in its temperature occasioned by the heat of a human body is enough to cause a loud squeal to issue from the loud speaker.



The actual apparatus used in the experiments at the Vienna broadcast station. The left end of the lever merely rests on the flowers.

As may be seen from the accompanying illustrations, the oscillators are built into two adjacent metal cans which shield them completely from each other. Each can contains an oscillator coil, a vacuum tube, and the usual filament resistors and radio-frequency chokes. The "A" and "B" batteries for each circuit are contained in the same cans, but separated from the radio-frequency components by metal partitions.

The front panel of the instrument looks like a large one-dial receiving set. It holds two meters, a dial to adjust the tuning condenser of one of the oscillators (the other being fixed), and two auxiliary knobs for filament control. Once adjusted, the apparatus is left alone.

"It Isn't All in the Set—It's in the Location!"

AN editor's mail contains few surprises, but, on the contrary, a great deal of matter which can be expected daily in proportions determined by the law of averages. If he is a radio editor, he will know that the quest for "DX" is an undying flame, by the number of inquiries like this, from a Virginian, "How far can KFI be received in the daytime?"—or this, from a Californian, "Is there any set made that can reach out practically any time and pick up New York from here?"

The power of the transmitter and the signal-amplification factor of the receiver are the only two terms of the problem that occur to the average inquirer. If a receiver gets a 1,000-watt station 1,600 miles away, for Smith in Ohio, why should it not get any 1,000-watt station at the same distance for Jones in Nevada, or Robinson in New York City? Why this discrimination? inquires many an indignant set owner, who has been spending money freely in order to have on his log just as good and far-off stations as anybody.

The letter which follows puts the case just as thousands see it, but in so clear a manner that we leave Mr. Timberlake to state the position of the set owner who is disappointed of the distance reception for which he is willing to pay, and oftentimes has paid, good money.

WANTED, A REAL DISTANCE-GETTER

Editor, RADIO NEWS:

I have been a constant reader of your most excellent paper since the first few issues, and I assure you that I have more than appreciated the great interest it has afforded me over a period of years.

I should like to enter a plea, one that will no doubt be echoed by thousands of your readers, a plea for a real distance-getting receiver, if necessary, regardless of cost.

I have purchased and built up practically every powerful (so-called) receiver advertised in your paper during the last four or five years. I have also built up from the best of parts the majority of sets described by the contributors to your magazine; but they have all fallen short, very far short, of the results claimed by designers or manufacturers. It may be my own fault, but I cannot see where I have slipped up. I have used patience, the best of parts, and extreme care over details.

From time to time I read of the very wonderful results obtained by some of your readers, both on long and short waves, and wonder why I cannot duplicate their reception with sets that should be many times more powerful. By the word powerful I mean their ability to get distance stations.

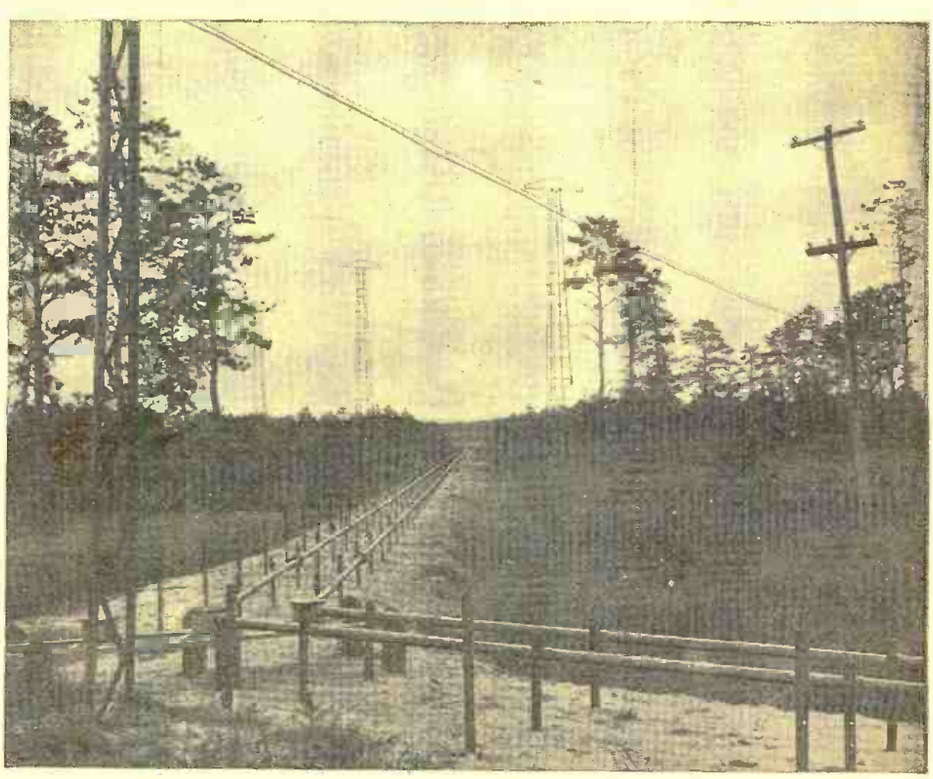
At the moment I am using a set having five R.F. 222 tubes. It has a range, either on detector using phones, or speaker volume using four stages of audio, of about 1,200 to 1,500 miles at the outside on a very good night—no greater range than that obtained with a duplicate receiver using five 201As, or a three-tube Peridyne. On all three sets, using the same aerial at about the same time, a number of stations can be heard murmuring away off in the distance; but no amount of experimenting with tubes, ground, aerial, etc., will make the slightest difference. This applies to both my town and country location, the latter being by the side of a large lake, where reception should be good. (*This is not necessarily true.*—EDITOR.)

THE GOOD OLD DAYS

Won't some learned individual or progressive manufacturer come forward with a really powerful and efficient receiver that will reach out and get a few of the stations that are now on the extreme edge of our present reception; which edge is about the same distance away as it was in the old days of the one-tube set? The cost of such a set should not prevent a number being sold, as $600.00 to $1,800.00 (in Canada) is being paid for very indifferent sets buried away in very ornate cabinets, the owners of which quickly become dissatisfied when they realize that they have paid a great deal of money for a receiver which will do little or no better than a set costing ten times less.

Quality of tone from nearby stations is a good argument; but the majority of listeners would be more than willing to pay more for a receiver that will occasionally get a *different* station further afield.

(*Continued on page* 862)



Communication companies, to whom certain reception is their bread and butter, cannot depend on the best receivers alone. They spend thousands to find a good location, and thousands more for an aerial system like that shown—a short-wave R.C.A. antenna at Riverhead, N. Y.

Radio Echo from the Depths of Space?

Are Short-Wave Signals, Escaping from the Heaviside Layer, Turned Back by Magnetic Field a Million Miles Away?

By C. P. Mason

AN astounding, and yet unexplained, phenomenon has been observed by European scientists and engineers, and brings to mind at once all ideas that have been proposed with more or less practical plans, for communication with other worlds than ours. It is nothing else than the echo of radio signals, observed after a period when no possible circuit of the wave round and round the earth's circumference could leave it with sufficient amplitude to be recognized. The first hypothesis set forth, with a plausible argument in its support, is that the waves are reflected back from an electrified region—*not* the famous Heaviside layer, at its supposed height of sixty to three hundred miles, but one far outside the orbit of the moon—one which is perhaps 1,250,000 miles away.

It has been known for some time, and recorded by delicate automatic machinery, that the signal from a very powerful short-wave station is received, not only once at the time of its arrival over the shortest great-circle path of reception and again on its arrival over the longer route in the opposite direction, but even after it has gone again around the world. The fact is indicated by a duplication or shadowing effect in the record of the signal on the sheet of the recording instrument. But less than one-seventh of a second is required for a radio wave to go around the world through the atmosphere.

A SURPRISING DISCOVERY

Late in 1927 a Norwegian engineer, Jürgen Hals, detected a similar effect in reception from the short-wave station PCJJ, at Eindhoven, Holland, on 30.20 meters. He could hardly believe the fact, for the interval between the main signal and its "shadow" was no less than *three seconds*. In this time a radio wave has, presumably, time to travel twenty-two and one-half times around the earth, or out to the moon and back. Repeated observations confirmed the presence of the delayed echo; but Mr. Hals, unable to give any explanation which seemed logical, kept his discovery to himself for several months. He then enlisted the services of Professor Stürmer, a well-known authority on terrestrial magnetism. The latter made arrangements with Dr. van der Pol, technical director of PCJJ; and a series of 31.4-meter transmissions, with undamped waves, were effected for the special purpose of testing the conditions under which this echo was produced. For some time the results were negative; but, on October 11 last, echoes were noted plainly.

An idea has undoubtedly occurred at once to our readers; that radio reflections from the moon have been received. Well, plausible though that supposition may seem, the new observations added even more startling phenomena to be accounted for. The radio echoes were heard after the lapse of from three *up to fifteen seconds*, corresponding to the time of travelling nearly three billion miles, or to a point five times as far away as the moon, and back again. A race of 110 laps around the globe, certainly, would leave a radio wave rather too exhausted to wiggle even the most sensitive aerial circuit.

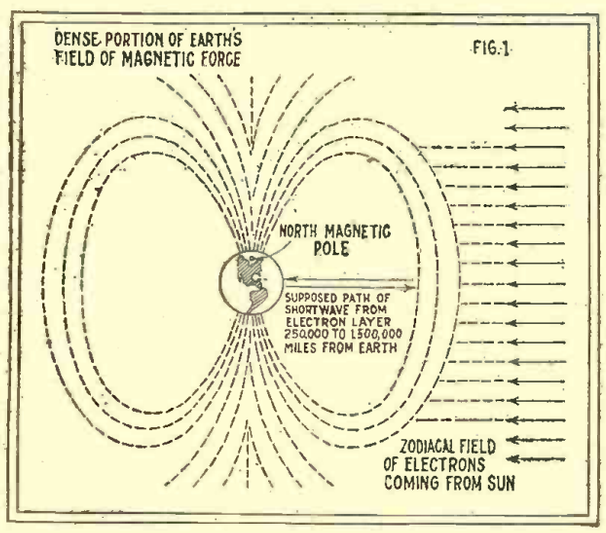
OUR ELECTRON GIRDLE

Presenting a purely temporary hypothesis in a letter to *Nature* (London) Professor Stürmer suggests that the wave is reflected from the electrified region in space where electrons emitted by the sun are captured by the earth's magnetic field (See Fig. 1). Many years ago he published a mathematical survey of this field, concluding that the earth must be surrounded by a huge, though invisible, electric belt not unlike the well-known rings of Saturn in its arrangement (Fig. 2C). At the magnetic equator, this region would be farthest from the earth, while the captured electrons and other electrified particles would come down closest to the earth in the polar regions; thus producing the well-known effect of the aurora, which manifests itself whenever the sun is in a state of electrical and magnetic eruption.

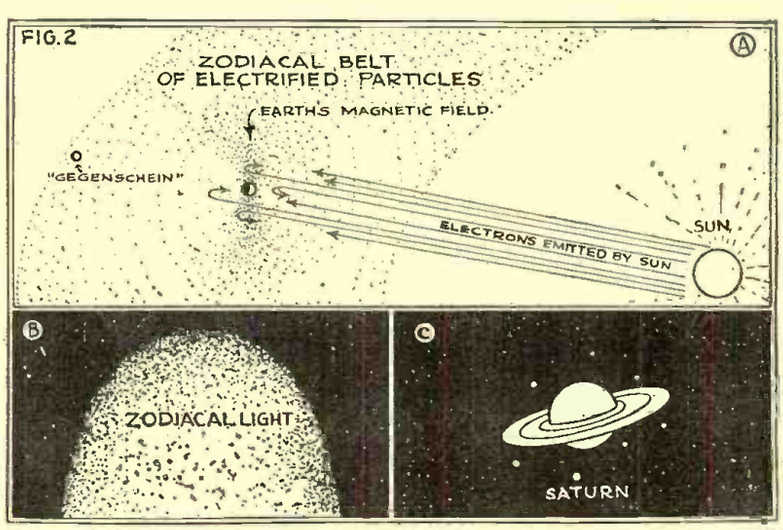
Other observers contributed suggestions. They point out that audio-frequency disturbances of a natural nature (in addition to radio-frequency "static") may be picked up out of the ether. A distinct click will be followed by whistles at intervals of some seconds; and it is suggested that these are due to disturbances, perhaps at a very great height, whose reflections from enormous distances over varying paths draw them out from sharp tones to protracted whistles.

Be this as it may, very profound reflections are caused by the reported phenomena, no matter what the cause. It has long been known that the sun carries with it (in addition to its visible satellites, the planets) attendant masses of invisible matter, very finely divided, yet of considerable mass in their total. The phenomenon of the *"zodiacal light"* has not been fully analyzed; but it is enough to say that, under favorable conditions, a broad luminous area may be detected in the night sky, evidently centered around the position of the sun below the horizon (Fig. 2B). This area obviously extends past the earth in the *zodiacal* region in which the planets move; for in the place in the sky exactly opposite the sun may be seen

(*Continued on page* 881)



The echo heard, occasionally only, when conditions are right, indicates that the radio wave is reflected from an electrical layer at a distance of more than a million miles. It is calculated that this forms a "toroid" almost empty of electrons.



The reflection of faint light in the night sky indicates that space beyond the earth is filled with microscopic particles forced out from the sun. In this region the earth revolves with its magnetic field. The well-known "rings" of the planet Saturn are a more spectacular illustration of a like condition.

"Miniature Music"---A New Point of View

Since Radio Has Brought Music Into the Listener's Home, Out of the Auditorium for Which It Was Orchestrated, Shall We Revise Our Notions of Quality?

By R. Raven-Hart

IN practically all cases, the reproduction of an orchestra in a normal home must be at a very considerably lower level of volume than that which would be heard by a person having a good seat at the concert. For not only is the expense of reproducing an orchestra at full power prohibitive in most cases, but also there are "the neighbors" to be considered, to say nothing of those members of the household itself who wish to study or read or talk.

We may safely assume, then, that in nearly all cases we shall reproduce the music at a reduced volume. Now it is well known (see page 216 of RADIO NEWS for September 1928) that, if the volume of music is reduced, the reduction is chiefly noticeable on the lower notes; that is to say, if we listen to a well-balanced orchestra from a distance, we shall notice a lack of bass notes. Equally, if our reproduction is perfect as regards the balance between high and low notes, but reduced in volume (as we can assume will be the case), we shall miss the lower notes; and we shall thus have the illusion of listening to the orchestra from a distance—from the last gallery, or even the vestibule, let us say.

A NEW STANDARD

All attempts of radio engineers at present appear to be in the direction of equalizing the reproduction through the audible scale, and thus giving us this illusion, thanks to the perfect balance of the sounds emitted by the loud speaker.

In view of the reduced volume almost inevitably associated with this reproduction, I would reply, *emphatically,* no; although in so doing I may run counter to practically all published technique. On the contrary, I would suggest that we abandon all attempts to reproduce the illusion of being present at a concert, and boldly make for a new standard in music, suited to radio conditions, and which one might call "miniature music." By this I mean that radio sets should be so designed that the *ear* receives balanced music; not that the loud speaker should put out a balanced reproduction, but that the parts of the musical scale which the ear hears as weaker than the rest should be *over-amplified,* taking into consideration the over-all volume which the set is intended to give. (Thus, for example, in a set designed to give a loud-speaker reproduction of the unobtrusive sort that can be ignored if one wishes, the bass would be over-amplified, and to a less extent the extreme upper frequencies.)

NO REAR-SEAT REPRODUCTION

It seems to me, in fact, that it is time for radio engineers to realize that the listener of the future, and even the listener of the present to a far greater extent than is realized, *will base his musical education on the music as heard by radio,* and will very rarely attend a concert. Why, then, continue to strive after the illusion of being present at a concert (and in a bad seat at that!) just because the listeners of the past were more accustomed to hear directly than by radio and thus found it more pleasant to revive memories of concerts by means of a faulty reproduction than to hear *all* the orchestra, properly balanced but in miniature?

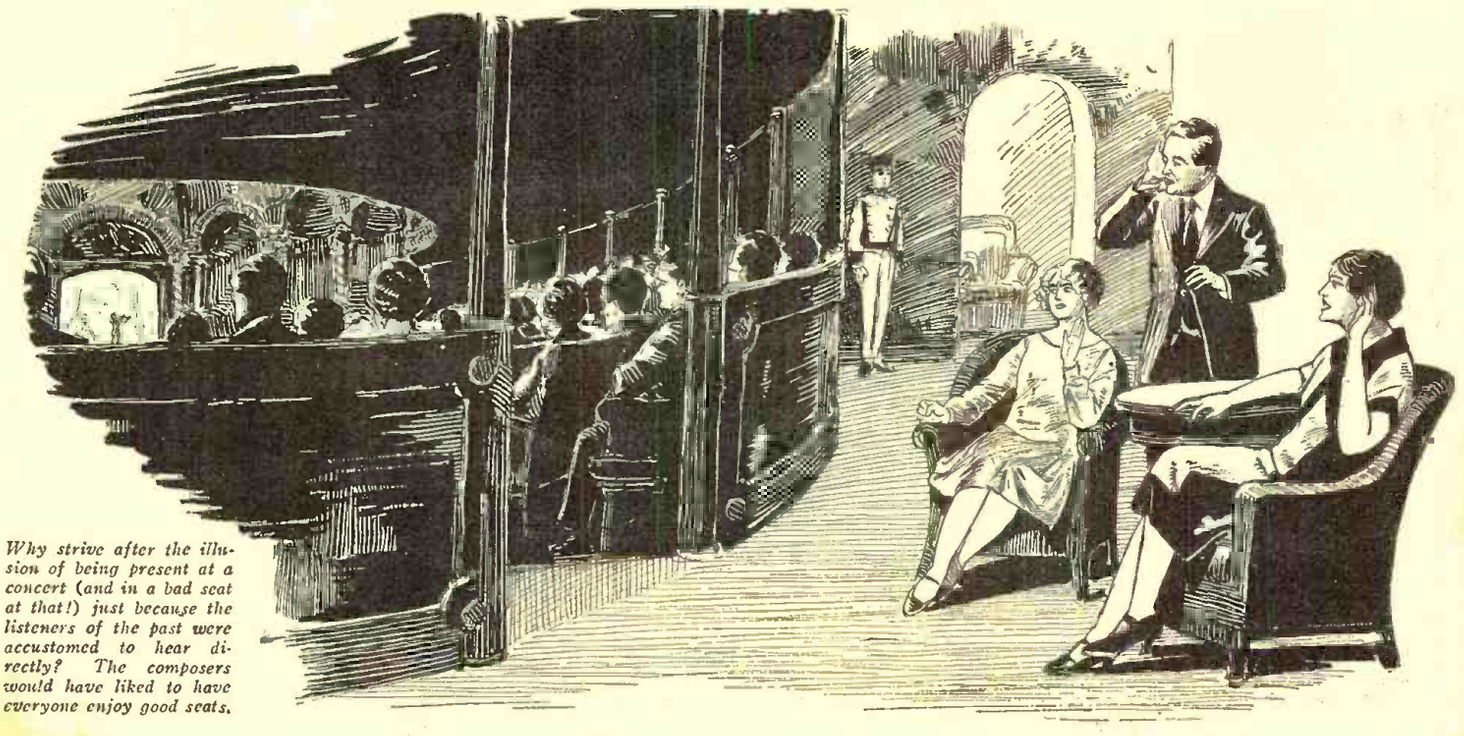
Two objections may be raised. One is that the average and inexpensive radio apparatus of the future will probably be able to give full-power reproduction, and that, therefore, fidelity can be obtained only if the balance is perfect. Admittedly, if it is a case of reproduction in a hall approximating in size that of the concert hall itself; but such volume is utterly undesirable in a normal home, and any steps taken to reduce it (*e. g.,* by a volume control in the set, or by putting the loud speaker in another room), at once re-introduce the defective balance due to the ear, unless this defective balance is corrected by an unbalance of the reproduction.

There is one interesting technical development possible, however, and that is a *discriminatory* volume control, such that, as the volume is reduced, the portions of the scale which the ear then hears as over-weakened are automatically not cut down to the same extent as the rest—in other words, a volume control such that the equilibrium, as determined by the ear, is preserved at all levels of volume that the set will produce. Nothing of the sort seems to have been designed as yet; a resistance shunt of considerable self-capacity, across the loud speaker, would act in this way to a certain extent, as regards the lower notes at any rate, but something more exact is required.

WHAT DID BEETHOVEN MEAN?

The second objection is that the composers did not intend such unbalanced reproduction; that we should strive after the effect that would have been produced by their original performance on persons sufficiently far away from the orchestra to hear the music at the reduced level suitable for our

(*Continued on page* 866)



Why strive after the illusion of being present at a concert (and in a bad seat at that!) just because the listeners of the past were accustomed to hear directly? The composers would have liked to have everyone enjoy good seats.

ON the broad piazza of his magnificent laboratories building, Harold Dare, the great impelling power of Flicker Films, lounged in a comfortable chair at the close of a long day of strenuous endeavor and accomplishment. The full moon, glowing in the heavens like a soft amber spotlight, threw into bold relief the distinguished features of Harold Dare's classic face—the high, broad forehead, the straight line of his sensitive, artistic nose, and the firmly-chiseled chin. It was for him a time of quiet meditation upon the weighty problem of the morrow.

Suddenly a muffled explosion, followed by another, and yet another; a flash of blinding flame, and great billows of black smoke belched from the windows across the street; an instant's deathly silence, and a terrific explosion shattered the very foundations of the night.

Harold Dare sprang from his chair and strode rapidly into the laboratory where the technicians were working at their instruments. "Come, staff!" he cried: "A terrible menace threatens the public safety! We must avert it! To the rescue! Run hose lines! Man the pumps!" Seizing a carboy of carbon tetrachloride and a fire extinguisher, he dashed from the room.

Fire engines were already arriving, their roaring exhausts and shrieking sirens making a bedlam of the night; department after department was responding to the summons to pit its puny strength against the red demon that was ravishing the beautiful building. In the light of the red flames, the struggling firemen frantically dashed into the swirling, stifling smoke, only to come stumbling back, blinded and choking, gasping for breath, while higher and higher rose the flames.

Then Harold Dare and his men apppeared on the scene. A great cheer went up from the assembled crowd. Through the smoke-filled doorway he led his men, who dragged with them the heavy armored hose from the laboratory. Dare himself shouted the signal that sent a powerful current of carbon tetrachloride pulsing under tremendous pressure through the hose.

The rest was merely a matter of moments. Before the heroic efforts of Harold and his men, the flames quickly gave way. And when the great film star stood in a window of the wrecked top-story and faced the newsreel cameras that were clicking away a record of the terrific struggle, the crowd burst into a demonstration which lasted for many moments. As decisively, as dramatically, as gloriously as in one of his own super-productions, Harold Dare had saved the day!

* * * * *

Upon one end of a long table in the Dare laboratories, lay a pile of junk: twisted scraps of metal, fragments of wire, bits of steel, all rusty and smoke-stained, all methodically arranged and ticketed. At the other end lay a mass of papers—records gleaned by long hours of intense study, watching, and application—piles of prints and data sheets gathered through long vigils of ceaseless research and deduction. And about this table, the cream of the world's engineering talent sat spellbound, listening with intense concentration to their chief, as he unfolded a story of dark and devious doings, of criminal activities against one who had ever stood upon the highest pedestal of honor and rectitude—a story which was within the hour to set the whole world aghast with horror at the diabolical deeds of a fiend who would stop at nothing to accomplish his fell designs. Beautiful Dorothy Golden, Harold Dare's private secretary, recorded for posterity the words of this historic conference.

"Gentlemen," said Scott, Dare's famous chief engineer, "let us summarize our findings in this despicable, depraved plot against the man who has done more than any other man in history, not only to further the advancement of science, art, and the movies, but to uplift the masses and raise them constantly to higher and ever higher realms of happiness, health, and harmony.

"We have found that the terrible explosion which destroyed the building across the way was caused by an incendiary bomb—a miniature airplane which dropped out of the sky, laden with explosives and incendiary material; while miles away, a cruel, coldly-calculating fiend sat at a radio transmitter, directing by radio control the flight of the plane with its cargo of death. What could be the motive? Would anyone go to the expense and trouble of so complicated and difficult an undertaking as this, merely for the purpose of setting fire to an empty office building—when a dozen ways would have been safer and easier? No! But across the street, gentlemen, was an immense laboratory, wherein an organization of highly-trained experts work night and day toward the execution of the plans of a great man for the betterment and benefaction of his public. And much as I regret to say it, there is a person—nay, fiend—who would stoop to such a dastardly deed as this. Dandy Diavolo, who, as the world's greatest villain, has pursued Harold Dare through countless reels of the Flicker Films, alone would resort to such tactics to ruin—and probably blot out of existence—the one whom he has ever hated and persecuted.

"Do you remember," he continued, with growing earnestness, "how, in that great film drama, 'The Clutch of the Corsican,' Diavolo, as chief of the ring of opium smugglers, attempts by means of a radio-controlled aerial torpedo to blow up the Federal secret service building, where Harold Dare, as a U. S. secret service agent, and Ruth Roguish, his co-operative, are on the point of giving to their chief information which will result in the arrest and imprisonment of the ring; and how Mr. Dare, just in the nick of time, glimpses the winged death hurtling through the air, steps over to the radio transmitter in the chief's office, starts up the rotary gap and sends out the signal that deflects the torpedo into the bay? And now, gentlemen, history repeats itself: Diavolo has endeavored to duplicate the tragedy that very narrowly overtook his hated arch-enemy. He has failed once; dare we hope that he will fail a second time? No!! We must act! Let us devise a means of foiling the fiend, as did Mr. Dare in his great celluloid drama! To your places, men!"

Silently that great organization set about its tremendous task, to pit its combined intellectual powers against the terrible cunning of a fiend; while outside, the public, warned by swift radio bulletins from the Dare station WROT, suddenly awoke to the perilous situation. The Chief of Police offered his full cooperation, and all the resources of the great city of Los Angeles were placed at the star's disposal. Whole carloads of detectives armed to the teeth were sent whizzing through the city in all directions. A cordon of policemen was thrown about each of the city's public institutions, for it was generally conceded that a fiend who would adopt such terrible means of accomplishing his private ends would as likely as not direct his next attack upon orphan asylums and hospitals. As quickly as the keen mind of Scott had formed an opinion, the public likewise drew swift conclusions regarding the probability of Diavolo's implication in the outrage; yet, although every movement of the villain was shadowed, no clue could be found to link him with the explosion. The aeronautical industry was at a standstill, for every airplane, balloon, and glider was looked upon with intense suspicion by every right-minded citizen. And when the positives of the Dare picture, "The Clutch of the Corsican," were brought from the vaults and exhibited at motion-picture theatres, the rush to see them was so tremendous that scores were trampled to death and the gross box-office receipts were the greatest recorded in the history of the industry.

A strange structure appeared upon the roofs of the Dare studios. At the suggestion of a Dare engineer, a huge steel net was stretched over the entire group of studio buildings. Although not a great deal of confidence was placed in this device, still it was hoped that it might lighten the effects of an explosion. A captive balloon was anchored above the studios, and from it observers watched constantly; by day through powerful prism binoculars, by night through a super-sensitive sound detector.

As soon as possible the great Dare organization resumed its regular activities. In order to safeguard the lives of star and staff, production was concentrated upon outdoor scenes for the time being, and work

upon the indoor stages practically ceased. But, conscious of their responsibility to the public to carry on the plans of their chief for everything that was bigger and better, the devoted members of the Dare engineering staff remained faithfully at their posts. In the laboratories building, where the danger was greatest, the various groups worked calmly at their research, heedless of the terrible hazard, thinking only of their duty, and of the bonus promised them by the thoughtful Dare.

The great Scott, with his group of associates, was personally proceeding with an investigation which he had been conducting when interrupted by the terrible explosion. The purpose of the test was to determine the television transmission-characteristic of the Dare broadcast station, when operating by remote control over a short telephone line leading from the laboratories building to the broadcast studio. A test chart consisting of a number of converging fan-shaped, pointed segments of solid black against a white background was being televised. Its television equivalent was carried to the studio by the telephone line, broadcast, and the received version photographed upon the motion-picture film, later to be compared with the original. The sharpness with which the converging points were defined constituted a measure of the quality of transmission. And now, in a darkened projection room, the engineers were tracing, point by point, the effect of certain adjustments upon the operation of the circuits.

"Cut!" suddenly spoke Scott to the operation of the projection machine: "What has happened to the film?"

Across the center of the screen ran a series of white dots, like minute punctures of the tiny film of the camera.

The lights blazed on; the operator stopped his machine, opened the cover, and extracted the reel of film.

"See!" he exclaimed, holding the film in the powerful light of the projector. "The dots are printed into the film. Some stray current must have interfered."

"Nonsense!" snapped Scott: "A burst of static, or battery noise, would have marked perhaps a dozen frames—not more. Perhaps something has gone wrong with the camera shutter. This pattern of dots runs right along for a dozen feet. See! This was no mere stray current."

"Perhaps," suggested another engineer, "another station was operating upon the same wave. A wave modulated by a single audio frequency would force such a pattern."

"You forget," replied Scott, "that we have an exclusive channel. No station has the right to use the same wavelength. Let us see if the dots continue throughout the film."

The film was replaced and projection resumed. For several minutes the dots wove a zig-zag pattern across the screen. Then suddenly they ceased and the pattern of the chart stood out in sharp contrast. "See!" said Scott. "It was an exterior signal! It came from—

He gasped. Like those at the feast of Belshazzar, all the staff sat petrified with amazement and fear; for across the very blackest of the chart shone forth a gleaming death's head—glistening, threatening, terrifying. For a moment it regarded them with a baleful stare; then it was gone.

The last of the film clattered through the machine; but that grave group sat paralyzed. The handwriting on the wall! A miracle! What was its meaning?

"Let us see it again," weakly murmured an engineer. The film was rewound, and again it clicked through the machine. Three minutes passed; the strange pattern of dots flickered and disappeared; then again rose that dreadful spectre, its ghastly grin striking many a cold chill to the hearts of that dauntless staff.

The great Scott rose and addressed his unnerved engineers. "Staff, there is one possible cause for the terrible spectre we have just witnessed. Some outside station was operating upon our exclusive channel, emitting a wave modulated by some peculiar combination of frequencies. For each cycle of the current, a bright spot was produced on our television screen. The wave must have been keyed in such a way that the bright spots formed first the pattern of dots, and then the terrible death's head. Who was operating upon our channel? Miss Golden kindly take this note: To the Supervisor of Radio, 999th district: 'Sir: This is to report the reception of interfering signals from an unknown station operating upon our exclusive short-wave channel. The signals were heard from three minutes, beginning at 7:42 p.m. and lasting until 7:45 —'"

"Great Scott!" exclaimed one of the engineers, in a queer, choked voice. "7:45! That was when the explosion occurred!"

Pandemonium broke loose. On all sides engineers rose from their chairs, wildly tearing their hair, shouting at one another, while Scott rapped frantically for order. "Men," he said, " we must act. We have found the wavelength of the control station which directed the radio torpedo; for only a signal such as that used for controlling a tuned-reed relay and other radiodynamic equipment would cause the pattern we have observed. We must deduce from the record the combination of signals which operates the controls, and devise means to deflect the plane if it should approach again. To work, men! Duty calls!"

Instantly that great organization sprang into swift action. Engineers seized their slide rules, integraphs, transits, levels, and plumb bobs, and set to work with tremendous energy upon their appointed tasks; while Harold Dare, summoned from his executive offices, personally supervised their work.

They had barely begun when the telephone rang furiously. The great Scott seized the receiver. The voice of the lookout in the captive balloon came shrilly to his ears. "A high-speed airplane motor can be heard in the sonophone. It is coming this way."

At that moment the door flew open. A laboratory assistant burst into the room. "Help!" he gasped. "The death plane—it is coming!"

The engineers turned white; Dorothy Golden screamed; but dauntless Harold Dare had already rushed from the room, Scott close behind.

In the radio laboratory, the screen of the televisor showed the same pattern of dots which had appeared upon the film. "Quickly!" shouted Scott, "Reload the film!"

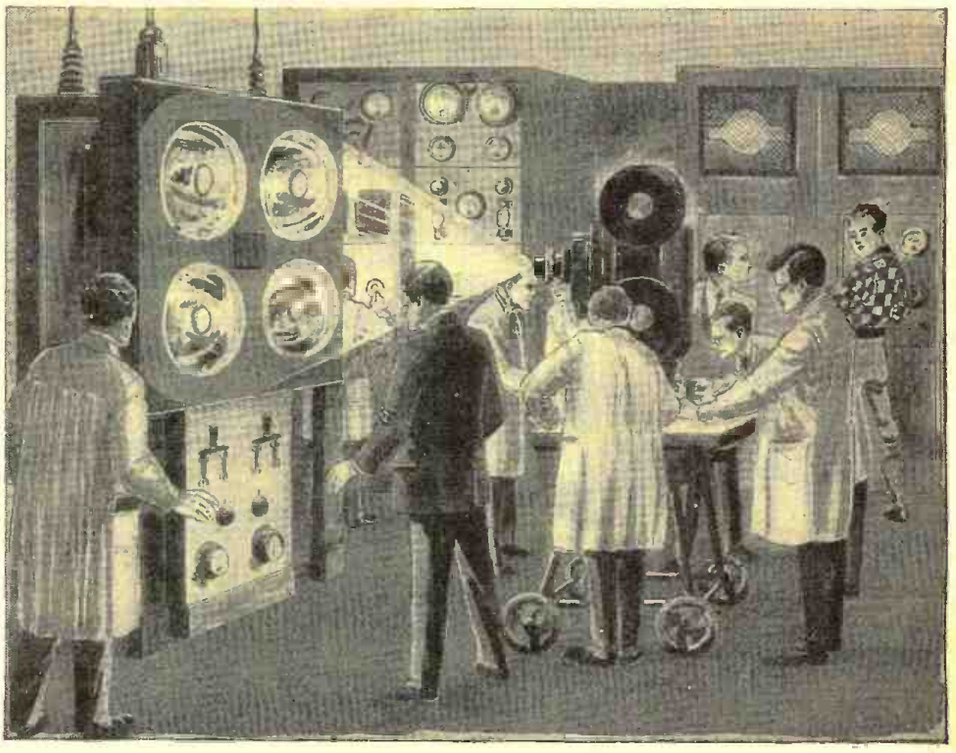
The table bearing the projection machine was wheeled over to the radio table, and while the operator loaded the machine with the reel of film which bore the record of the crucial experiment, Scott trained the lens upon the bank of photoelectric cells constituting the pick-up apparatus of the television transmitter. He made a few quick connections. An excited chorus told him that the engineers at the window could see the plane through their night glasses.

"Quickly!" cried Scott. "The power!"

Harold Dare flew across to the switchboard and gave the signal which set the huge short-wave transmitter of WROT oscillating at full power. Scott clicked shut the transfer switch which connected the television transmitter through the remote-control line, to the studio.

"Harold! Harold! Fly! Fly! Your life must not be jeopardized!" screamed Doro-

(*Continued on page* 866)



"Scott trained the lens upon the bank of cells constituting the pick-up of the television transmitter."

What's New in Radio

All apparatus described in this department has been tested in the RADIO NEWS *Laboratories and found of high quality in design and construction.*

Scanning Disc Is Adjustable To Four Transmissions

THE usual difficulty encountered by experimenters with television receivers is inability to synchronize the signals from more than one or two stations, due to the difference in the number of holes in the scanning discs. This has necessitated the use of a different disc for every station picked up. The speed can easily be controlled by either friction or resistance devices, but the discs cannot be changed so easily.

These difficulties can be overcome by using one of the devices illustrated on this page. It is 24 inches in diameter and contains two discs of aluminum, one behind the other. One of these discs is fitted with a bushing for the motor shaft, while the other is cut out in the center and mounted on the first by several machine screws. The main disc is drilled with several lines of holes, in the usual spirals, and the second also is pierced by similar spirals; but they are so arranged that the holes of only one spiral coincide in the two discs at the same time. The second disc is mounted with slotted holes and a key is provided so that any of the spirals can be used by merely sliding the discs with the key until the holes match. An indicator shows which set of holes is in line.

The disc is provided with four sets of holes. The first has 24 holes and is suitable for use when receiving WGY, W2XAD, W2XAF, Schenectady, or W4XA, Memphis, Tenn. The second has 36 holes for W6XC at Los Angeles. The third has 45 for WCFL and WIBO, Chicago; and the fourth has 48, the recommended standard, used by other transmitters such as WRNY and W2XAL, New York and W3XK, Washington.

Manufacturer: *Pohl Brothers, Detroit, Mich.*

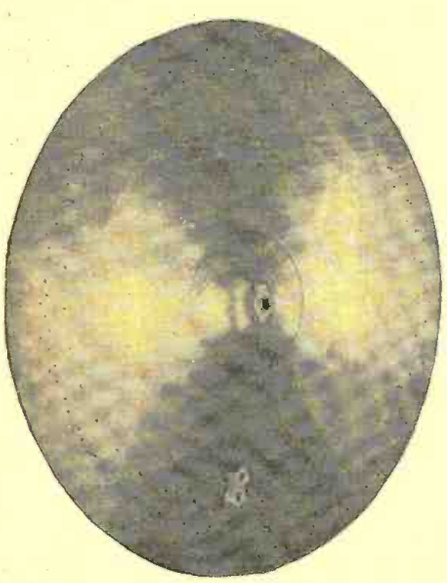


Fig. A

The key shown below turns the 24-inch disc to present a 24-, 36-, 45-, or 48-hole spiral.

New Variable is Designed for Short-Wave Work

A NOVEL and very handy condenser designed for short-wave receivers and transmitters, which can be utilized as either a single individual tuning condenser or a "vernier" adjustment, has recently been placed on the market. One novel feature of this condenser is a screw adjustment which allows the maximum capacity to be varied, in order to adapt the condenser to different uses. A bushing, placed on the shaft of the rotor plates, and two nuts with a spring, allow the rotor to be moved closer to or further from the stator plate.

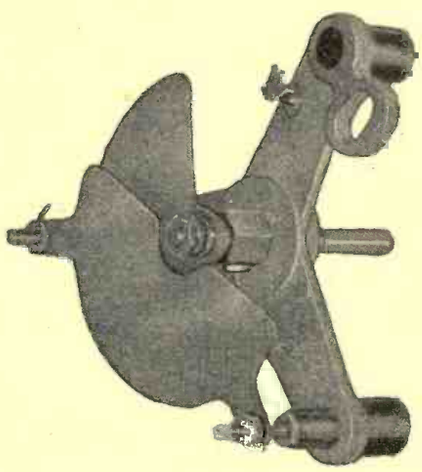


Fig. B

The two brass plates of this condenser are mounted on an aluminum frame. Their spacing is adjustable, varying the maximum capacity.

With the plates exactly ¼-inch apart, the condenser has a maximum capacity of 17 mmf.; while, by placing them closer together, this capacity can be increased to almost double this value. The condenser is mounted on a sturdy cast frame, with the insulation at the corners; the least possible amount of the latter material is employed, in order to keep the losses low. This condenser should find a great many uses with the short-wave enthusiast, in both receiving and transmitting work.

Manufacturer: *Radio Engineering Laboratories, Long Island City, N. Y.*

Metallic Rectifier for "A" Supply Has Lamp Base

A METALLIC rectifier, which can be used to replace the rectifier bulb in the 2-ampere chargers using this method of rectification, has been placed on the market by a St. Louis manufacturer. The advantages claimed for the new rectifier are longer life, ruggedness, and an economical replacement of the rectifying elements when the rectifier shows signs of deterioration. The rectifier is of the "dry" type, using metallic discs for the rectifying action. The unit is adaptable to all battery chargers up to 2½ amperes and can be used with good satisfaction in trickle chargers, as well as those with a faster charging rate.

The rectifier is equipped with a regular Edison base, to be screwed into the socket provided for tungar and similar types of tubes. The terminal formerly connected to the top or side of the original rectifier tube is connected to the prong on the top of the metal tube. A very long life is claimed for the rectifier, which can be refilled with new metallic elements at little expense.

Manufacturer: *Interstate Electric Co., St. Louis, Missouri.*

Compact Coil Provides Its Tube with Socket

THE present demand for compact construction in home-built receivers has led to the development of a clever device in which the R.F. coil fits snugly about the tube socket. Essentially, the apparatus is a combination of an interstage transformer and a tube socket which is mounted within the coil form, so that the same sub-panel space is occupied by both the tube and the coil. The transformer consists of a molded-bakelite form, one end of which is closed, except for four small holes to receive the screw connections on the tube socket which is mounted on the closed end of the form. The latter measures 1⅝ inches in height, and the same in diameter. No. 30 enameled wire is used for winding the primary and secondary, the leads of which terminate at four soldering lugs at the bottom of the form.

To mount this R.F. transformer, it is necessary to drill eight holes in the sub-panel

Fig. D
(below)

The neat base shown on this tube is actually an R.F. transformer whose terminals are the lugs at the bottom. The tube itself is connected through screw terminals which run through the sub-panel. The assembly of an R.F. stage is thus made extremely compact for shielding. A cross-section of the coil-socket appears on page 819.

Fig. C
(above)

This half-wave dry metallic rectifier fits the Edison base used by vacuum tubes of similar duty-rating.

(four for the socket terminals; four for the coil lugs), using a drilling template which accompanies each set of coils. The compactness of the components makes their external field comparatively small; it is thus possible to place them close together and yet obtain a fair degree of stability of operation. It is recommended that a shield of copper or aluminum enclose each unit to insure maximum results.

These units are available for the 201A-type tube, for which UX sockets are supplied, as well as for A.C. tube operation,

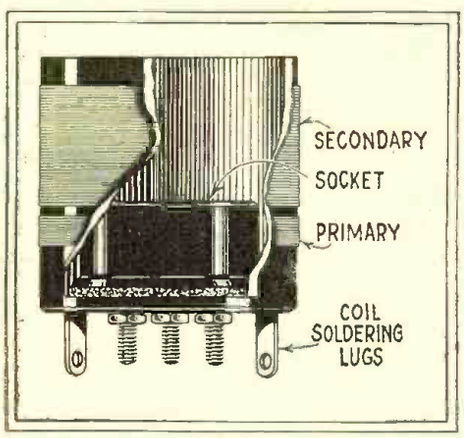


Fig. 1
When a tube is plugged into the socket in this R.F. coil, contacts are made through the base.

which requires one coil mounted with a UY (five-prong) socket.

Manufacturer: *Gainey's Radio Shop, Danville, Ill.*

Crystal Detector Adjustable by Screw Pressure

THE use of fixed crystals in the *Interflex* and *Peridyne* receivers and others for detection purposes, has brought about renewed demand for a crystal which will

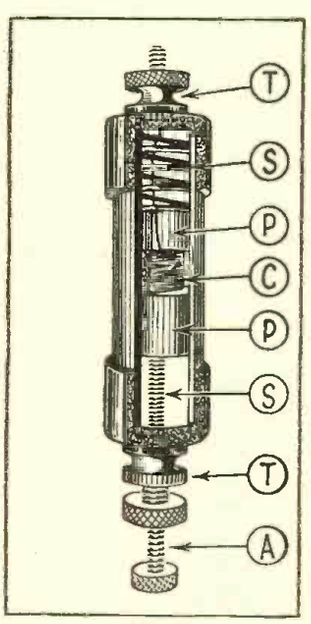


Fig. 2
Cut-away view of new Carborundum detector; A, adjusting screw; C, Carborundum crystal; P, plungers, S, springs and T, terminals.

be equally adaptable to all circuits. In answer to this demand, a well-known manufacturer has introduced a crystal mounted in a cartridge from which it can be readily removed to facilitate replacement. The crystal is equipped with an adjusting screw at the end, so that the most effective pressure can be obtained; this feature allows it to be adjusted to the particular circuit requirements of the set. A lock nut also is provided, so that the setting can be kept intact after the crystal has been adjusted.

Unlike the usual galena and similar crystals which were used so extensively some years ago, the Carborundum crystal requires a heavy pressure in order to give the greatest sensitivity. The pressure is rather critical and much better results can be obtained with one of these crystals if it is properly adjusted. The method employed in the new method of mounting effectively overcomes the difficulties often encountered in the past.

The new crystal functions in exactly the same manner as the older type and should have a bias of about 1½ volts, to give the best detecting action. The usual method of using a potentiometer and dry cell can be employed to obtain this.

Manufacturer: *The Carborundum Co., Niagara Falls, N. Y.*

Loud-Speaker Control Does Not Affect Others in Use

A SPECIAL panel-mounting resistor to control the volume of one speaker without affecting the volume of others connected to the same amplifier has been made available by a Mid-Western manufacturer. The resistance element is divided into two

Fig. E
The dual-resistance volume control, mounted on the frame of a cone-speaker, with knob to the front. It is suitable also for use on the panel of a radio receiver.

special tapers, one of which will maintain in the line a constant resistance equal to the impedance of the speaker used; the other is tapered to give a smooth and gradual control of volume. The first resistance is in series with the line and the second is shunted across the speaker; both are regulated by one knob. Turning the knob to reduce volume by shunting the speaker will add to the output load enough of the other resistance to maintain it at a constant impedance; so that, when the speaker is completely turned off, there is enough resistance in the line to match that of the speaker. This allows signals to be heard from the other speakers in the circuit at the same volume as before the first speaker was cut out. Thus, the maximum number of speakers any amplifying system will carry can be connected in series or parallel; and the volume of each speaker will be smoothly adjusted to fit individual requirements, without interfering with the others in the circuit.

The constant-input resistor is of a size easily assembled in standard outlet boxes; it is housed in a molded-bakelite case with

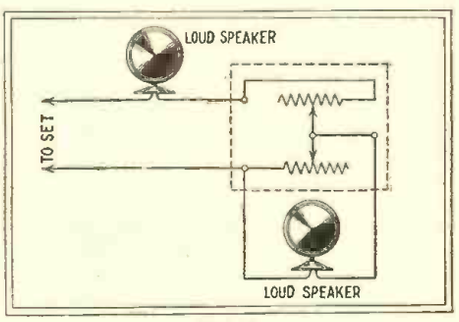


Fig. 3
With this hook-up of the dual volume control one resistance increases as the other decreases; so that the load on the set is the same.

air-tight metal cover, 1¾ inches in diameter. These units are made up to match the impedances of the speakers with which they are to be used; the manufacturer recommends that these be measured in ohms at 1,000 cycles when computing the needs of a speaker circuit.

Manufacturer: *Central Radio Laboratories, Milwaukee, Wis.*

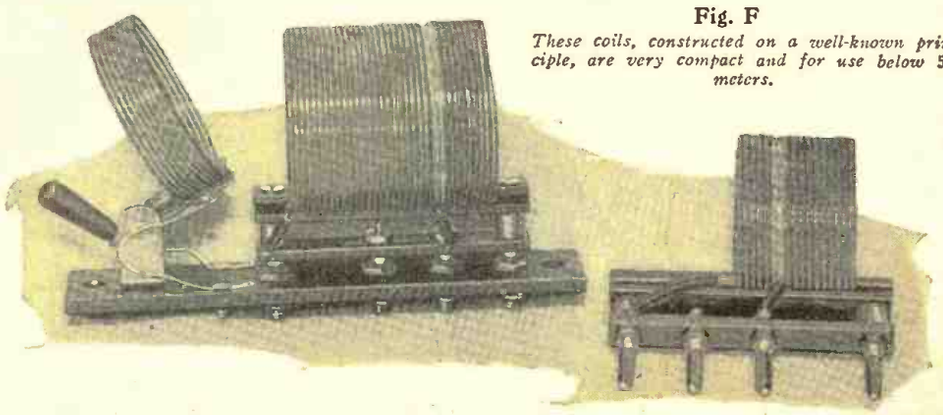
Small Plug-In Short-Wave Coils Are Rugged

HAVING in mind the present interest in short-wave reception, a New York radio manufacturer has designed a new group of coils, to facilitate the construction of short-wave sets. The coils are 2 inches in diameter and equipped with plugs which allow a quick change from one waveband to another. The coils are wound with a definite spacing between the turns and supported on a thin but strong layer of transparent dielectric material, in which the wires are partially embedded. This prevents them from coming loose and affecting the characteristics of the coils.

The primary winding, which is used for all the coils, is mounted on the base, which also contains the jacks into which the coils

(*Continued on page* 867)

Fig. F
These coils, constructed on a well-known principle, are very compact and for use below 50 meters.



Radio "Filters" and Their Many Forms and Uses

By C. Walter Palmer

THE advent of "B" power units and electric sets has caused a large increase in the use of filters in radio sets. When battery-operated receivers were used exclusively, the electric filter was very little known and its use was confined almost entirely to telephone engineering and other similar highly specialized fields. However, because of the wide use of these filters in power packs, almost every radio enthusiast can now tell what sizes of chokes and condensers are used in the filter circuit of a power unit and how they are connected. Of course, the filter used in the "B" power unit is only one of a number of types and, even in this case, most fans cannot tell *how* the filter operates or *why* certain values are chosen for the coils and condensers.

The purpose of an electric filter is not very different from that of any other filter; it is simply a device for separating several things which are mixed together. In this case they deal with electric currents of different characteristics; *i.e.*, direct and alternating currents, or alternating currents of different frequencies. The electric filter acts just as a sieve does, in separating objects of different sizes.

Although the design of filters involves the use of intricate mathematical calculations, the general nature of these units and how they operate will be of interest to most radio beginners. Their action depends on several well-known facts: first, that an inductor ("inductance") permits the passage of direct currents and low-frequency currents with much less resistance than it offers to high-frequency currents; second, that a condenser will pass high-frequency currents more readily than one of lower frequency, while it stops or "blocks" the flow of direct current; and third, that *tuned circuits* will permit the passage of alternating currents in a narrow band of frequencies and will oppose the flow of currents at other frequencies, or *vice versa*. By a proper arrangement of condensers and coils, any desired filtering action can be obtained.

TYPES OF FILTERS

Besides the special filters, which are used only for special purposes and will be described later, there are four general classes. The first is the *"low-pass"* filter, which prevents currents of a frequency *higher* than a certain predetermined value from passing. This type of filter will pass direct current and all alternating currents of a frequency lower than the critical value mentioned above.

Next comes the *"high-pass"* filter, which will pass all currents of a frequency higher than a certain value. In most cases a filter of this type will stop the flow of direct current as well as that of low-frequency alternating currents.

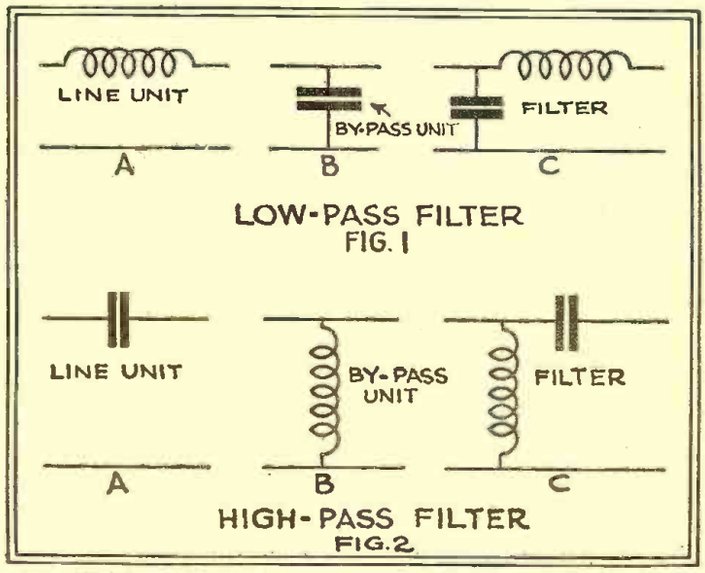
The third is the *"band-pass"* filter, which is designed to let through any current which has a frequency *between* the upper and lower limits of the band covered by the filter. In this case, currents of either higher or lower frequencies are stopped.

The fourth and last of the general types is the *"band-elimination"* or "band-exclusion" filter. The frequencies between the limits covered by the filter are *suppressed* in this case; this is just opposite to the operation of the band-pass type.

LOW-PASS FILTERS

As explained above, the "low-pass" filter is used to allow all frequencies below a certain value to pass. An inductance coil in series with the line, as shown in Fig. 1, will allow low-frequency currents to pass with little "impedance," while it will oppose higher-frequency currents to a much greater extent. In order to return the high-frequency currents to the source, a condenser is often connected across the line. By choosing the correct values, high-frequency currents are by-passed; while the impedance to low-frequency currents is high enough to prevent them from being by-passed with the others. At the right of the diagram the combination of coil and condenser is shown. Since the "cut-off points" of the coils and condensers in such a filter are not sharp, a series of such sections is often used to improve the operation of the filter. A practical application of the low-pass filter is the "B" power unit. In this case, the "rectified" direct current is passed through the choke coils with little trouble and, since direct current cannot pass through a condenser, the direct current is kept in the correct path. The high-capacity condensers in this filter are so designed that alternating currents of both high and very low frequencies are by-passed, which leaves the output free of all alternating currents which would otherwise cause "hum."

In most "B" power units a two-section filter is employed, comprising two choke coils and two or three filter condensers.



LOW-PASS FILTER
FIG. 1

HIGH-PASS FILTER
FIG. 2

The "filter" arrangements above shown, though not commonly so called, will be found throughout every schematic radio diagram. It will be seen that the only difference between the "low-pass" and the "high-pass" filters is their arrangement and the way they turn "traffic."

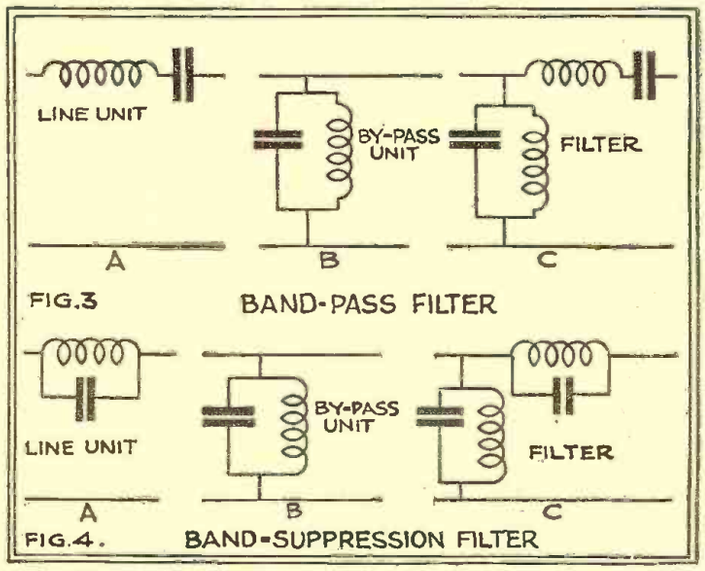


FIG. 3 BAND-PASS FILTER

FIG. 4. BAND-SUPPRESSION FILTER

The "tuned R.F." stages of the ordinary radio receiver sound much simpler than "band-pass" filters; but the latter is a description that may be applied to them with perfect accuracy. The "wavetrap" too is a "band-pass" or "band-suppression" filter—as you choose to view the signal.

When using 30-henry chokes and 2-microfarad condensers, the filter will pass currents of a frequency lower than 20 cycles, which excludes the 60-cycle hum which it is desired to eliminate. Most of the "line noises" and all the "harmonics" of the 60-cycle hum are also included in the scope of the filter, so that it is almost ideal for this purpose.

HIGH-PASS FILTER

The operation and construction of the high-pass filter is just the reverse to that of the low-pass filter; a combination of this type is shown in Fig. 2. The high-pass filter is designed so that all frequencies below a certain value are by-passed back to the source (through the inductor); while the frequencies higher than this value are allowed to pass. An inductor will allow a comparatively free flow of currents of low frequency, while a high-frequency current is hindered much more. A condenser in series with the line will prevent the flow of direct current and, if the correct value is chosen, the low-frequency currents up to the required value will also be blocked. In this case, also, the number of units may be increased to make the cut-off frequency more sharply defined.

The actual application of this type of filter is not as common as that of the low-pass type; but it will be found that most applications of radio-frequency choke coils in a receiver actually make up a single-section high-pass filter. For instance, in the detector plate lead, a radio-frequency choke is placed in series with the line, while a by-pass condenser is connected from the plate to the filament. The low-frequency currents (the audio-frequency "signal") and the direct currents from the "B+Det" lead pass though the choke while the high-frequency (radio-frequency "component") currents are carried back directly to the filament circuit through the condenser.

BAND-PASS FILTERS

The purpose of the band-pass filter is to allow the passage into a circuit of currents of a narrow band of frequencies, excluding all others, whether higher or lower than the limits of this band. Fig. 3 shows the make-up of this filter. The combination of a coil and a condenser in series (as shown at the left of the diagram) will "resonate" on a certain frequency and the circuit will have *least* "reactance" to currents of this frequency. On the other hand, a coil and condenser in parallel (as shown in the center of the diagram) connected across the line carrying the current, will offer the *greatest* opposition to currents of the frequency to which it is tuned. By combining the two circuits, which are adjusted to the same frequency, a fairly sharp cut-off on either side of the required frequency will be obtained. By increasing the number of filter units, the band can be made more sharply defined. The combination of the two filters is shown at the right side of Fig. 3.

The application of this type of filter will be found in wavetraps using "acceptor" and "rejector" coils. *Every tuned circuit in a radio set is really a single-section filter,* designed to pass currents of one particular small band of frequencies to which it is tuned, and block all others or by-pass them to ground, as the case may be. If the tuned circuit is arranged in series (as at the left of Fig. 3), the filter *passes* the required frequency; while if it is in shunt (as at B) it *blocks* the required frequency and passes all others. The selected frequency is then carried on to the other apparatus, usually the grid of the vacuum tube.

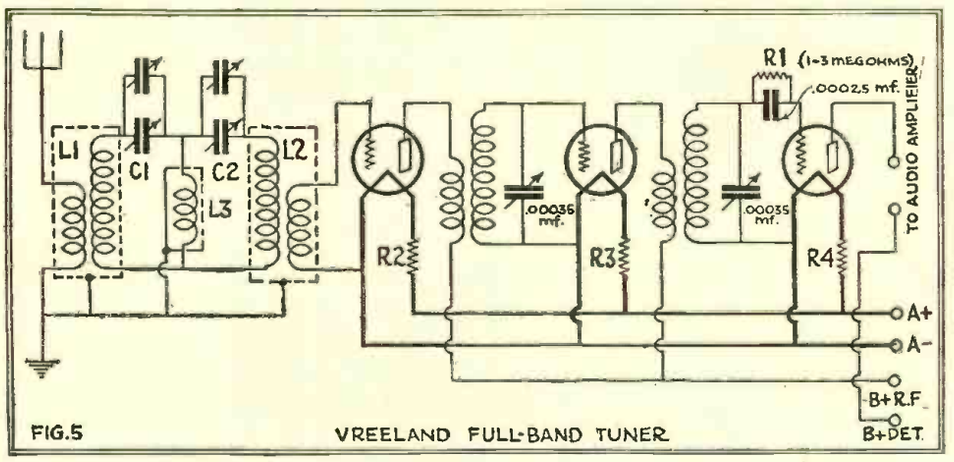


FIG. 5 VREELAND FULL-BAND TUNER

The two tuned circuits L1-C1 and L2-C2 have in common L3, which causes them to tune sharply, not to their exact natural frequency, but to a band on each side of it; while excluding everything else. The principle is used in the "RADIO NEWS *Hi-Q" described on page* 826.

BAND-EXCLUSION TYPE

The band-exclusion filter is used for a purpose just opposite to that of the band-pass type; to *prevent* the passage of the current in the band, a tuned circuit of a coil and a condenser in parallel are connected in series with the line. The by-pass unit then consists of a coil and condenser in series; these units are shown at the left and center of Fig. 4, while the complete filter is indicated on the right. The application of the band-exclusion filter is limited mostly to telephone work; although a filter this variety might be required in a radio receiver of special design.

The general types of filters described above are often varied, so that the correct filtering action may be obtained at the required frequency. For instance, in the band-pass filter, either the condenser or the coil may be removed from the series or shunt position; in order to increase or decrease the frequency; since the limits of the frequencies which may be covered by a tuned circuit of the type shown are limited.

Resistors cannot be considered as filters, since they impede currents equally at all frequencies. They do, however, have a different effect on filter circuits. They do not change the frequency at which the filter operates; but they do affect *the sharpness of the band.* In other words, they may be used when it is desired to broaden the tuning of the filter and, if the filter is to be tuned very sharply, care must be taken to keep the resistance of the circuit as low as possible. A similar effect may be obtained by increasing the number of units in the filter, but as a general practice it is less advisable.

SPECIAL TYPES

Besides the general types of filters described above, there are a number of others which cannot be brought under these classifications; although they follow the same rules as these four general types in the matter of the use of condensers and inductances for specific purposes. One of these is the Vreeland *"full-band"* filter, which was described in the March, 1928, issue of RADIO NEWS. The data for building a filter of this type were published in the December, 1928, issue, so that it is not necessary to give them here; but we reprint the diagram in order to illustrate the operation. (See Fig. 5.)

This unit is really a band-pass filter of special design and has the advantage that currents within the band are amplified to an almost, if not quite, equal ratio. This provides the necessary selectivity (10-kilocycle coverage) without reducing the quality, and without making the tuning too broad. As explained in the original article, the Vreeland system employs two "reactive couples" L1-C1 and L2-C2, preferably alike, each having a capacity and inductance that

(*Continued on page* 869)

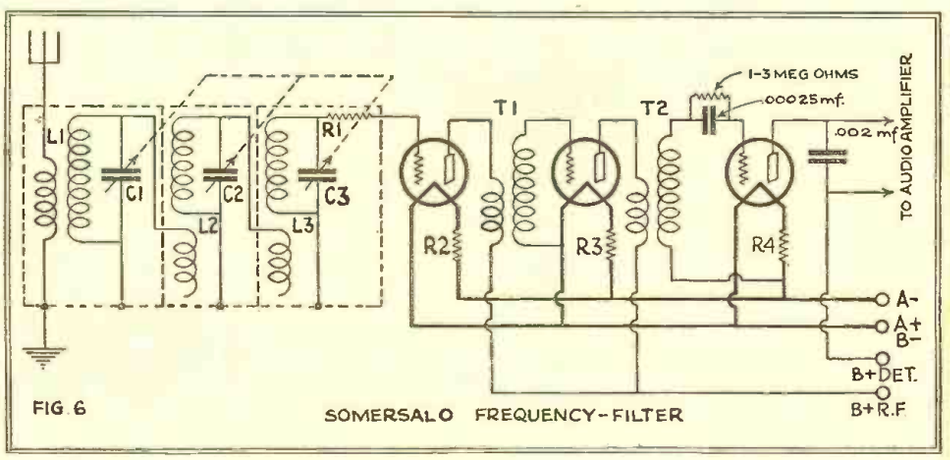


FIG. 6 SOMERSALO FREQUENCY-FILTER

The three tuned circuits ahead of the first tube here compose a filter which is followed by an untuned amplifier. In this manner, there is no source of feed-back through the system. It will be noticed that the primaries of the coils L2 and L3 are each open at one end.

Radio Tubes and Their Characteristics

[PART II.]

With an Explanation of the Alternating-Current Tube and Just Where the Alternating Current Is Used

By H. M. Bayer

THE question has often been asked, "How can alternating current be applied to the filament of a tube without the accompanying 60-cycle hum becoming a pronounced factor in the output?" It can readily be seen that this problem becomes somewhat hazy to the uninitiated, when they know that raw alternating current is used to light the filament of the 226-type tube, and, to all appearances, the 227-type tube as well.

THE "DIODE"

In order to gain a clearer understanding of the functions of an A.C.-operated tube, it is first necessary to review the *electronic action* which adapts a vacuum tube for use in radio reception and transmission. Without entering too lengthy a discussion of this subject, it may be stated briefly that the electrical characteristics of the vacuum tube depend on the *electron-emitting* property of a heated metal; this action was first discovered by Thomas A. Edison and is known as the "Edison Effect." Edison found that, by heating a piece of metal to a high temperature, he obtained conditions permitting the flow of electricity in a vacuum; now known to be due to the emission of electrons.

Some time after Marconi had obtained his first patents, J. A. Fleming made use of this effect and constructed the first vacuum tube to be used in radio circuits. This tube was a crude affair containing a filament which, when heated by a battery, served as the electron-emitter, and a plate which was kept positive by connecting it to the "+" side of a high-potential generator (the "B" battery). When the filament was heated it emitted a constant stream of electrons which were directed toward the plate, by its attraction for the electrons, which are negative. (The half-wave rectifiers described in this article are actually "Fleming Valves" in operation, though greatly improved electrically and mechanically.)

As long as the filament remained incandescent there was an electrified region between filament and plate, providing what is known as "a path of *unilateral conductivity*"; that is, permitting a current in one direction only. This "one-way" characteristic provided a sensitive rectifier (or what was then considered sensitive) necessary to "detect" radio waves and reduce them to audio frequencies.

THE "TRIODE"

This development was the forerunner of the modern three-element vacuum tube, which was invented by Dr. Lee de Forest and by him styled the "audion." He found that, on inserting a third element (the grid) between the filament and the plate, he obtained a sensitivity of detection heretofore unknown. This resulted from the grid's action in responding to the feeble flow of energy collected by the antenna and so affecting the current of electrons from filament to plate. The introduction of the grid made possible also audio-frequency amplification, radio-frequency amplification and the adaptation of the vacuum tube to radiotelephone and telegraph transmission, where it is employed as a generator of high frequency currents. There is no doubt that, without the *triode* or three-element vacuum tube, radio telephony could never have even neared the perfection it enjoys today.

While the battery-operated three-element vacuum tubes gave excellent results, and for that matter still do, the public's demand for increased simplicity of operation brought forth A.C. tubes, designed for operation from the light socket. Incidentally, it may be mentioned here that (contrary to a general belief) there is a theoretical difference only in efficiency between the two classes of vacuum tubes; the practical differences are found merely in the convenience of maintenance and operation. Where the 201A-type requires a storage battery or an "A" power unit with rectifier and filter, the 226- and 227-type tubes require for filament excitation only a step-down transformer; which in turn is connected to the house-lighting line, thus doing away with the routine of charging and watering a battery.

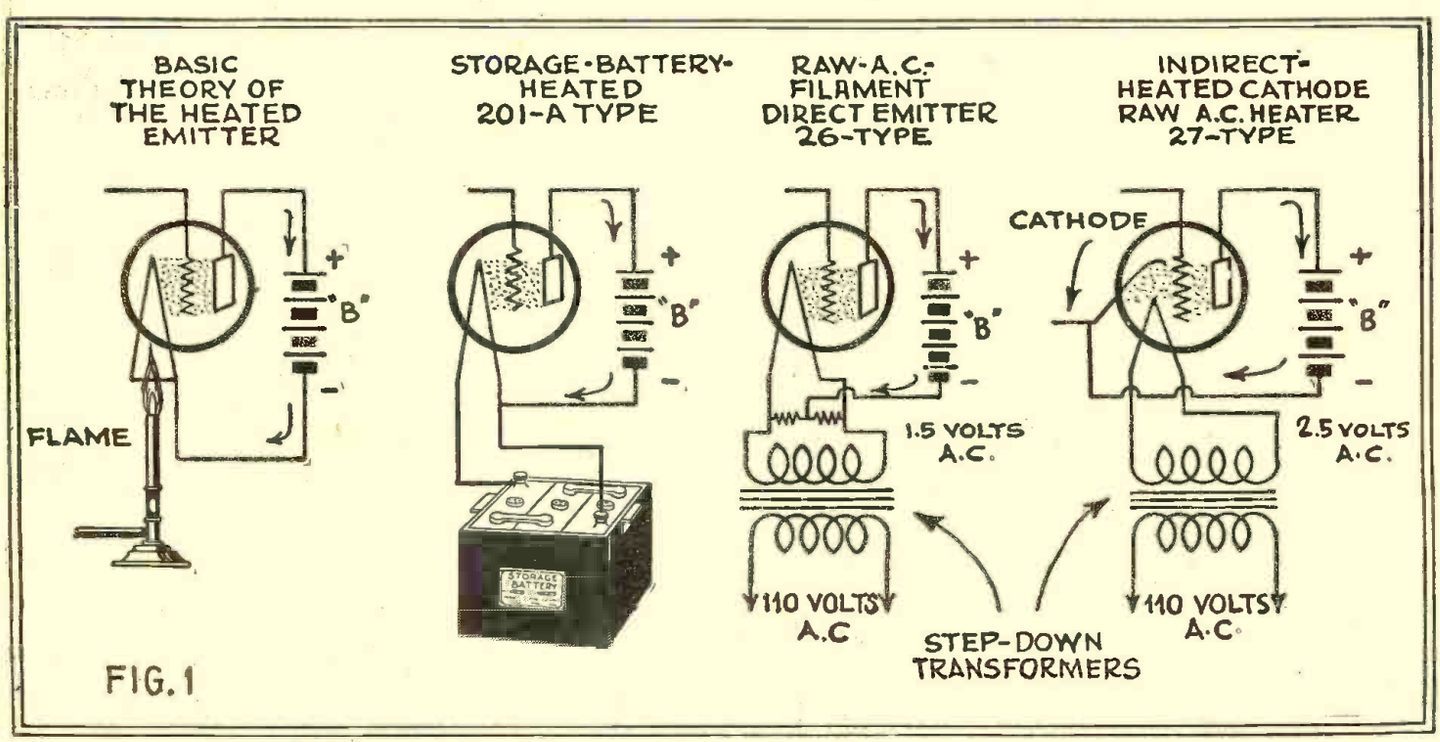


FIG. 1

The filament or "A" current takes no part in the operation of a tube, except as it is used incidentally to give bias. A tube may theoretically be operated with a gas flame to heat its filament, as at the left. A storage-battery tube (even if operated from an "A" unit) has only direct current in its filament; so has the No. 27-type tube at the right, in which the alternating current does not enter the cathode, which acts as a filament. The 26-type, however, has slight A.C. coupling in its filament circuit.

However, for the benefit of those who lack a source of alternating current it should be repeated that, other things being equal, they are equalling the results of the A.C. tube users except in the previously mentioned matter of convenience.

WHAT THE A.C. TUBE DOES

In the first diagram (Fig. 1) a three-element vacuum tube, the filament of which is brought to incandescence through the medium of a flame, is shown at the left. This, of course, is merely to illustrate the "Edison Effect" in its basic form and has no practical counterpart in the commercial or present-day experimental field; though Dr. de Forest is said to have used a flame in his early experiments in order to obtain electronic emission from a filament. It will be noticed that the plate current, carrying the signal heard in the loud speaker, travels from filament to plate and "return" and is entirely independent of the heating method used on the filament.

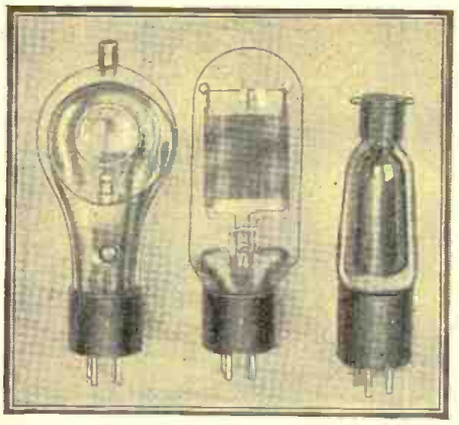
The second sketch in the same illustration shows the conventional direct-current tube with its battery-heated filament. Of course, this may as well represent any of the dry-cell tubes; the principle is the same with the exception of the voltage and current demands of the respective filaments. Here, as in the first sketch, the filament-plate current follows the same path.

Before proceeding with a description of the A.C. tube, it should be emphasized that the only difference between the latter and the D.C.-filament types lies in the construction of the filament. This is, of necessity, much heavier in construction in the A.C. tubes. Necessarily, there is a difference between the filament circuits of both types; the grid and plate circuits, however, are similar and require no changes in the event that a D.C. receiver is rewired to use A.C. tubes; except that the return is made to the "midpoint" of the filament circuit. This refers to the 226-type tubes, which can be used only in radio-frequency and audio-frequency amplification circuits, and not as a detector.

ELIMINATING A.C. HUM

The schematic structure of the 227-type A.C. detector is illustrated in Fig. 1; this tube employs a "heater" which is entirely independent of the grid, plate and filament-return circuits and, for this reason, produces less hum than the 226-type. Many commercial receivers employ these tubes throughout the amplifying stages to guard against any possibility of hum. Unlike the 226, this tube employs for its electron-emitter a fourth element known as the "cathode" (this accounts for the fifth prong on the UY socket), which is nothing but a cylinder built about the filament or "heater." It is the sole function of this heater to heat the cathode until it has reached the temperature where it will emit electrons. (See the sketch at the right of Fig. 1.) This explains the slight delay which takes place between the switching-on of an A.C. receiver and the moment its detector begins to function; this interval averages about 30 seconds and has always been somewhat of a mystery to the layman.

Another hazy subject, to the beginner, is the center-tapped resistor which is placed across the secondary of the step-down 1½-volt filament transformer used in lighting the filament of the 226-type tubes. Briefly, the reason for the use of this component is the necessity of providing an electrical balance in the filament circuit, in order to



Left, a photoelectric cell; center, a neon television lamp. Right, an "overhead-filament" 3-volt A.C. tube, with three prongs.

allow as little "ripple-voltage" or hum as possible. Such a resistor must be connected as shown in Fig. 1, where it is balancing the filament of the 226-type tube; as the alternating current flows back and forth in the filament, voltage at its center is practically uniform. This resistor is absolutely essential when using 226-, 171-, 210- or 250-type tubes in A.C. circuits.

15-VOLT A.C. TUBES

The first part of this article, in last month's RADIO NEWS, described the 1½- and 2½-volt alternating current tubes, which include the 226-, 227-, Hi-Mu 26- and A.C. 22-types.

Another class of alternating-current tubes makes use of the separate heater-filament for all types, instead of A.C. current led directly to the filaments as in some of the A.C. tubes listed above. These tubes require a step-down transformer with a single fifteen-volt secondary; whereas the others require transformer secondary voltages of 1.5 and 2.5, in addition to a separate supply for an accompanying power tube.

15-Volt 26-Type (A.C.)

Use, detector; socket, UX-type;
Filament voltage 15 raw A.C.; current 0.35-ampere;
Plate voltage 22½ to 45; current 1 to 2.5 mla.
Grid bias 4½ to 9 volts positive.

28-Type

Use, amplifier (not power); socket, UX-type;
Filament voltage 15 raw A.C.; current 0.35-ampere;
Plate voltage 90; current 7.5 mla.;
Grid bias 1.5 volts;
A.C. plate resistance 9,000 ohms;
Amplification factor 10.5.

30-Type

Use, power amplifier; socket, UX-type;
Filament voltage 15 raw A.C.; current 0.35-ampere;
Plate voltage 180; current 22 mla.;
Grid bias, 27 volts; A.C. plate resistance 3,500 ohms;
Amplification factor 3.8.

32-Type (High-mu)

Use, amplifier (not power); socket, UX-type;
Filament voltage 15 raw A.C.; current 0.35-ampere;
Plate voltage 135; current 1.5 mla.;
Grid bias 3 volts; A.C. plate resistance, 32,000 ohms;
Amplification factor 30.

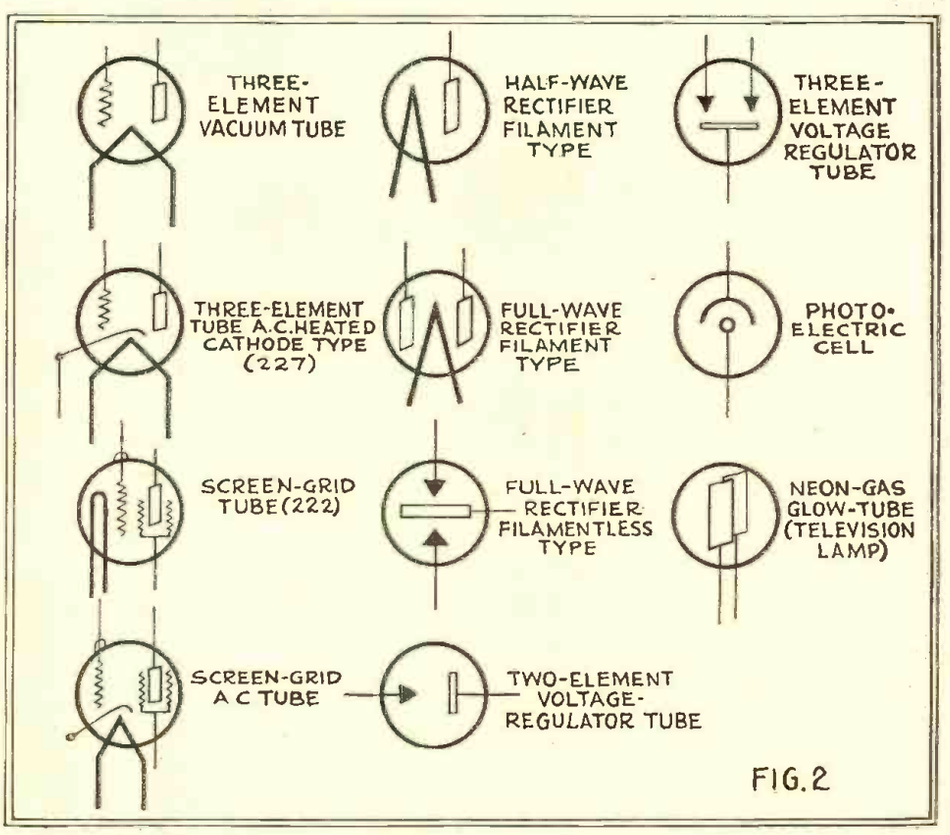
40-Type

Use, power amplifier; socket, UX-type;
Filament voltage 15 raw A.C.; current 0.4-ampere;
Plate voltage 180; current 21 mla.;
Grid bias 40½ volts;
A.C. plate resistance 2,000 ohms;
Amplification factor 3.

48-Type (A.C.)

Use, amplifier; socket, UX-type;
Filament voltage 15 raw A.C.; current 0.35-ampere;
Plate voltage 90; current 4.5 mla.;
Grid bias 4½ volts;
A.C. plate resistance 9,200 ohms;
Amplification factor 11.

(*Continued on page 872*)



The symbols used in schematic diagrams to indicate the types of tubes here described. The first, and commonest, symbol is the same for a direct-current tube or for one working with raw alternating current on its filament.

A typical group of meters, as found on the work-table of an active experimenter. Left to right: 0-100 milliammeter; 0-6 D.C. voltmeter; 0-600 A.C.-D.C. voltmeter; 0-50, 0-250 D.C. high-resistance voltmeter; 0-250 milliammeter.

What Meters Does the Radio Fan Need?

By Robert Hertzberg

IT is a fact, though an unfortunate one, that most radio experimenters and many custom radio builders do not properly appreciate the value of voltmeters and ammeters. They regard these instruments, usually, as desirable luxuries; whereas they should consider them as important necessities. Some men will spend hundreds of dollars on radio parts and accessories without even thinking of meters until some time when they encounter puzzling problems; and then they suddenly realize that a good set of measuring instruments would help to find the trouble in a few minutes.

A few years ago the home experimenter or service man could get along fairly well with a 98-cent combination meter that looked like an overgrown pocket watch. With this he could test the six-volt storage battery and the 90-volt "B" battery that formed the power-supply equipment of practically all broadcast receivers of early vintage; if the readings satisfied him, his use for the meter was ended. Today, however, there are actually dozens of different types of tubes, requiring power supplies widely different. The man who contemplates any serious experimental work, or who has occasion to do even casual testing of power units, will be as helpless without meters as an automobilist driving in the dark without headlights.

The writer wishes to reassure the reader that this article is *not* inspired by manufacturers of meters who desire to increase the sales of their products. It is the result rather of considerable observation of home radio experimenters, custom builders and service men, and of their methods of working. The incident that led directly to its preparation for RADIO NEWS was an interesting and illuminating one, and serves to emphasize the points the writer brings out.

A man owning a tuned R.F. receiver of a good commercial grade, equipped with an external resistance-coupled audio amplifier and "B" power supply, found one night that the set squealed badly, was very weak, and produced scratchy music when it produced any at all. He learned that his 11-year-old son had innocently twisted the knobs on the power unit; thereby upsetting the output voltages and throwing the receiver altogether out of kilter. He telephoned for a local service man—so called—who arrived with his pockets jammed with tools, tubes and wire, *but no meters*, and twisted the knobs for a hour without helping matters much. The variable resistors used in the power unit happened to be of the compression type, with an adjustment range of three full turns. He finally left, saying he'd be back with some more tubes and remarking that the unit was well adjusted.

Worth its weight in gold—the Weston A.C.-D.C. test set. This is equipped with a rotary switch which makes the two meters read every current and voltage value in a receiver.

TO THE RESCUE

The owner of the set called the writer, explained the trouble, and asked what could be done about it. Being idle at the moment, the latter put a high-resistance voltmeter in his overcoat pocket and drove to his friend's house. In five minutes he learned that the detector tube was being supplied with 102 volts, the R.F. tubes with 16 volts, and the A.F. tubes with 49 volts, instead of their required 200. The grid circuit of the audio power tube—a 171A—was practically open, a condition which accounted for the scratchy signals. In another five minutes the knobs were adjusted to give 67 volts to the R.F. tubes, 20 to the detector, 200 to the resistance-coupled audios, and 180 to the 171A, with the proper 40-volt grid bias. The receiver then resumed its normal condition of stability and gave forth music that was a pleasure to the ear. A single, simple voltmeter did the whole trick.

The writer is not going to recommend a list of necessary meters a yard long but, rather, will tell how to get along with the fewest number. The ambitious experimenter or builder can start at the top of the list and complete his collection as his finances allow or his business requires.

The first, and by far the most important meter for present-day work, is a high-resistance voltmeter, for measuring the output of "B" power units of all kinds. The most popular and useful instrument of this classification has a double scale, one reading from 0 to 50 volts and the other from 0 to 250. Either scale may be used if the connection is made to the right one of two "plus" posts on the base of the meter. A third post, always connected to the negative side of the circuit, is also on the base. The meter must be of the "high-resistance" type, so that only a very small current is consumed by it. The usual medium-priced instruments have a resistance of between 750 and 1,000 ohms per volt of scale reading.

There are many small voltmeters with scale readings which take in the usual voltages developed in radio power units; but these are not suitable because they take almost as much current as a complete radio receiver. A small voltmeter of the low-resistance type may draw as much as 20 milliamperes, which is as much current as a 171A power tube takes. This drain seriously affects the output of the power pack, and makes the meter readings false.

INCREASING THE SCALE RANGES

A voltmeter with a 250-volt scale can be used as it stands, for power units designed for sets employing R.F. and A.F. tubes of

the standard 201A, 226 or 227 types, and a power audio tube of the 171A type; for these tubes work on a maximum plate voltage of 180. When it is desired to measure voltages in excess of 250, this range can be extended by simply inserting a resistor *in series* with either the positive or the negative side. A simple and reliable method of determining the value of this multiplying resistor was described in detail on page 742 of RADIO NEWS for February, 1929.

Briefly, the idea is to use either a fixed or a variable resistor, the latter of the "universal" range type. Before connecting it, clip the meter across any available power unit so that you obtain a reading of exactly ninety volts on the 0-250 scale. Leaving the adjustment of the power unit unchanged, now connect the variable resistor in the meter circuit, and adjust it until the meter reads exactly thirty volts. This means that the scale reading is to be multiplied three times. The meter can thus be used for values up to 750 volts.

The writer found that an ordinary 250,000-ohm grid leak was just right as a three-time multiplier for his 0-250-volt meter. If a variable resistor is used, its adjustment should not be disturbed, once it has been determined; and it should not be used for any other purposes, unless you are willing to re-calibrate it every time you want it for voltmeter service.

On the 0-50 scale, this same voltmeter may be used quite successfully for measuring storage batteries or "A" power units designed for the 201A and similar tubes, which work on six volts.

A.C. INSTRUMENTS

The next meter, in the order of importance, is one for measuring alternating-current potentials up to 150 volts. There are on the market a number of very convenient meters for this work which have three scale readings: 0 to 4 volts; 0 to 8 volts, and 0 to 150 volts. The first takes in the filament voltages required by A.C. tubes of the popular 226 and 227 types; the second the filaments of power-amplifier and rectifier tubes like the 210, 250, 280 and 281 types; and the third allows the measurement of line-voltage on the house line. Either scale may be selected at will by connection to the proper post on the base of the instrument.

An A.C. voltmeter of this kind is nowadays considered by most service men fully as important as the high-resistance D.C. meter previously described. As many radio experimenters have learned to their financial distress, A.C. tubes are sensitive to voltage changes, and blow out on the least provocation, apparently. A few minutes' trial with a three-range voltmeter will quickly tell whether the so-called "110-volt" house current line gives really 110 volts or 126, and whether or not the individual tubes are being underloaded or overloaded. Most people are prone to blame the tubes themselves when they blow out but, in many cases, the trouble is actually caused by overloading. When a transformer that is designed to work on 110 volts is used on a 115- or 120-volt line (as many are), trouble is bound to develop.

An A.C. voltmeter left connected across the house line will also indicate to some extent whether annoying set noises are caused by line fluctuations. By watching the needle for an hour or so you will discover that the voltage changes considerably. If the fluctuations are very bad, the only remedy is an automatic regulator. There are a number of such devices, which are very effective in relieving some of the objectionable features of A.C. operation.

A word of advice in regard to the proper handling of the meters is in order. Remember that, when you are playing with a "B" power unit, you are likely to encounter voltages as high as 1,000 in 210 and 250 power packs and as much as 300 even in small 171 units. *Don't hold the two wires from the meter in your fingers* while you are measuring the voltage across any particular section of the circuit. Put a clip on one of the wires, snap it in place, and keep only one wire in your hand at a time. If you make a habit of this one-hand method you will never be shocked, as you are not part of a complete circuit.

The 110-volt line will not sting much but, as a matter of safety, keep your fingers away from live connections.

With these two voltmeters, the experimenter, custom builder or service man can diagnose about 90 per cent of all the trouble usually developed in either home-made or factory-built receivers, defective tubes excepted. In the absence of an expensive tube-tester, the easiest thing to do is to replace the suspected tubes by good ones, and to note the difference in results, if any.

AMMETERS AND MILLIAMMETERS

Ammeters and milliammeters are very useful for experimental work of all kinds, but are not indispensable to the service man. About the most useful meter of this class is a direct-current milliammeter, reading from 0 to 100 milliamperes. This can be used for measuring the current load imposed on "B" power units by the tubes of receivers of all kinds. The average five- or six-tube set with a 171A power tube draws perhaps 35 milliamperes, and larger sets with 210 or 250 tubes 65 or 75 milliamperes. Current drains of this order are easily and accurately measured.

The main value of a milliammeter in measuring the "B" circuit load is that it allows the owner of the set to determine whether or not the rectifier tubes are being operated properly. There is a definite safe operating value, for every type of rectifier, at which the tube will work efficiently for a long time without developing an excessive amount of heat. If current in excess of the figure given by the tube manufacturer is passed through the tube, its life will be shortened considerably and it will overheat badly, perhaps injuring neighboring apparatus as a result. Rectifier tubes are by no means as cheap as smaller receiving tubes like the 201A, so it pays to watch them closely. If the filament voltage as measured by the A.C. voltmeter is normal (or preferably slightly below normal) and if the current through it is within the safe maximum figure, the tube will last a long time. A life of three years or more for slightly-underloaded rectifiers is not unusual.

The combination of a milliammeter and a voltmeter may be used for the measurement of resistors of unknown values. Every experimenter has a fistful of odd resistors, taken from old power units, but he usually doesn't know their resistance in ohms because the labels have come off, or they are so dirty that the numbers cannot be distinguished. Every now and then he wants a resistor very badly, and then he has to take a chance with any one he picks up.

The method of measuring the resistance value is very simple. Simply connect the milliammeter *in series* with the resistor to be tested, and connect the combination across the lowest-value output posts of a "B" power unit. Clip the voltmeter across these same posts. Turn the unit on and observe the meter readings. If the milliammeter does not read at all, or if the needle moves only a fraction of a degree, increase the "B" voltage until you obtain a reading that you can note accurately. The resistance of the resistor in ohms is then equal simply to the voltage divided by the current. For instance, if the voltage is 96 and the current 10 milliamperes (.01-ampere), the resistance is 96 divided by .01, or 9,600 ohms. This figure is exact, and not merely approximate.

This method can be used only with resistors of the type employed for power units, and other applications where they normally carry more than a few milliamperes. It will work out easily for resistors under 25,000 ohms or so; because most resistors of this comparatively low value are intended for power use. Grid leaks and similar high-value resistors will not pass more than a small fraction of a milliampere without burning up.

As a further check on the operation of alternating-current tubes, an A.C. ammeter reading up to 5 amperes is useful; this meter is more or less of a luxury, and makes a nice addition to the experimenter's or custom builder's instrument case if he can afford its cost.

LOW-RANGE D.C. METERS

As stated before, a high-resistance D.C. voltmeter can be used for measuring six volts, as furnished by storage batteries or "A" power units to sets using direct-current tubes. If you have occasion to do extensive testing or trouble-shooting on receivers of this type (and there are many thousands

(*Continued on page 879*)

Another high-grade all-purpose instrument, the Jewell. The meters are thrown in and out of the circuit by means of small push-buttons. With the plugs, readings are taken at the sockets.

The Radio News 1929 Hi-Q*

A Six-Tube Receiver Combining the Highest Quality with DX-Getting Ability

By Herndon Green

Fig. A

The "1929 Hi-Q" built into a console cabinet of very attractive design; many styles are available nowadays.

THE "1929 Hi-Q" is probably the finest all-round broadcast receiver which RADIO NEWS has yet been able to present to its readers. It is designed specifically to operate under the present difficult conditions of broadcast reception, and possesses all the necessary requirements of quality, selectivity, sensitivity and ease of control. Its main feature is the use of a circuit, comparatively new in broadcast-receiver construction if not entirely new in principle, which is of the band-pass-filter type and ideally suited for the reception of broadcast stations without interference. The arrangement also makes possible a degree of tone quality hitherto not obtainable with ordinary forms of radio-frequency amplifiers.

Briefly, the tuning system in the "RADIO NEWS 1929 Hi-Q" provides even greater selectivity than the old-fashioned "razor-edge" regenerative set expertly operated, and sensitivity equal to that of most superheterodynes. In addition, the output from the loud speaker will satisfy the most critical music lover. Since the receiver in general is distinctly new and different, the details will be given.

THE "SIDE-BAND" PROBLEM

To start at the beginning, the layman will readily agree that good selectivity is a highly desirable attribute of any radio set. Good selectivity, however, has hitherto been understood to mean sharpness of tuning, which is not conducive to quality of reproduction. For example, the high-quality audio-frequency coupling devices now available make possible the construction of a practically-perfect audio amplifying system. If a power tube is used in the last stage of such an amplifier, and its output fed into a speaker of the best type, the system leaves little to be desired; it can, however, amplify and reproduce only what is fed into it by the detector tube, which in turn receives the signal from the radio-frequency amplifier. Hence, it is evident that even a perfect audio system cannot provide high-quality output from the loud speaker, if distortion is introduced in the R.F. amplifier; due, let us say, to excessively sharp tuning, technically known as "side-band cutting." This illustrates the opposite nature of two desirable characteristics, quality and selectivity.

Also, the attainment of a high degree of radio-frequency amplification (sensitivity) is a distinct asset, if it can be attained without instability (tendency toward self-oscillation of one or more tubes), which impairs the quality of reproduction. High amplification is desirable because it enables the set owner to receive programs from very distant stations when he feels so inclined, and also because it makes possible quite satisfactory reception from local and moderately distant stations on a small indoor antenna, even in unfavorable locations. However, selectivity and sensitivity are also incompatible.

RADIO NEWS BLUE PRINT No. 76

This receiver, one of the finest ever made available to home and custom radio builders, incorporates two "flat top" band-pass filters, described in previous issues of RADIO NEWS. *These transformers, which must be laboratory-matched, make it possible to give both selectivity and very high amplification. Full constructional blueprints will be furnished for 25 cents; coupon which appears on page 879 should be used to expedite the order.*

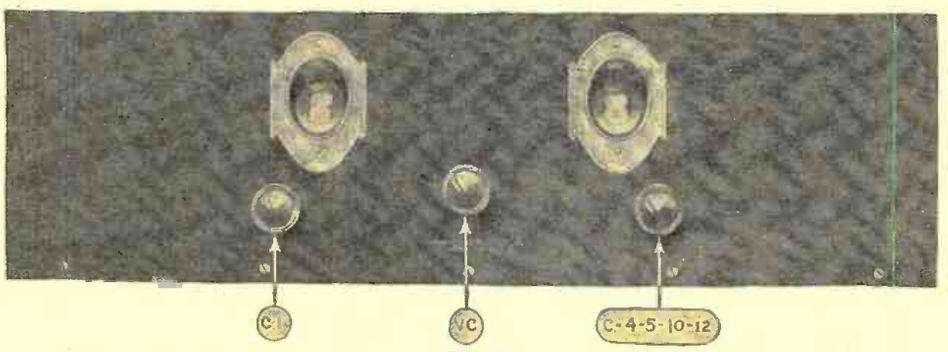


Fig. B

The center knob VC is the volume control; the tuning control C1 governs the antenna condenser, and the right knob the four condensers tuning the band-pass filter circuits.

TRUE AND FALSE SELECTIVITY

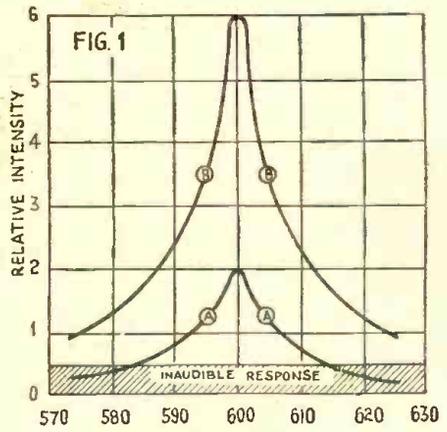
One of the reasons for this condition is not generally understood, and is even more seldom taken into consideration. The average receiver owner or experimenter bases his judgment almost entirely on the *apparent* selectivity; this is quite natural, in view of the fact that the *actual* selectivity of a receiver can be determined only by a series of very careful measurements. The apparent selectivity of the ordinary radio set decreases as its sensitivity increases. Therefore, of two receivers having exactly similar "actual" selectivity while one has, say, three times the sensitivity of the other, the set having the higher sensitivity (or amplification) will invariably seem broader or less selective.

This principle is very clearly shown in Fig. 1. Line A is the response-curve of the less-sensitive receiver when tuned to 600 kilocycles (500 meters). Assuming that no 600-kc. station is on the air at the time, no sound will be heard from the loud speaker, as the sensitivity of the set is not great enough to bring a 580-kc. station (which is assumed to be on the air at the time) above audibility. Line B represents the response-characteristic of the more sensitive receiver and, under conditions described, the 580-kc. station will now be heard; since the increased amplification of the more sensitive receiver is sufficient to bring the signals above audibility. Thus, it is quite easy to understand why the more sensitive of the two sets will "appear" to be less selective; although in reality one is equally as selective as the other. This fact illustrates the need for specially-designed tuning circuits in a receiver having a very high degree of radio-frequency amplification, if it is to have an unusual degree of selectivity.

SCREEN-GRID TUBE PROBLEMS

The enormous amplification and extremely low plate-to-grid capacity of the screen-grid tube would at first glance seem to make this

* RADIO NEWS *Blueprint Article No. 76.*



While B is the curve of a more sharply-tuned set than A, the additional amplification of B brings into audibility signals in channels beyond those heard with A. The result is an effect of "broader tuning" in B.

an ideal amplifier; but yet it has acquired the reputation of causing "broad tuning," for the reason explained above.

The natural advantages of the screen-grid tube were carefully considered by the designers of the "1929 Hi-Q," and various methods of overcoming the apparent disadvantages were investigated. Two stages of radio-frequency amplification were decided upon as sufficient, as they could reasonably be expected to produce an over-all voltage gain of more than one thousand. In order to achieve a high degree of selectivity with this amount of amplification, some special form of tuning is necessary. The combination of a conventional antenna coupler and two interstage tuned-radio-frequency transformers is wholly inadequate in the matter of selectivity, although the amplification is good. The tuned-plate-impedance, coupling-condenser and grid-leak arrangement specified by the manufacturers of the tube was passed up for the same reason. Calculation showed that it was quite feasible to tune both the grid and the plate circuits of these screen-grid tubes. This is one of the marked advantages of this type of tube; since an attempt to tune both the grid and plate circuits of an ordinary amplifier tube invariably results in uncontrollable oscillation.

MULTIPLE-TUNING SYSTEM

When both grid and plate circuits are tuned, a two-stage radio-frequency amplifier has a total of five tuned circuits, including the grid circuit of the first tube. This increased number of tuned circuits would, naturally, produce a marked increase in selectivity. In fact, the scheme looked so good on paper that an experimental receiver embodying these ideas was constructed. On test, this model performed in a truly remarkable manner, greatly exceeding expectations.

The radio-frequency gain was very high; enough to bring in many distant stations, including one on the Pacific coast. The selectivity was such that more than a dozen of these distant stations were received while the locals were operating. (This test was made last May, using a 75-foot antenna, located in mid-town New York—a location, be it said, full of interference and not conducive to making DX records.)

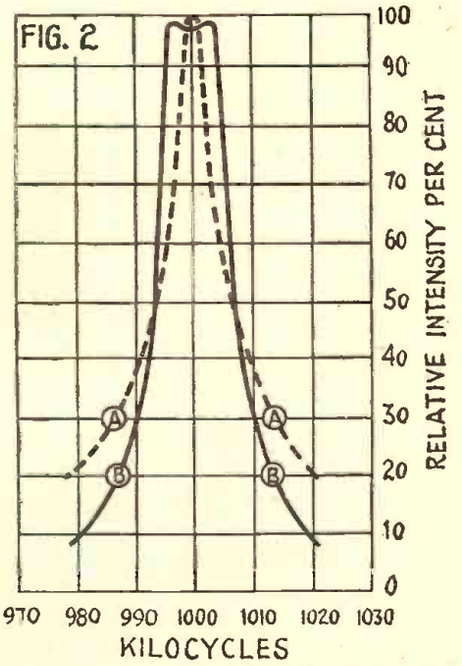
The remarkable performance of this receiver can best be understood by a consideration of the principles involved in its design. The inter-stage radio-frequency transformers (L2, L3) are quite unique in that they consist of two exactly similar coils. One constitutes the primary of the transformer and is connected in the plate circuit of the preceding tube; the other coil acts as a secondary and is connected to the grid of the following tube. Each coil is tuned to resonance with the desired signal by means of a .00035-mf. variable condenser (C4, C5, C10, C12). Because of the rather unusual arrangement, the *mutual inductance* or coupling between the primary and the secondary is *much smaller* than in ordinary circuits.

However, this does not mean that the energy transfer from primary to secondary is inefficient. In the case of the coupling coils used in the receiver under discussion, the maximum secondary voltage is obtained with a coupling co-efficient in the order of *one per cent.* The physical arrangement of the coils as shown in the various accompanying photographs of the completed receiver was chosen, because it seemed the simplest way to secure such loose coupling while keeping the coils still close to each other; thus conserving space.

R.F. "BAND-PASS" COUPLING

Due to the inherent characteristics of loosely-coupled tuned circuits, each of these double-tuned radio-frequency transformers really constitutes a "band-pass" filter. This is quite clearly shown in Fig. 2, illustrating the tuning characteristics of one of these double-tuned, loose-coupled transformers. The dotted line represents the response curve of one tuned circuit alone, and the solid line that of both circuits properly coupled. It will be noticed that the former is a typical "resonance-curve"; very sharp on the top at exact resonance and sloping gradually toward zero as the frequency is increased or decreased. On the other hand, the solid curve of the double circuit is quite broad and almost flat on the top, but slopes more steeply on the sides and the response approaches zero much more rapidly above and below the resonant frequency.

The curves shown in Fig. 2 are based on actual measurements of one of the new radio-frequency transformers used in the "1929 Hi-Q."

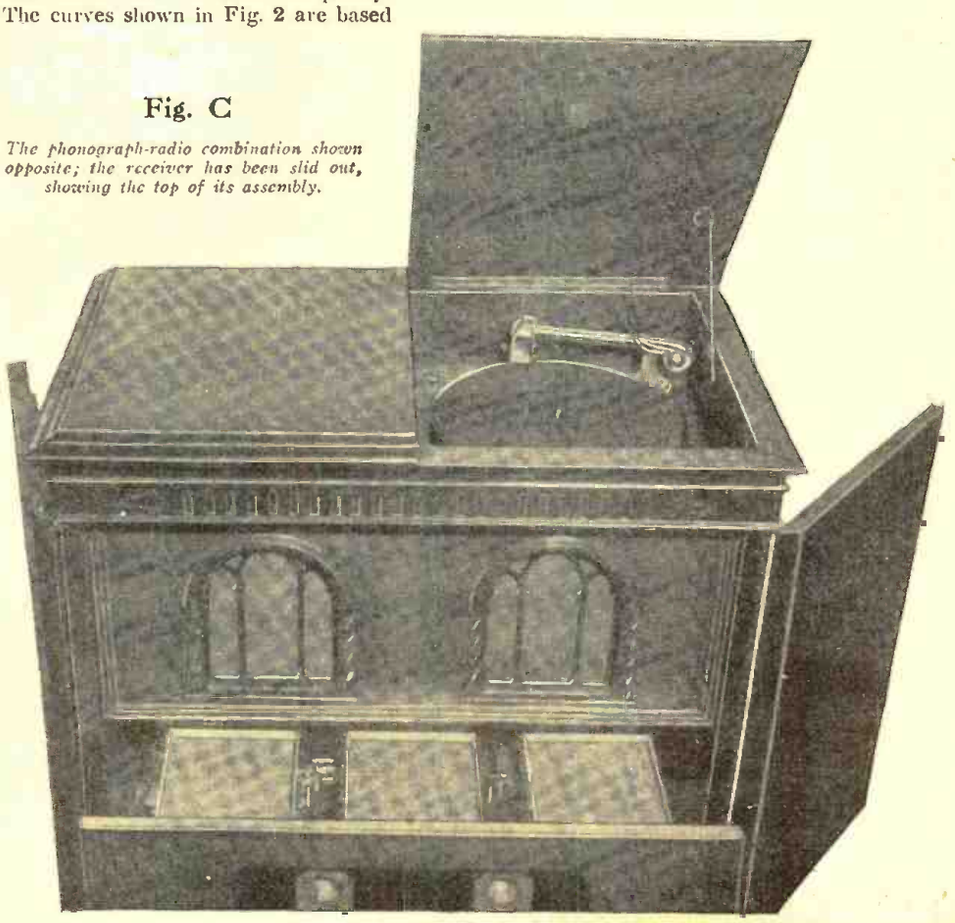


The sharply-defined peak of A here is that of a resonant circuit. It will perceptibly "cut sidebands." That of B represents the combination of two loosely-coupled circuits, as employed in the R.F. transformers of the "Hi-Q".

While the use of one of these double-tuned radio-frequency transformers produces an unusual degree of selectivity, the use of two such stages in cascade results in a vast improvement. As an illustration, note that the response of an interfering signal 20 kilocycles below resonance on the solid curve of Fig. 2 is but 9% or about one-eleventh of the response at the frequency for which the set is tuned. This is for one stage only. After going through the second stage, how-

Fig. C

The phonograph-radio combination shown opposite; the receiver has been slid out, showing the top of its assembly.



ever, the intensity of this interfering signal will have been reduced to 0.8%, less than one one-hundredth. At the same time, the addition of the second stage does not materially affect the shape of the top of the response curve. The top of the curve remains substantially as shown in Fig. 2; while the sides become much steeper and the response approaches the zero line at a much more rapid rate.

The width and flatness of the top of the solid curve shown in Fig. 2 has an important bearing on the quality of the received speech and music. This is due to the fact that broadcast stations do not transmit a single frequency, but rather *a band of frequencies.* The width of the side-bands varies somewhat, depending on the transmitter adjustments and also on the type of program being broadcast; they are, however, generally conceded to require about five kilocycles for high-quality transmission. It is therefore apparent that the receiver should be capable of amplifying a ten-kilocycle band of frequencies, with substantial uniformity, if the program is to be received faithfully. Hence the desirability of the wide flat top on the over-all response curve of a high-grade receiver.

When the top of the response curve is sharp instead of flat, all the frequencies in the band are not amplified equally. Consequently, certain of these frequencies reach the detector much stronger than others; with the result that even the most perfect audio-frequency amplifier and loud speaker will be unable to reproduce the program with its original quality. This is the type of distortion referred to previously as "side-band cutting" and results in the loss or weakening of the high audio frequencies, making the output from the loud speaker dull and muffled.

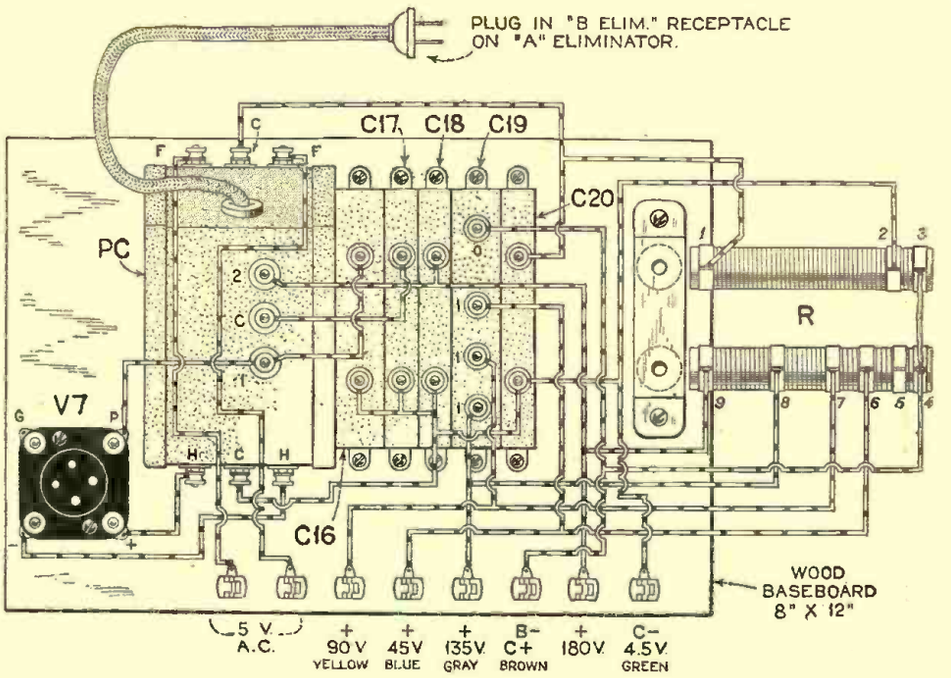


Fig. 3

The compact layout of the power unit; compare with illustration and schematic diagram on page 829. A filamentless rectifier tube is used, and a voltage-dividing resistor of special design.

RECEIVER COMPONENTS

The following parts are required for the construction of the "Radio News 1929 Hi-Q":

One antenna coil, tapped (L1);
Two R.F. transformers, specially made, screen-grid type (L2-L3);
One variable condenser, .00035-mf. (C1);
Two two-gang variable condensers, .00035-mf. each section (C4-C5-C10-C12);
Two drum dials, illuminated;
Four adjustable compensating condensers, 35-mmf. (C3-C6-C9-C13);
One impedance-matching transformer for phonograph pick-up (T1);
One audio-frequency transformer, standard type (T2);
Two push-pull audio-frequency transformers (T3-T4);

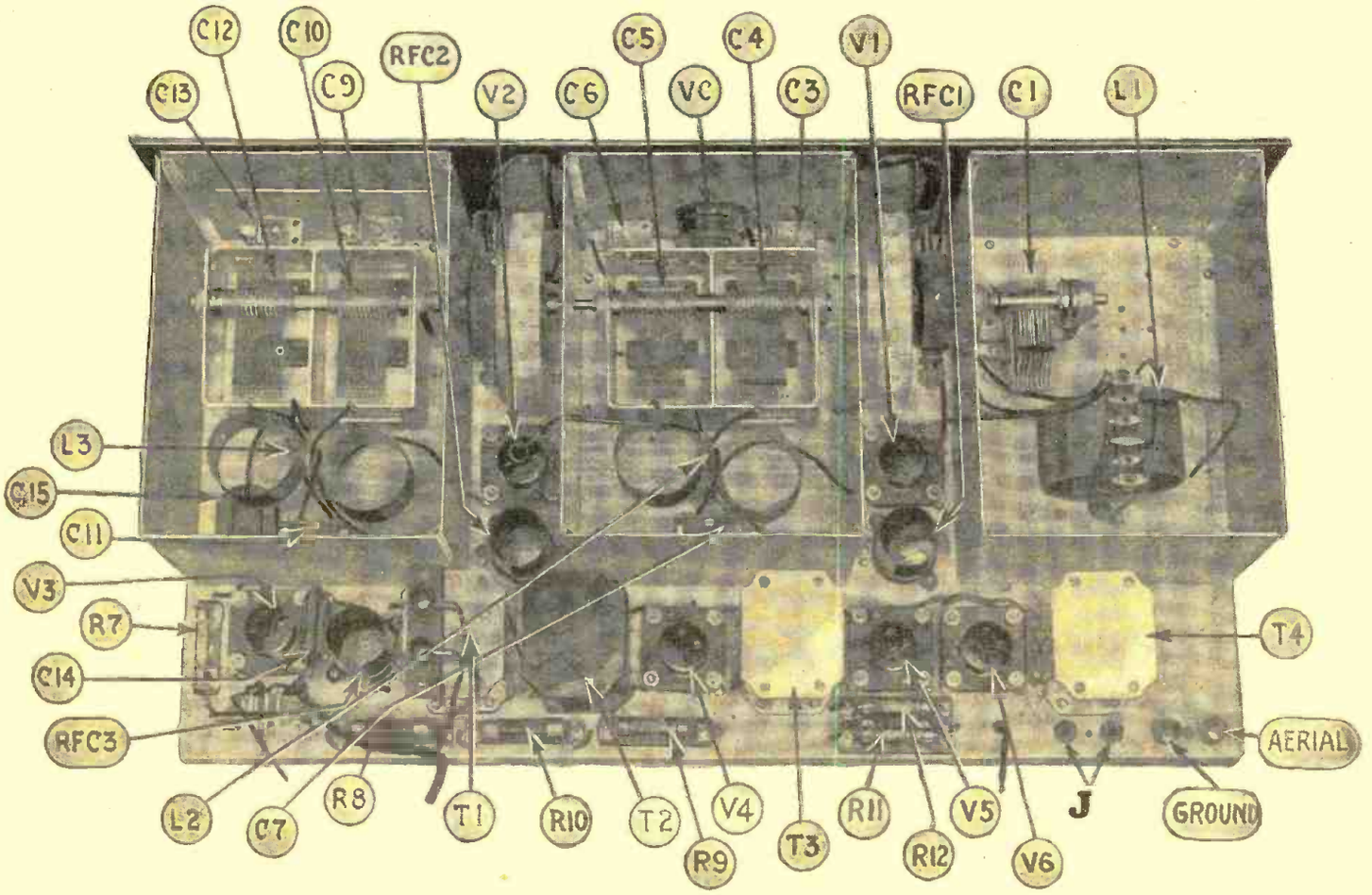


Fig. E

The completed "Hi-Q" without its shield tops; note the clip on L1 which adjusts the primary to the aerial used.

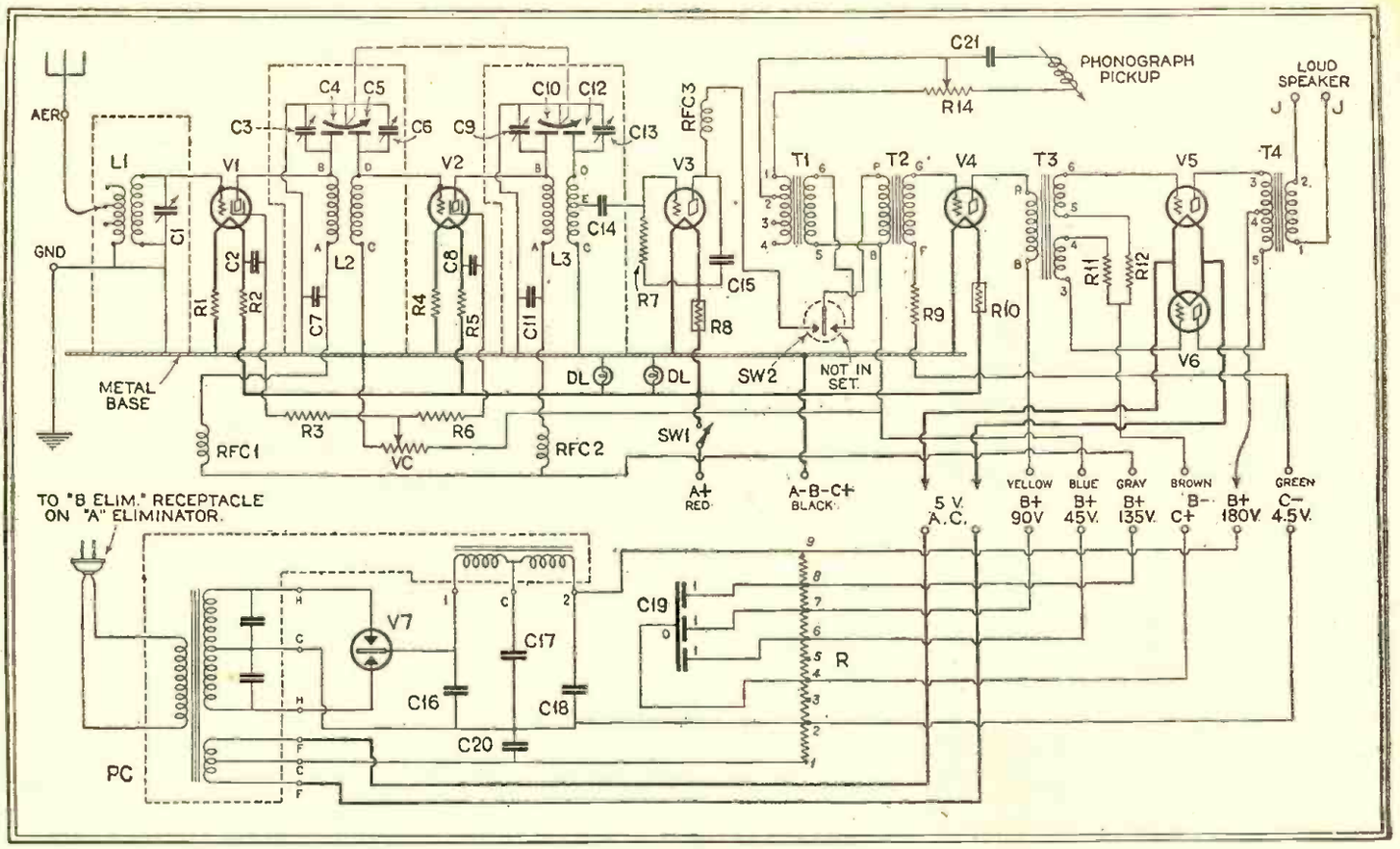


Fig. 5

This receiver with its "B" unit may seem complex, but is really simple to assemble, because more difficult connections are included in the components, and with the proper chassis, the wiring is practically all the work. The volume control C21-R14 is mounted on the phonograph's turntable board; and the magnetic pick-up is connected to two binding posts on a bakelite strip above T1.

Six tube sockets, UX-type;
Three R.F. choke coils, 85 millihenries (RFC1-RFC2-RFC3);
Three shield cans, 8x6x5¾ inches, aluminum;
One potentiometer, incorporating filament switch, 0-100,000-ohm (VC-SW1);
Two filament resistors, 10-ohm (R1-R4);
Two filament resistors, 15-ohm (R2-R5);
Two resistors, wire-wound, 5,000-ohm (R3-R6);
Two filament ballasts, ¼-ampere (R8-R10);
One grid condenser, .00025-mf. (C14);
One grid leak, 2-megohm (R7);
One resistor, metallic type, 50,000-ohm (R9);
Two resistors, wire-wound, 50,000-ohm (R11-R12);
Four by-pass condensers, 0.5-mf. (C2-C7-C8-C11);
One by-pass condenser, .001-mf. (C15);
Two phone-tip jacks (J);
Four binding posts;
One seven-wire plug-in cable and cable connector;
One front panel, 7x24x⅛ inches, drilled and engraved;
One steel chassis, 23½x12 inches (inverted-dish type, 1-inch deep) already drilled;
Two screen-grid tubes, 222-type (V1-V2);
One detector tube, 200A-type (V3);
One general-purpose tube, 201A-type (V4);
Two power tubes, 171A-type (V5-V6).

"B" POWER COMPONENTS

One power compact with built-in chokes and buffer condensers (PC);
One filter condenser, 2-mf., 400-volt rating (C16);
One filter condenser, 2-mf., 200-volt rating (C17);
One filter condenser, 4-mf., 200-volt rating (C18);
One condenser bank containing three 1.0-mf. by-pass condensers brought to terminals 0-1-1-1-mf. C19);
One filter condenser, 1.0-mf., 200-volt rating (C20);
Two resistors (special design), (R);
One tube socket, UX-type (V7);
One filamentless gaseous-rectifier tube, 125-mla. (V7);
Eight spring-clip binding posts;
One wooden baseboard, 12x8x½ inches.

PHONOGRAPH EQUIPMENT

One motor and turntable;
One phonograph pick-up with arm;
One S.P.D.T. toggle switch, mounted on phonograph board (SW2);
One S.P.S.T. toggle switch for motor control;
One potentiometer volume control, 0-20,000-ohm (R14);
One by-pass condenser, 0.25-mf. (C21);
One motor board;
Two needle receptacles.

MECHANICAL CONSTRUCTION

The two double-tuned radio-frequency transformers used in the "Radio News 1929 Hi-Q" necessitate the use of four variable condensers—one to tune each of the four coils. Since all four of the tuned circuits are identical, these four variable condensers are rotated by a common shaft actuated by a drum dial which has a smooth positive drive without back-lash. The tuned input circuit connected to the grid of the first shield-grid tube V1, and often referred to as the antenna coupler, is of the conventional type, having a tapped primary L1 adaptable to different length antennas. The variable condenser C1, which tunes this antenna coupler, is on a separate shaft and has a separate drum dial; thus enabling this circuit to be tuned to exact resonance with the received signal, regardless of the type of antenna used.

The volume control is quite out of the ordinary and possible only through the characteristics of the screen-grid tubes. It consists of a 100,000-ohm potentiometer VC connected across the 45-volt "B" supply. The movable arm of this potentiometer provides a variable voltage which is impressed on the screen-grids of the two R.F. amplifier tubes. The amplification obtainable from the latter varies within wide limits as the voltage on the screen-grids is varied; being at maximum around 45 volts and dropping rapidly as the screen-grid potential is reduced. This

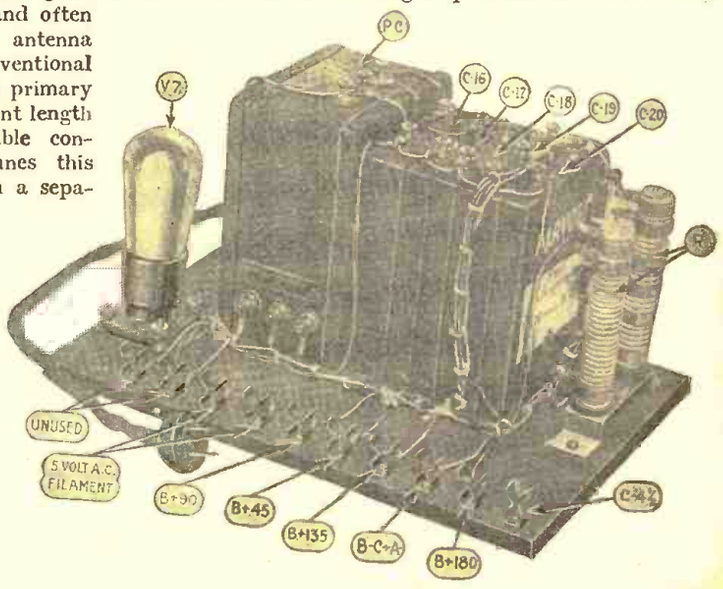


Fig. F

This power unit supplies all "B" current, but filament current for the push-pull stage only. The resistor R is provided with proper taps for this receiver and needs no adjustment.

provides a smooth control of volume within wide limits without affecting quality or tuning in the slightest degree.

ISOLATING CIRCUITS

While the screen-grid tubes have an extremely low value of capacity between plate and grid, thus almost entirely obviating the tendency of feed-back through the tubes themselves to cause self-oscillation, this advantage is nullified if feed-back occurs in other parts of the receiver. Taking this into consideration, every effort has been made to isolate all circuits in which coupling might result in instability. The negative bias for the control grids of the R.F. tubes is secured by the drop across individual ten-ohm resistors (R1, R4) in series with the negative leg of each screen-grid tube filament. Since the screen-grids of both these tubes are biased by the 10,000-ohm potentiometer, 5,000-ohm isolating resistors R3, R6 are inserted in the leads to the screen-grids, which are in turn by-passed by means of separate 0.5-mf. by-pass condensers C2, C8. The plate circuits of these tubes are likewise isolated by individual filters con-

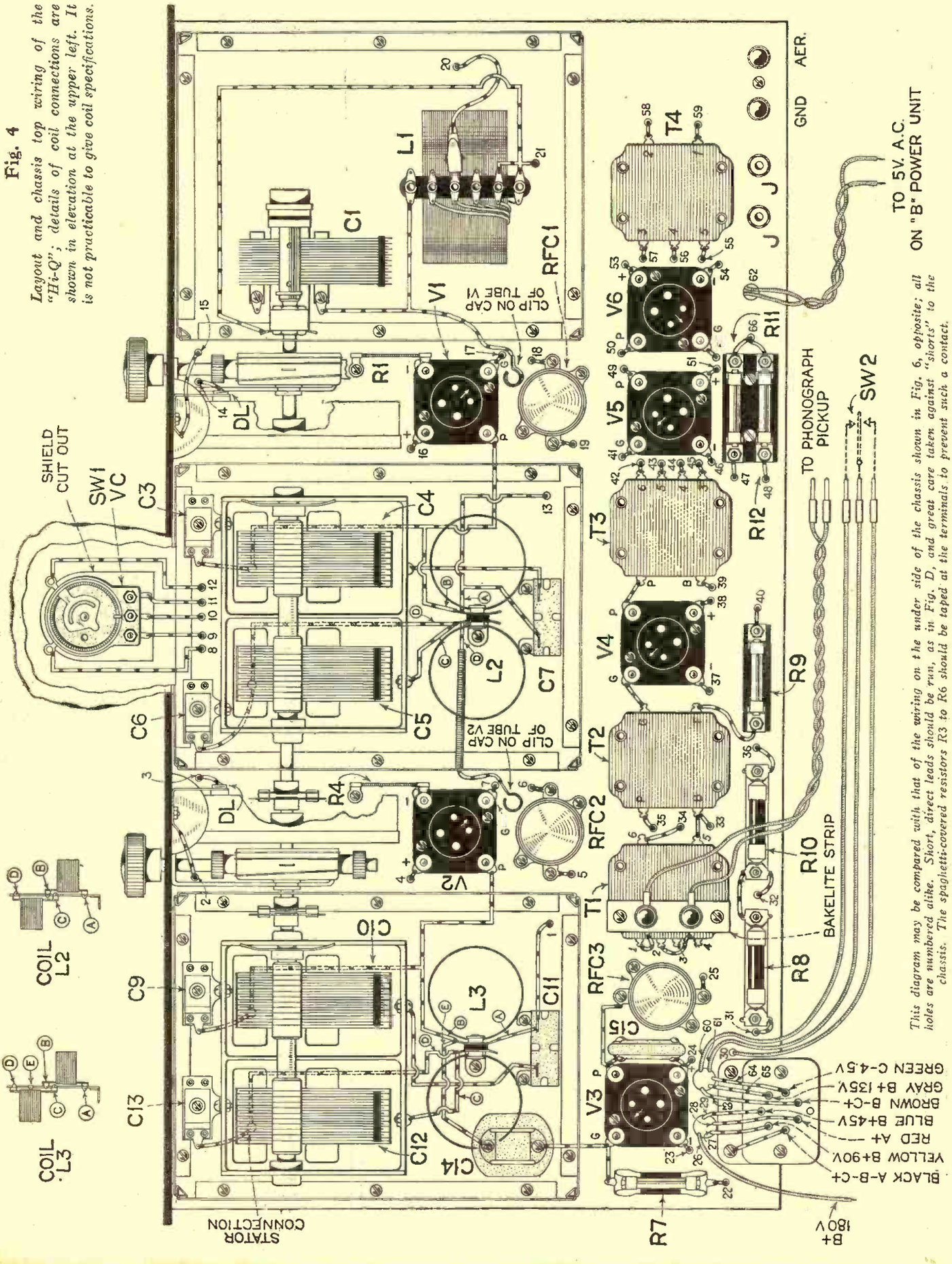


Fig. 4

Layout and chassis top wiring of the "Hi-Q"; details of coil connections are shown in elevation at the upper left. It is not practicable to give coil specifications.

This diagram may be compared with that of the wiring on the under side of the chassis shown in Fig. 6, opposite; all holes are numbered alike. Short, direct leads should be run, as in Fig. D, and great care taken against "shorts" to the chassis. The spaghetti-covered resistors R3 to R6 should be taped at the terminals to prevent such a contact.

sisting of separate radio-frequency choke coils and by-pass condensers RFC1, C7 and RFC2, C11.

In addition to these precautions, the entire R.F. end of the receiver is thoroughly shielded. Each stage is entirely enclosed in a snug-fitting aluminum box which is securely fastened to the metal chassis. The screen-grid tubes V1, V2 are so located that the leads to the control grids are as short as possible and farthest away from the plate leads, which are also short. By placing these tubes between the cans, the side walls of the latter are used also as electrostatic tube shields, effectively preventing coupling between the tube elements and other parts of the circuit. This arrangement produces the minimum of coupling between output and input circuits, which is extremely important.

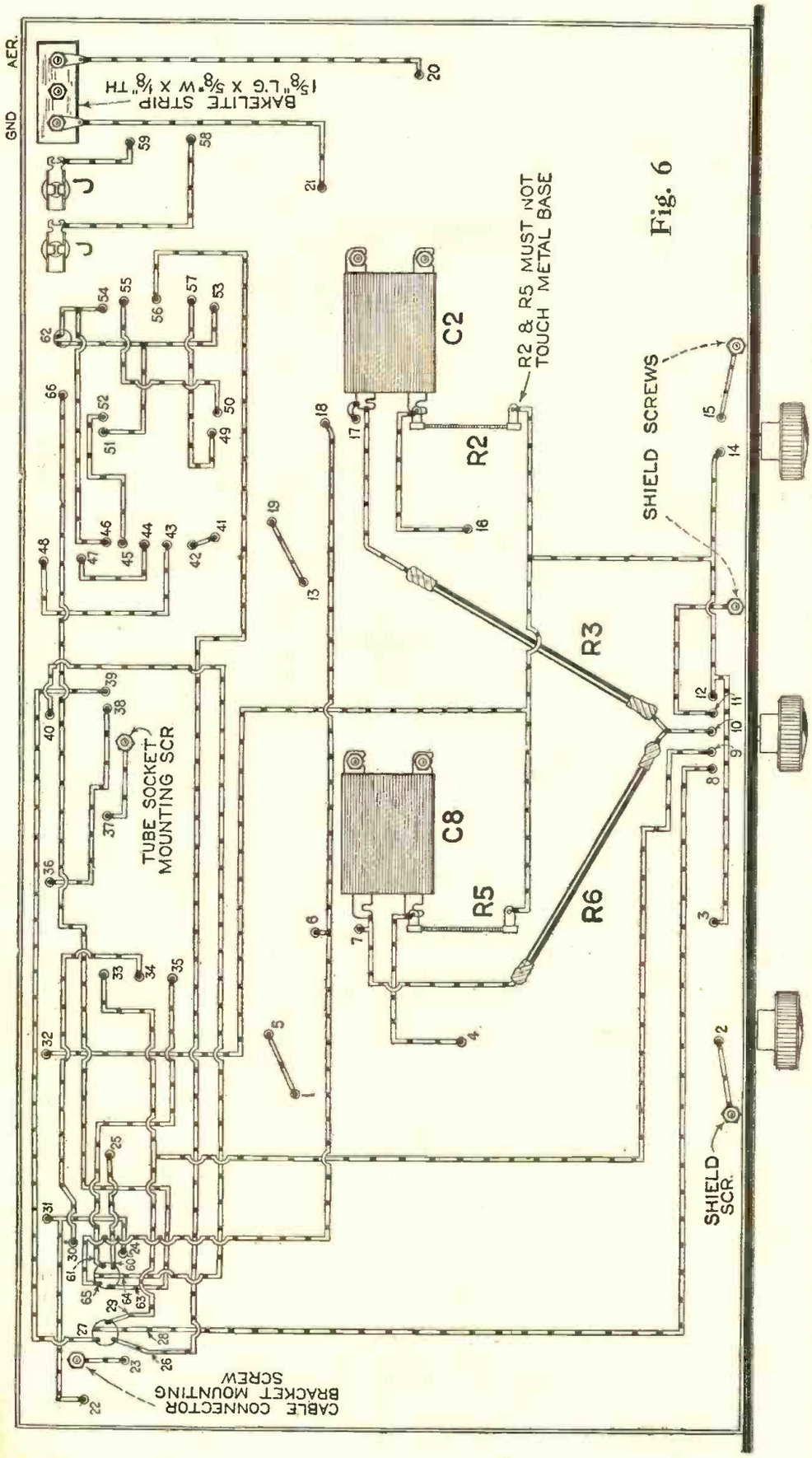


Fig. 6

THE AUDIO END

The audio-frequency amplifier is of the conventional type, consisting of two stages of transformer-coupled amplification. The A.F. transformers used have a flat frequency-characteristic over the usual range. A radio-frequency choke coil RFC3 is placed between the plate of the detector tube and the first A.F. transformer to prevent any stray R.F. voltages from getting into the A.F. amplifier.

In addition to the three regular A.F. transformers, the set is equipped with an impedance-matching transformer T1 which couples an external phonograph pick-up unit to the A.F. amplifier itself. The use of this transformer provides high-quality reproduction of voice and music from phonograph records. It is thrown in and out of the circuit by means of a single-pole, double-throw toggle switch SW2, mounted on the board which supports the phonograph motor and turntable. When this switch is thrown to "Radio," it cuts out the phonograph pick-up and the transformer T1, and connects the plate circuit of the detector V3 to the primary of the first audio transformer T2. This is a very simple arrangement and in no way complicates the operation of the radio receiver and amplifier.

LAYOUT OF SET

The general arrangement of the Radio News 1929 Hi-Q is clearly shown in the various accompanying illustrations. The components of the receiver proper are mounted on a pressed-steel chassis to which is fastened an upright front panel. It is possible to buy both panel and chassis completely drilled and engraved for the various parts. These two units are very cheap and save the constructor an enormous amount of work; with the panel and chassis on hand, the assembly of the set is then merely a matter of screwing down the various coils, condensers, sockets and transformers.

The coil L1 and condenser C1, comprising the tuning elements of the grid circuit of the first screen-grid tube V1, are enclosed in an aluminum shielding can; this occupies the left front corner of the chassis and sub-panel, and the tuning is controlled by its own drum dial.

The components of the first band-pass filter stage occupy a second can which is placed in the center of the chassis, against the front panel. The parts enclosed are as follows: the double tuning condenser C4 and C5; the first interstage radio-frequency transformer L2; the two midget compensating condensers C3 and C6; the volume control VC; and the by-pass condenser C7. If the reader will refer to the photographic illustration on page 828, showing the top view of the assembled receiver, he will notice that the shaft of this double condenser extends through the wall of the middle can and terminates at the drum dial to which the shaft of the other double condenser (which likewise extends through the wall of its can) is fastened. The dial thus controls both double condensers at once. The parts in the third can include, besides the double condenser C10 and C12, the matching con-

densers C9 and C13; by-pass condensers C11 and C15, and the second interstage radio-frequency transformer L3.

The detector and audio system is arranged along the back edge of the chassis. The socket for the detector V3 is located directly behind the third can; together with the grid leak R7, grid condenser C14, R.F. choke RFC3, and the receptacle for the battery cable. Following in line are the impedance-matching transformer T1; the first-stage A.F. transformer T2; socket for the first A.F. tube V4; the push-pull input transformer T3; sockets for the power tubes V5 and V6; and, finally, the push-pull output transformer T4. The filament-ballast and other fixed resistors R8, 9, 10, 11 and 12, are mounted directly along the back edge of the chassis. This arrangement makes the wiring very short and very easy to install.

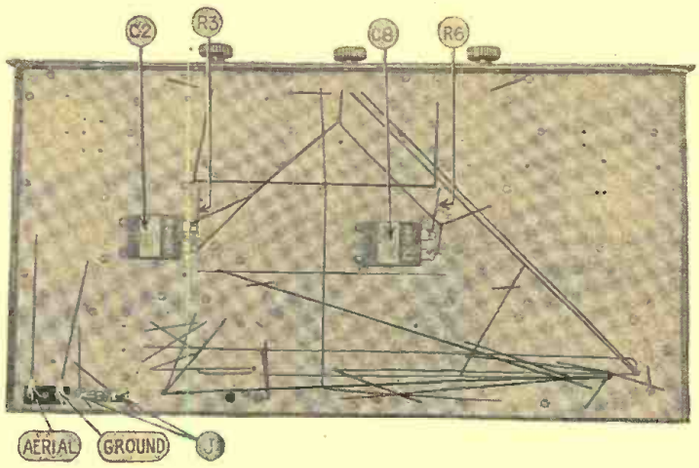
The "Aerial" and "Ground" binding posts are located in the extreme rear left corner of the chassis. Slightly to the left of them is a pair of tip jacks, insulated from the metal chassis and connected directly to the secondary of the output transformer T4, to receive the loud-speaker cord tips.

The underside of the chassis holds merely a few fixed resistors and by-pass condensers. Another picture (at right) shows these and the directness of the wiring.

All of the connections should be made with insulated wire, *as the metal chassis forms part of the circuit.* The point-to-point system of wiring may be used.

Fig. D

Here we have the bottom of the "Hi-Q" chassis, illustrating the various leads and the proper method of wiring, actually used in the set; whereas the diagrams on the preceding pages show the connections at right angles, for the sake of clearness. The "shortest distance between two points" is good practice in radio construction. The "Aerial" and "Ground" posts are mounted on a bakelite strip which insulates the former from the chassis.



A DESIRABLE COMBINATION

The receiver as it stands is a complete unit, except, of course, for the necessary "A" and "B" supply units. It can be installed in any suitable cabinet of either the table or console type. The particular receiver illustrated on pages 826, 827 and 832 is an exceptionally-complete, high-grade instrument. The set itself occupies the lower portion of the cabinet. The upper-right section (as viewed from the rear) contains, first, a loud speaker of the dynamic type and also an "A" power unit; the "B" supply unit and the phonograph components are at the upper left. A section of the top of the cabinet, directly above the rear compartment, is hinged and, when opened, reveals a phonograph turntable and an electric pick-up mounted on a square board set below the level of the top. The turntable is revolved by a small electric motor. Also mounted on the phonograph board are two switches: one to turn the electric motor on and off, and the other (SW2) to switch from phonograph to radio. The phonograph board is provided also with two small receptacles for used and unused phonograph needles.

This complete phonograph and radio combination is as fine an instrument as any music lover would care to possess. The custom-radio builder who boasts of a fairly well-to-do patronage can undoubtedly sell several such instruments in the course of a year. Of course, he can also incorporate the receiver into simpler and less pretentious cabinets, of which many are available.

The "B" power unit is of perfectly standard and straightforward design. It consists of a power compact which includes a step-up transformer and choke coils; five fixed condensers; rectifier tube and a resistor bank; these parts are mounted on a simple wooden baseboard. The various binding posts and connections are plainly indicated and need no explanation. The rectifier tube V7 is of the filamentless type; a filament-type rectifier tube may easily be substituted in this position, if the constructor so desires.

POWER SUPPLY

Many readers will express surprise on learning that the "129-Hi-Q" receiver is not an A.C.-operated set; that is, it does not use A.C. tubes, although they were tried in early experimental models. It is believed preferable to substitute tubes of the D.C. type and to use an "A" supply unit which works off the 110-volt A.C. line. This arrangement is fully as satisfactory in every regard as straight A.C. operation with A.C. tubes working off an A.C. transformer; if anything, even better. There are numerous "A" power units on the market which work quietly and efficiently and which require practically no attention.

The constructor who has a storage battery or a storage-battery-and-charger combination may, of course, use this with the "Hi-Q."

The switch to turn the whole set on and off must necessarily control the current of both the "A" and "B" units. Most "A" power units are equipped with a long flexible cord to which is attached a switch of the pear type. Also most of them have a receptacle into which the plug from the "B" unit may be connected.

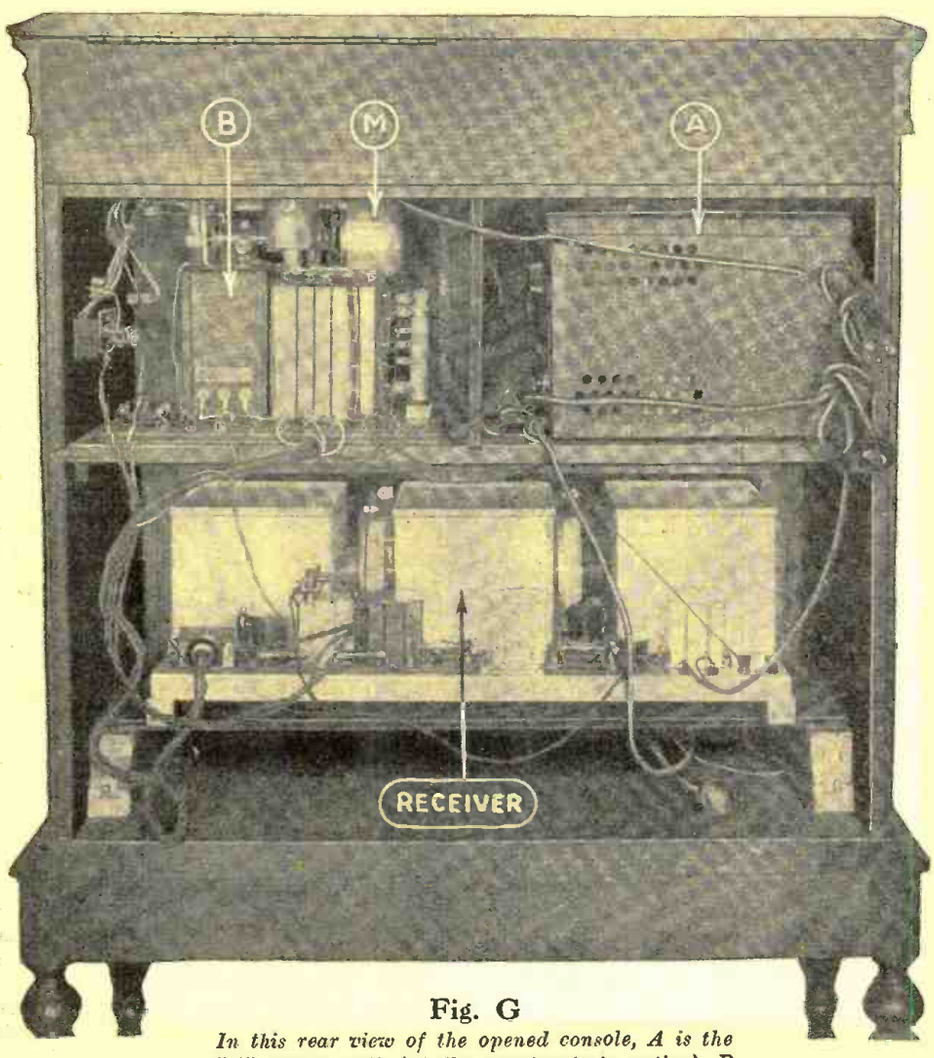
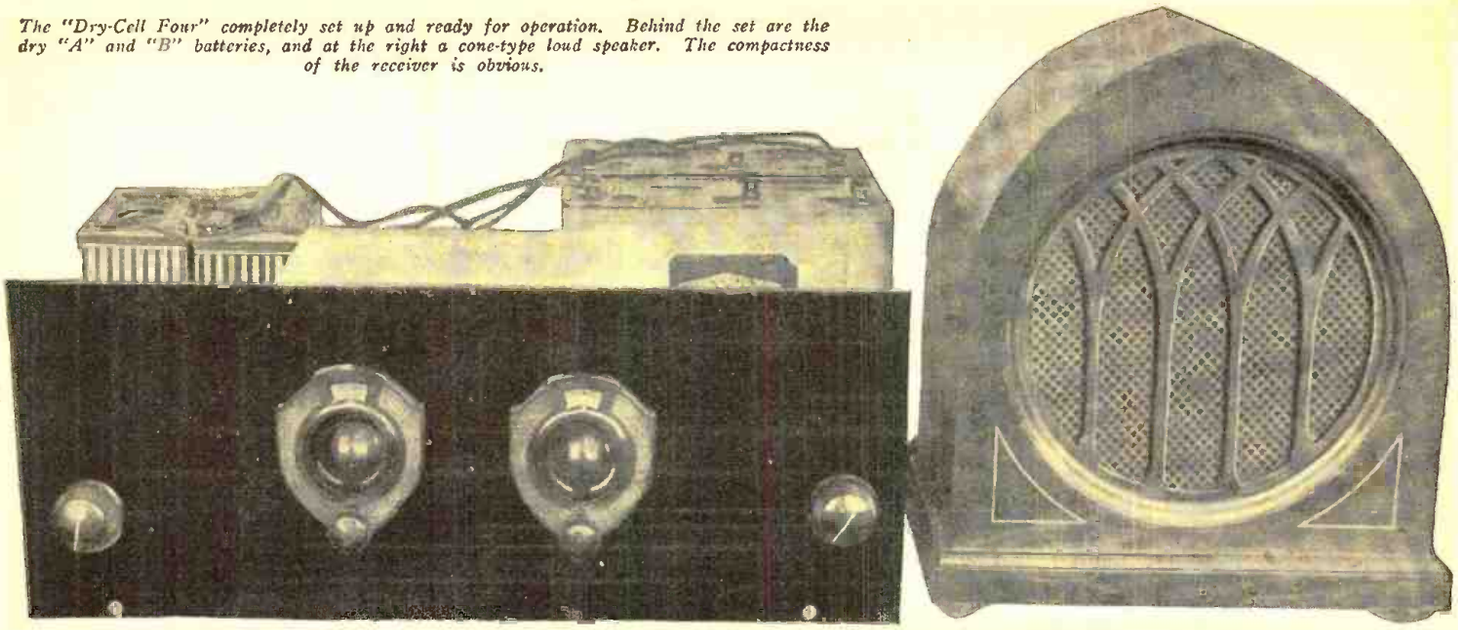


Fig. G

In this rear view of the opened console, A is the "A" power unit (at the constructor's option) B the "B" unit and M the motor driving the phonograph.

The "Dry-Cell Four" completely set up and ready for operation. Behind the set are the dry "A" and "B" batteries, and at the right a cone-type loud speaker. The compactness of the receiver is obvious.



"The Dry-Cell Four"—An Economical Set*

By B. B. Bryant

THE receiver described in this article is what may be termed an "advanced beginner's" receiver, so simple is its construction; and yet it offers results desired by the fan who has built his simple one- or two-tube outfit and is now looking about for something which will offer him quality reproduction, ability to bring in that distant station and, withal, simplicity of construction, low initial cost and low upkeep cost.

Primarily, this receiver has been designed for the listener who, because of his location or other circumstances, finds it inconvenient or impossible to operate an A.C. receiver, while he has no facilities for the charging of storage batteries. This condition compels the use of dry-cell batteries for filament lighting as well as for plate current. This is not meant to imply that dry-cell operation is a matter of "Hobson's Choice"; excellent results and reproduction of really good quality are obtainable with the use of the 199-type and other 3-volt tubes, providing they are intelligently handled.

The receiver described here employs a highly-sensitive 222-type screen-grid tube in a stage of tuned-radio-frequency amplification before the detector. The regenerative detector is a 199-type tube followed by two stages of transformer-coupled audio-frequency amplification; the first of which comprises a 199-type tube and the last a 120-type power amplifier. One metal can, which is divided into two compartments by the insertion of an extra partition, furnishes the shielding which is so necessary when using a screen-grid tube.

MECHANICAL DETAILS

A 7 x 18-inch hard-rubber panel mounts two tuning dials of the vernier type, a high-resistance control for regeneration, and a 20-ohm midget rheostat. The baseboard is of wood, 15 x ½ x 7 inches, and has under each end a strip of wood, measuring 6 x ½ x ½ inches. This raising of the baseboard is necessary to allow for the wiring, which is to go underneath and thus run directly into the six-lead cable, thus obviating the need of binding posts. The small number of terminals and the simplicity of the wiring in this receiver make this a rather easy method and a highly convenient one at that. With the assumption that a battery cable or a set of battery leads *must* be used, there is no reason why the cable cannot be incorporated into the construction of the set, thus bringing down a flock of birds with the proverbial pebble.

Four binding-posts are used; one for the aerial connection, one for the ground, and two for the loud-speaker cord. The ground post is secured to and makes electrical contact with the shield. The aerial post also is secured to the rear shield, but is insulated from the latter by means of a hard-rubber bushing (or any other device convenient to the constructor) which will prevent the post from making a short circuit with the shield. In the event that the builder finds difficulty in arranging this, the aerial post may be mounted on the baseboard and the coil lead to it brought out through the can. The same procedure may be followed in mounting the ground post, though it will hardly be necessary because of the simplicity of the suggested method.

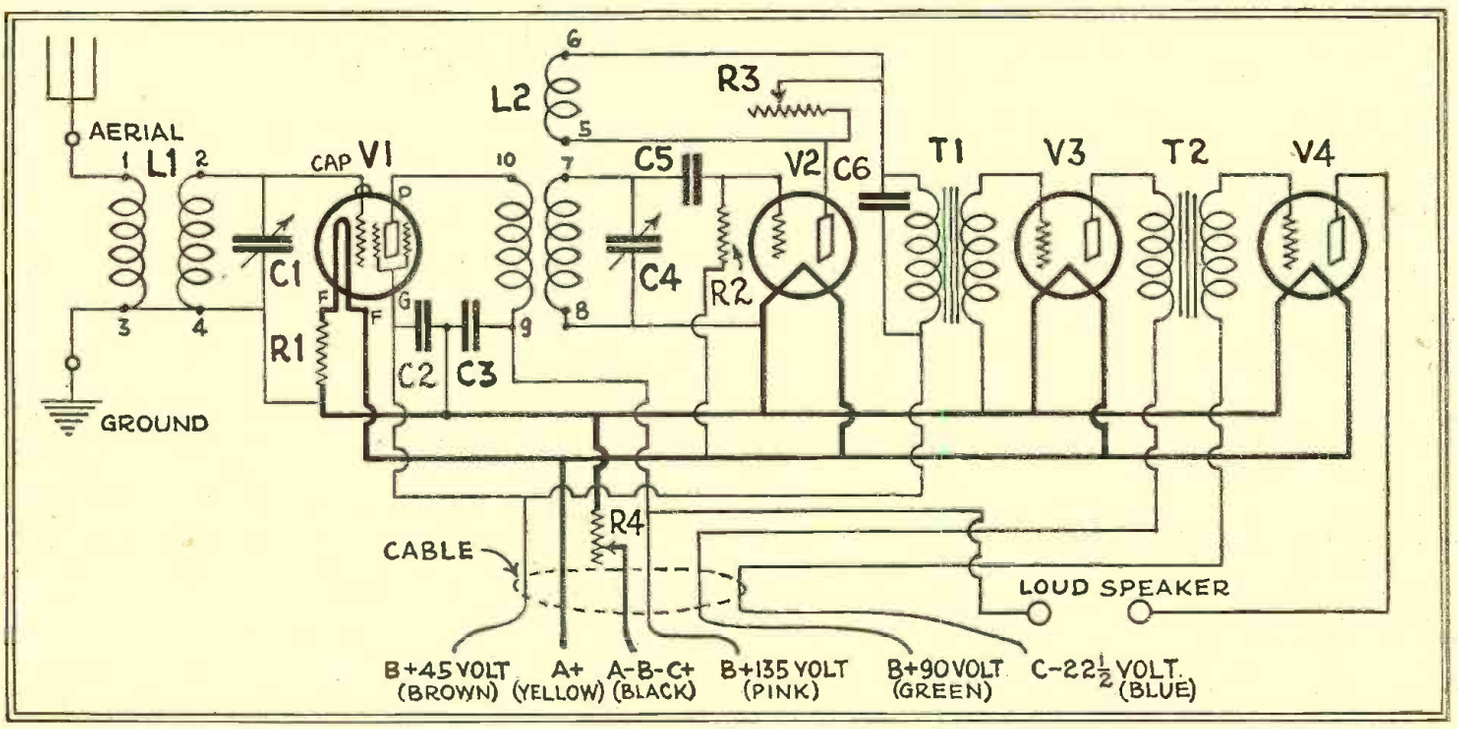
The two binding posts for the speaker terminals are mounted on a strip of hard rubber and the latter, in turn, is mounted on two terminals of the last socket, V4, facing the rear of the baseboard; these terminals are the plate post and one of the filament posts of the socket. It should be carefully noted that, although the speaker-terminal strip is mounted directly to two socket binding-posts, only one speaker post is connected to one socket post. The plate post of the socket is connected to the speaker post directly in line with it, while the filament post of the socket and the remaining post on the speaker strip may be said to go about their business in standard fashion. That is to say, the filament post of the socket is led to the filament circuit and the second speaker post to the 135-volt lead of the cable. The foregoing should be watched carefully as, with the suggested mounting of the speaker posts, the con-

RADIO NEWS BLUE PRINT ★ **No. 77**

THE "DRY-CELL FOUR" has been produced in response to an insistent demand from readers, which shows that there is still need for compact, economical sets operated from batteries. While no attempt is made to offer this set as a "portable," it more nearly deserves this name than any other of like power. It may be taken anywhere, and operated from dry batteries. Its filament consumption is but three-eighths of an ampere at three volts; the fact that the screen-grid tube uses the same voltage as the 199-type permits the inclusion of an R.F. stage of high amplification which, with the regenerative detector, makes this set the equal as a distance-getter of any set except the very largest. It is probable that, in any ordinary location, this set will give reception as distant as any receiver can afford. In addition to this, notwithstanding its low filament voltage, the 120-type tube used in the final stage is a true power amplifier, practically equal to the 112A, and suitable for operating any speaker at room volume.

Those who desire the large blueprints (with list of parts used) for the "Dry-Cell Four" must fill out and send in the coupon provided for that purpose on page 879, with the required 25 cents. No more blueprints will be sent free.

* RADIO NEWS *Blueprint Article No. 77.*



The various "A," "B" and "C" wires are bunched together to form a cable. If desired, binding posts may be mounted along the back of the set instead. Note that rheostat R4 controls the current to all the tubes. This is the best arrangement when dry cells are used as a source of "A" supply. A storage battery may, of course, be used with sufficient resistance in series with the tubes.

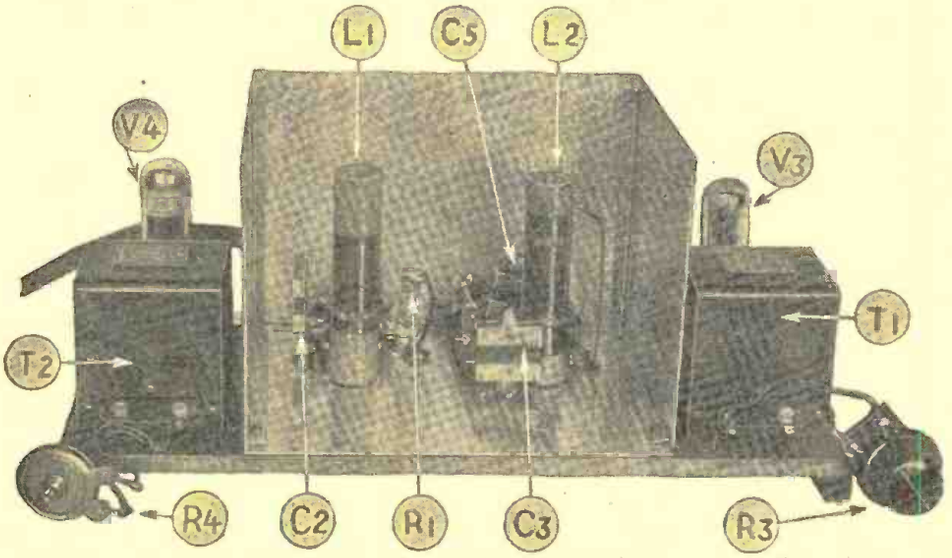
structor is apt to yield to temptation and connect the second speaker post to the filament post of the socket; which, of course, would bring undesirable results.

READY-MADE VS. HOME-MADE

Perhaps the most awesome part of the receiver in the eyes of the beginner who may build this receiver is the matter of shielding. The can used in this set is composed of aluminum and measures 8 x 6 x 5¾ inches. An additional section of the same metal, 5¼ x 6 inches, is inserted so that it divides the shield into two compartments of equal dimensions and thus provides for the two tuning circuits. Those who desire to construct this shield can easily do so with a quantity of thin sheet aluminum, copper or brass and a pair of tinsmith's shears.

However, the manufacturer's price of this can is so little that it may be recommended that this item be purchased, if it can be done conveniently; as it would hardly pay to go to the trouble of scouting about for the proper materials, and building the can, when a neatly-finished product can be obtained for considerably less than the total cost of the material and the value of time spent in constructing the shield. The shield used in this receiver required nothing more than the addition of the dividing section as mentioned above.

The two coils, L1-L2, are the only other components to be constructed; these are wound on one-inch cardboard, fiber or hard-rubber tubing with No. 30 enameled wire. As the illustrations offer complete data on the winding of these coils, little need be said regarding their construction with the exception of the age-old warning that windings on the same form must turn in the same direction; which should be strictly heeded. A right-angle bracket may be employed to secure the coils to the floor of the shield can; but the method used in the construction of this receiver seems to be about the simplest. Two small blocks of wood, a trifle larger than the inside diameter of the coil form, are screwed to the bottom shield of the can, and each coil is forced over one of these blocks; this will hold the form in a firm, upright position, and also facilitate its being removed from and replaced in the set, should the occasion arise.



The half-completed set, as it appears from the front, with the panel and tuning condensers removed. The symbols on the parts correspond with those in the schematic diagram above.

PARTS REQUIRED

The components herewith listed are those which were used in the original model, here illustrated; and, while substitutions may be made, it is suggested that, if so, the alternative parts be chosen with an eye for similarity of size and wiring positions of their terminals. The reason for this is obvious; an oversized component will necessitate a new layout and different measurements for the front panel and baseboard.

Two variable condensers, .00035-mf. (C1-C4);
Two fixed condensers, .006-mf. (C2-C3);
One fixed condenser, .00025-mf. (C5);
One fixed condenser, .0005-mf. (C6);
One resistor strip, 10-ohm (R1);
One grid leak, 5-megohm (R2);
One variable resistor, 0-2000-ohm (R3);
One rheostat, 20-ohm midget type (R4);
Four tube sockets, UX-type (V1-2-3-4);
Two audio-frequency transformers (T1-T2);
One shield can (as per text) and partition;
Two vernier dials;
One screen-grid vacuum tube, 222-type (V1);
Two vacuum tubes, 199-type (V2-V3);
One vacuum tube, 120-type (V4);
One hard-rubber panel, 7 x 18 x 3/16 inch;
One wooden baseboard, 15 x 7 x ½-inch;
One battery cable, 6-wire;
Four binding-posts;
Three coil forms, 1-inch diameter, 3 inches long.

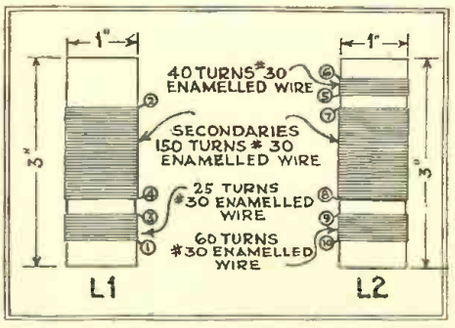
RADIO-FREQUENCY CIRCUITS

The first compartment of the shield can houses the stage of tuned-radio-frequency amplification with its screen-grid (222-type)

tube. The other components which go to make up this circuit are the inductor L1, consisting of a primary and a secondary winding; the .00035-mf. variable condenser C1, which tunes the secondary of L1; the vacuum-tube socket V1, which is of the UX type; the fixed condenser C2, which is soldered directly to the "G" post of the socket; and the resistor strip R1, one terminal of which is soldered to the "F—" post of the socket. The lead connecting the stator plates of C1 with the control-grid cap on top of the screen-grid tube should be a piece of flexible wire about five inches in length, to the tube end of which has been soldered a clip designed to slip over this terminal of the control-grid of V1. This clip may be constructed of any springy metal, and shaped by wrapping it about a lead pencil or any other suitable object of similar size.

The second compartment houses the detector circuit and its tuning components. As a matter of interest, it may be mentioned that, although the detector is regenerative, the oscillations it sets up do not enter the antenna because they are blocked by the previous stage of tuned-radio-frequency amplification. For this reason the operator of this receiver need have no fears of annoying his neighbors with a "blooper." The advantage of this particular circuit is that all the advantages of regeneration (as regards DX) may be enjoyed without any danger of creating a source of radio interference. The screen-grid R.F. stage before the detector not only prevents this annoyance, but adds greatly to the sensitivity and selectivity of the receiver.

The components in the detector compartment are very much like those in the radio-frequency stage. They comprise the .00035-mf. variable condenser C4, which tunes the secondary of the inductor L2; a vacuum socket of the UX type; the grid-leak holder



Details of the coils. L1, antenna coupler, L2, interstage transformer. The top winding of the latter is the tickler, the center one the secondary, and the bottom the primary.

and grid leak R2, which is connected from the grid of the detector tube to the "A+" line, instead of across the grid condenser as usually the practice; and the grid condenser C5, which is rated at .00025-mf. In the same compartment is found the by-pass condenser C3, which is part of the screen-grid tube's plate circuit, and is secured to the shield. Here, as in the first compartment, leads between terminals of components are made as short as possible; which, for that matter, is not difficult considering the size of the allotted space and the close proximity of the various parts.

THE AUDIO END

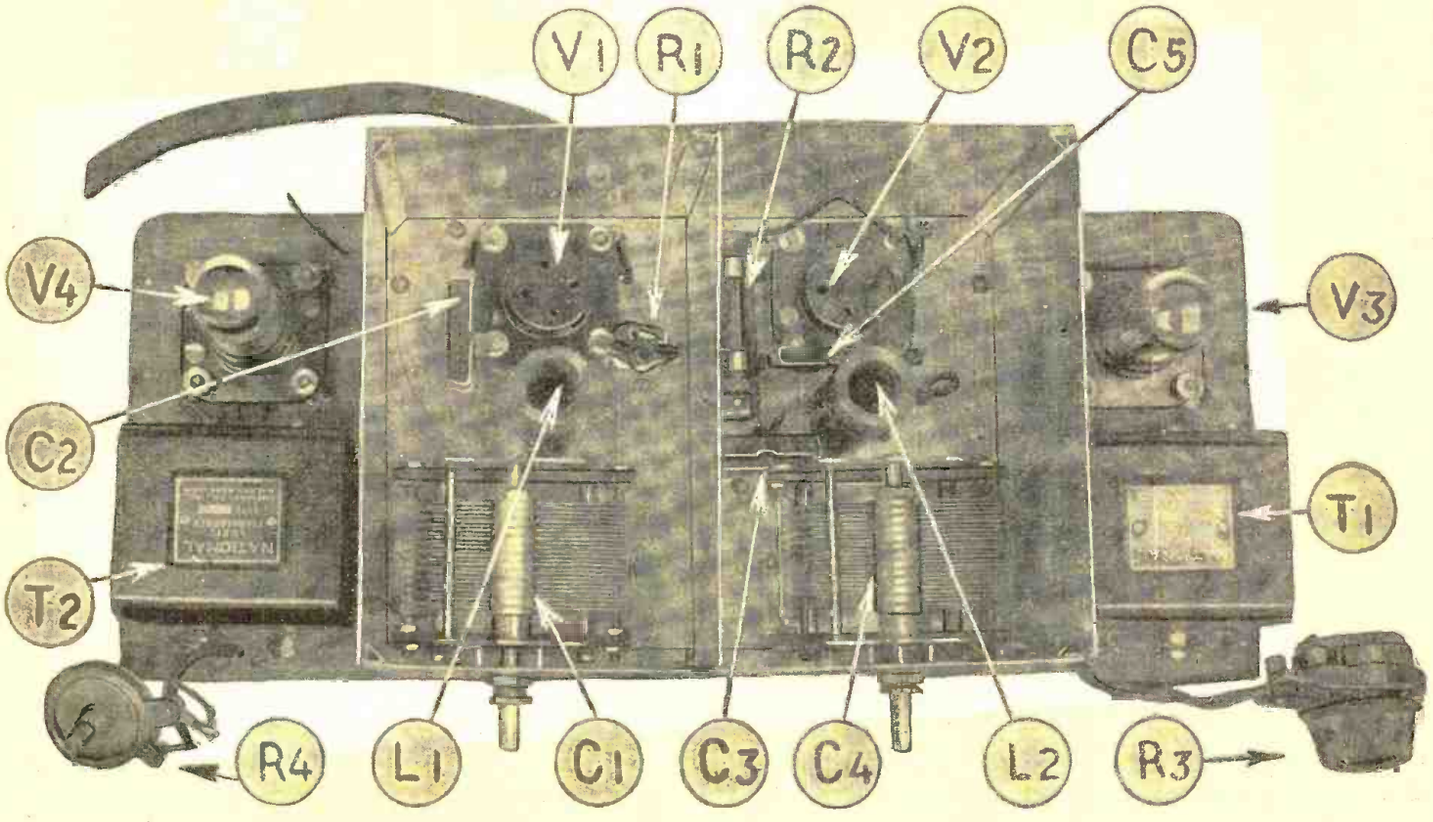
To the right of the detector compartment is the first audio-frequency transformer T1, with its accompanying tube socket V3 mounted directly behind it. Care should be exercised in mounting this transformer; as the regeneration control R3 must be mounted on the panel, somewhat in front of the transformer. This control has a high resistance value (0-2,000 ohms) and is shunted across the tickler winding of L2.

The connecting leads from the first to the second audio stage are run under the baseboard to the left of the receiver where the second audio-frequency transformer T2 and its tube socket V4 are mounted to the left of the shield can. Here, as in the case of the first audio stage, provision should be made for mounting the rheostat R4; this component is of the midget type and has a resistance of 20 ohms. Mounting the loud-speaker terminal strip on the rear posts of the socket V4 has been dealt with in a previous paragraph of this article and so requires no further mention.

No view of the baseboard is shown, the few wires being there hardly requiring that elaboration. Under the baseboard are placed also the by-pass condenser C6, which returns the R.F. component to filament; and the terminals of the battery cable, which is secured to the under side of the baseboard at the extreme rear by means of a U-shaped bracket. It is then a simple matter to wire the leads of the cable to their various circuits.

WIRING HINTS

The most convenient manner of wiring this receiver is by stages. First screw the front panel to the baseboard, after having drilled the necessary holes for the variable condensers, the regeneration control and the rheostat; then mount the front and bottom shields of the can, mount the apparatus previously described, and wire as much as possible. By taking note of the "A—" lead in the circuit diagram, those terminals which are soldered to this circuit may be connected to any part of the shield; thus simplifying the wiring job to some extent. For example, it is unnecessary to run any leads from the rotors of the variable condensers C1-C4 to the "A—" circuit; because, when these components are mounted, they make firm contact with the front shield of the can and



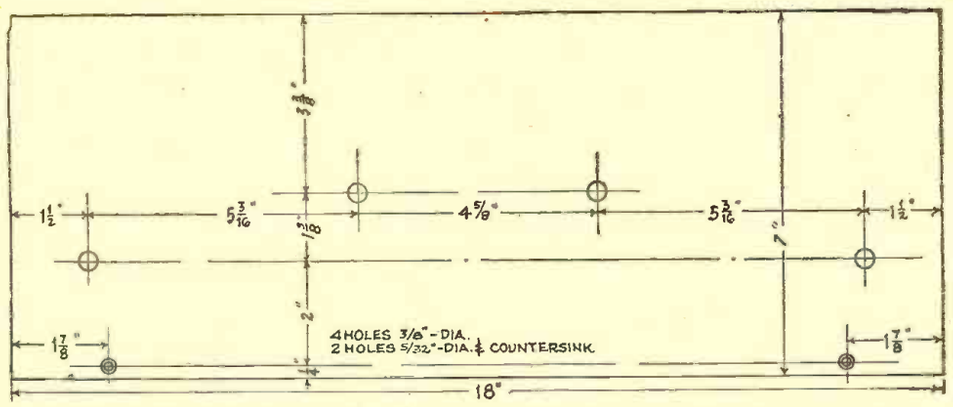
Top view of the "Dry-Cell Four" receiver, with the panel and cover of the shield can removed. L1, C1, V1, R1, components of the R.F. stage. C4, L2, V2, R2, C5, components of the detector stage. T1, V3, first audio; T2, V4, second audio; R4, filament rheostat; R3, regeneration control. The shield compartments afford ample room for the components without crowding; the coils are very small.

so provide a "ground" circuit without the necessity of extra wiring.

The operation of this receiver is much like that of any similar type; if the constructor desires, he may install a jack arrangement at the output so that phones may be used for distance work. It will be noticed that a "C" battery of 22½ volts is specified for biasing the last audio-frequency amplifier tube; this is highly important and must be used, as the 120-type power tube used in this stage requires this much "C" bias for proper operation. Any voltage appreciably lower than that specified will bring about distortion and, in general, cause unsatisfactory reproduction, as well as waste plate current.

Various arrangements for wiring the dry cells are optional with the constructor; three cells wired in series makes a basic "A" power supply. No fewer than three should be used to operate the filaments of 199-type tubes. The constructor who desires to forget about his "A" supply for as long a time as possible, may wire six cells in *series-parallel* as illustrated in the diagram. This arrangement gives the same voltage as three cells wired in series, but lasts approximately twice as long.

The choice of plate batteries is, of course, entirely up to the builder; however, he must remember that 135 volts with taps at 45 volts and 90 volts are required to obtain proper results. For this purpose three 45-volt blocks will do; these are obtainable in various sizes, and it is this choice which is open to the constructor, depending on his purchasing facilities. Obviously, the largest sizes (generally termed "heavy-duty") last much longer than their smaller brothers and, for this reason, are recommended as a matter of ultimate economy.



Drilling details of the front panel. This may be of bakelite, hard rubber, formica, or other standard panel material, 3/16- or ¼-inch thick.

ANTENNA SYSTEM

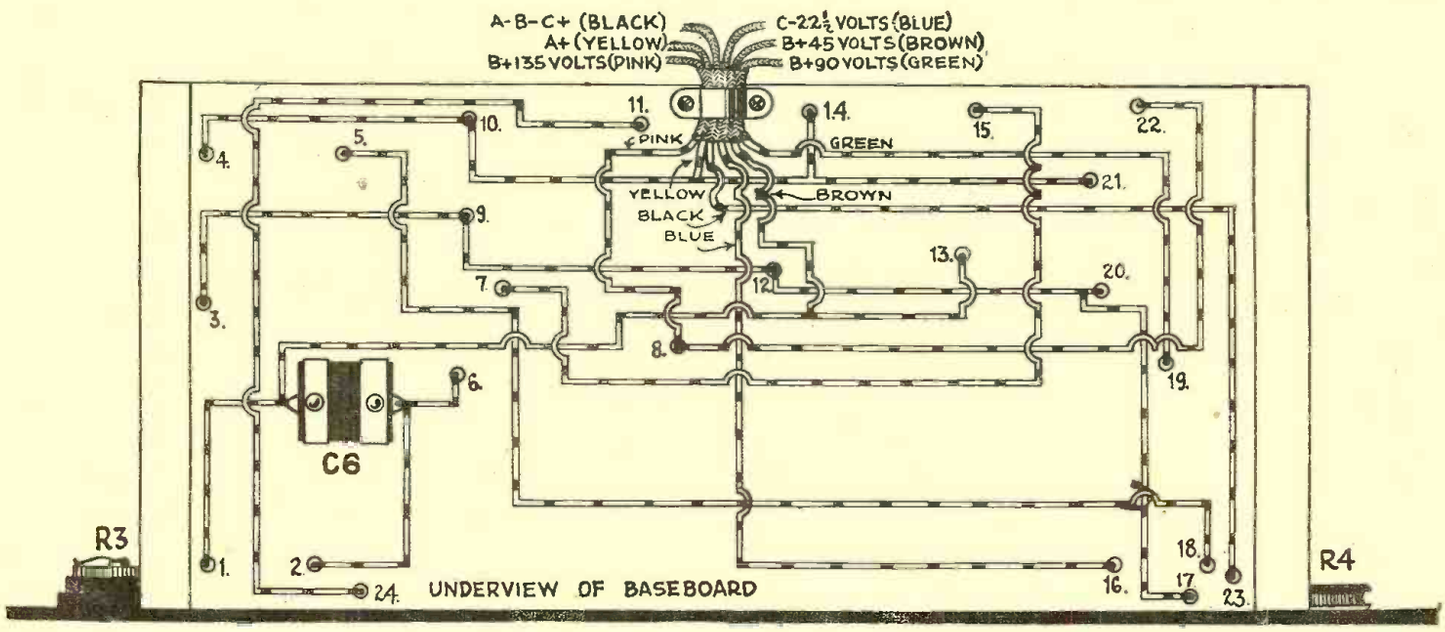
As this receiver has been designed with an eye to DX, the aerial and ground must of a necessity be constructed to conform with the best standards of radio engineering that circumstances will allow. For this reason a little rehash on the old subject of antenna installation will not be amiss. Antenna systems (meaning everything connected to the "aerial" and "ground" posts and outside the receiver) may be classified as having four distinct members: the aerial, which is the horizontal overhead wire; the lead-in, which is all the wire between the aerial and the set; the "ground" proper; and the wire connecting the ground to the receiver, which is known as the ground lead.

When considering the length of an aerial, the lead-in must be taken into consideration; for this reason, when the *length* of an aerial is discussed, both lead-in and aerial proper are covered by that appellation. Therefore, if the constructor desires to have an aerial 100 feet in length, and his lead-in measures 20 feet, his overhead span, or aerial, should be 80 feet. Many fans, when informed that their antenna is the cause of broad tuning, will say that this is impossible, as the length of their aerial is but 75 feet. However, investigation, as a rule, discloses a lead-in some 75 feet or thereabouts in length.

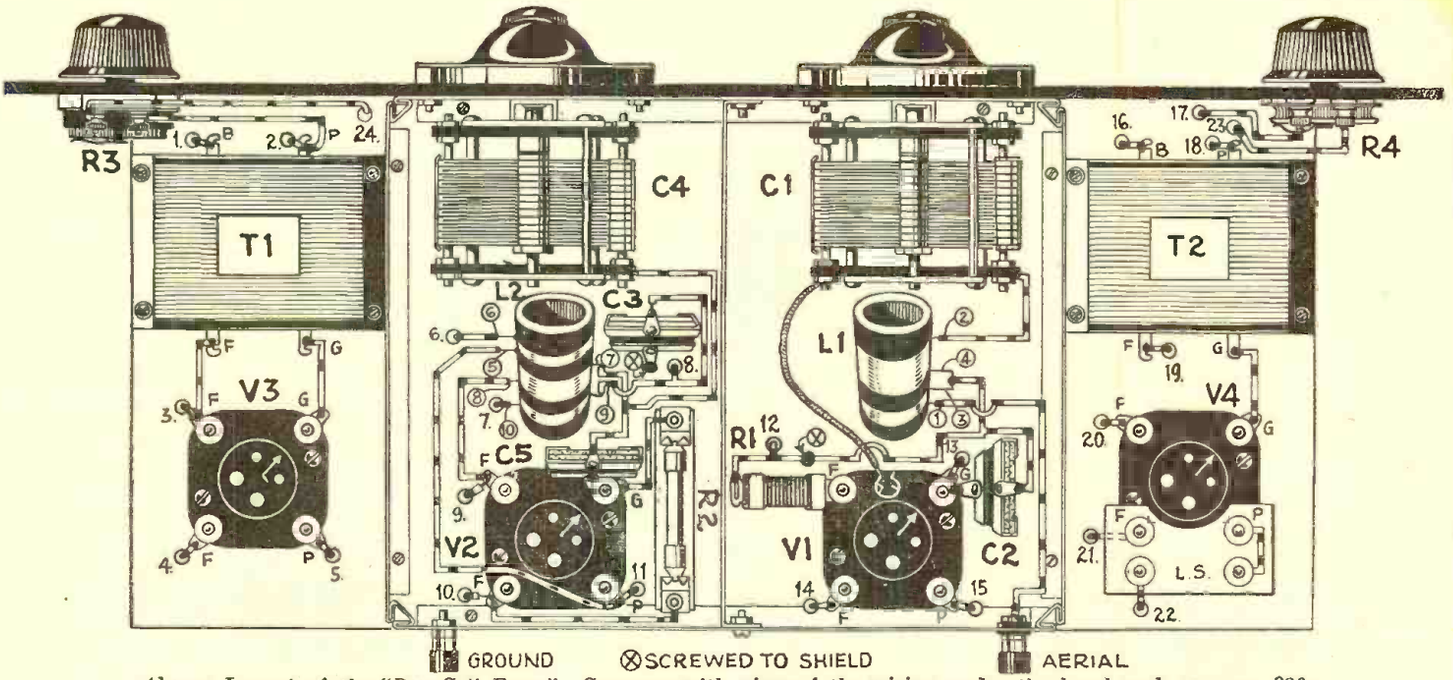
Experience has proved that the best all-around aerial combination for the broadcast fan measures about 100 feet in length, and is made up of No. 12 or 14 single-strand enameled copper wire for the aerial, and No. 14 rubber-covered single strand copper wire for the lead-in. The latter gauge of wire is used also for the ground lead.

If it so happens that the required space for an aerial of this length is not available, the constructor may make use of an aerial of the "flat-top" type, so called because of its appearance. Such an aerial is made up of two or more wires stretched between two "spreaders," for which purpose broom handles serve admirably. Perhaps the best all-around aerial of this type comprises four wires, each wire spaced at least two feet from the next, and insulated from the spreaders, while the spreaders are insulated from the rope holding the aerial aloft. Four leads are brought down from the aerial wires to a converging point, where they are soldered together, and from thence a lead-in wire which is brought down to the receiver.

Careful installation of the lead-in is just as essential as in the aerial. In all cases keep it as far from the wall of the building as possible and, where contact is inevitable,



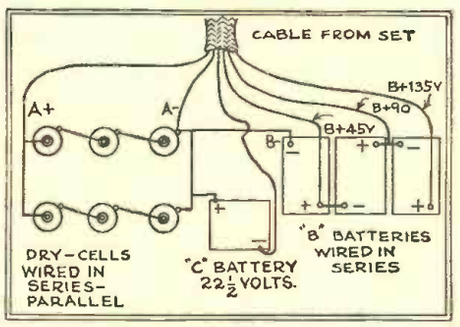
Under view of the baseboard of the "Dry-Cell Four," showing the connections to the battery cable. Wherever a wire is shown coming out of a numbered hole, it can be traced to the top side of the baseboard by reference to the picture diagram on the following page; each hole is marked with the same number in both diagrams. The wiring above is shown in straight lines; actually, the wires may be run directly from point to point, in order to keep them as short as possible.



Above: Layout of the "Dry-Cell Four." Compare with view of the wiring under the baseboard, on page 836; the holes are numbered alike. It is a good idea to cross out each wire in the diagram as the corresponding lead is soldered. Below: How the power supply of the set is made up, by wiring together six dry cells for the "A" current, three "B" and one "C" batteries as shown.

use some form of "stand-off" insulator. Many constructors, in order to avoid soldering in the aerial assembly, run a single strand horizontally for a suitable distance, continue it on through the hole of the insulator, make a few securing turns and continue the same wire down to the window.

The matter of a suitable ground is one that stumps many a constructor. City fans have the problem solved for them without choice; they must use one of the piping systems available, such as the water pipe or radiator pipe; do not use the gas pipe. It matters little to them whether these grounds



are or are not the acme of efficiency; either they employ one or more of them or use no ground at all.

However, those in suburban or rural communities may avail themselves of a fairly good ground if they will go to the trouble of digging a sizeable hole for the burial of a number of copper, brass or galvanized-iron plates. These are soldered to a suitable wire and the ground lead connected to the latter. It is suggested, also, that this particular spot be watered at times, so that the conductivity of the ground may be bettered. This usually is worth the trouble.

RADIO NEWS BLUEPRINTS

New Terms of Our Offer to Readers

(Read This Before You Write)

BEGINNING with the publication of this issue of RADIO NEWS, we announce a new policy with respect to the distribution of blueprints to our readers. A charge of 25 cents for each set furnished will be made; the filling of this order will be expedited by using the coupon printed on page 879 of this issue.

This will apply to all blueprints (from No. 52 up) issued by RADIO NEWS, except those called for by the Free Blueprint Coupons printed in our December, 1928, January and February, 1929, issues; these will be sent free, in exchange for these coupons, *until our present stock on hand is exhausted.* All other blueprints which we have issued in our free distribution series will be charged for at the rate of 25 cents a set. (Those made up prior to April, 1928, were produced by a more costly individual process and cannot be furnished at the above price.)

We believe that our readers are entitled to a frank explanation. During the past year we have distributed to them more than 68,000 blueprints—over 12,000 of the well-known "Junk-Box" alone. This has necessitated frequent reprints of the blueprints, and the maintenance of a large staff whose time is given up to this alone. The postage bill has been very large, as may be imagined. As RADIO NEWS has no apparatus for sale, it cannot recoup the outlay in this manner, like a manufacturer who sells kits at from $20 to $200. The price which we have established, 25 cents, is our average cost of a set of blueprints—a low figure obtained only by quantity production. The free distribution has entailed a huge expense, which has increased from month to month; and there is no doubt that thousands who are not regular readers have been taking advantage of it.

We have therefore decided to charge a uniform price of 25 cents for each set of blueprints; not with the expectation of making any profit from them, but with the intention of breaking somewhere near even. Those desiring previously-issued blueprints, not specified in any of the three "Free" coupons we have mentioned, must send this sum with their orders; which will be filled more promptly if the form printed on page 879 is used, as we have said. Other requests will not be supplied; nor will our "I Want to Know" department send any longer free hook-ups, diagrams, or other circuit information by mail.

We have said many times before that we have *no blueprints of commercially-manufactured apparatus for sale at any price;* nevertheless, ten or fifteen letters asking for them are received every day. Neither can we furnish bluprints to use the particular set of parts the constructor has in mind; it costs several hundred dollars to prepare a set of blueprints; and we cannot undertake to do this to order for a nominal sum.

We shall, however, continue to issue blueprints of sets of our own design that will, we think, appeal to our readers; and to publish full circuit and wiring diagrams in the pages of RADIO NEWS, as we have done. Those of our readers who wish, in addition, full sized blueprints of these sets may obtain them by sending in a Blueprint Coupon with 25 cents for each set requested. This applies to Blueprints Nos. 76 and 77, the "RADIO NEWS 1929 Hi-Q" and the "Dry-Cell Four," published in this issue, and to all later sets for which blueprints will be prepared.

The "Candy-Box Special"

A Novel Little Short-Wave Receiver That Produces Real Results

By Joseph Riley

The completed "Candy-Box" Special receiver set up for operation, with a plug-in coil and the two tubes in place. Two of the other coils are shown at the left of the box itself.

RADIO receivers have been built into many odd objects like fountain pens, vanity cases, sea shells, pipes and umbrella handles, but for the most part these instruments have been mere novelties possessing no practical value. They are intended to be shown as examples of mechanical ingenuity, and not to be used for regular reception of radio signals. However, it is possible to make a novel and unusual set that at the same time is more useful than for mere purposes of display. The writer constructed such an outfit out of parts that were gathering dust under his table, assembling them in a tin candy box that was once full of better things. When the completed receiver was shown to the person who was the original recipient of the box, she remarked, appropriately enough, "Isn't that sweet?"

Electrically, the set is a short-wave affair patterned after the famous RADIO NEWS "Junk-Box" receiver, and uses the same convenient system of midget tuning condensers and tube base plug-in coils. The circuit is exactly the same except for the elimination of the filament switch and the R.F. choke coil. By keeping the Junk-Box idea in mind, the constructor who has a small box or case of any kind on hand can make a very unusual-looking little receiver that will arouse a lot of comment from visitors and also produce real radio signals. Any small box about six inches long will serve the purpose: an old cigarette tin, a small cigar box, a jewelry case, a camera case, etc.

MUSIC FROM A CANDY BOX

The particular box used by the writer was a one-pound candy tin tastefully decorated in light lavender. It is six inches long, four wide, and three deep, and is fitted with a hinged cover. Into this space were put two midget variable condensers, each .0001-mf. maximum capacity; three UX-type tube sockets (one for the plug-in coils and the other two for the detector and amplifier tubes); one audio-frequency transformer; grid condenser and grid leak (separate units, not a combination); and two tip jacks for the phone connections. The coil and tubes stand upright when the set is in operation, the cover being swung back. With the coil and tubes removed the box closes in its normal manner.

THE construction of the novel little receiver described in this article is so simple and obvious that no constructional blueprints for it have been prepared. The accompanying illustrations show all the details of the assembly and wiring clearly and plainly, and every reader will be able to follow them without trouble.

No provisions for filament control are made in the box itself, because there is not enough room and because an external rheostat allows the use of either 199-type tubes on dry cells, or 210A-type tubes on a storage battery. Three ordinary 4½-volt "C" batteries connected in parallel, and a single 22½-volt "B" battery block will work the set very nicely. These batteries may be put in another box, and connected by three flexible wires to the set itself. One wire is for "A" minus and "B" minus, the second for "A" plus, and the third for "B" plus. A 10-ohm rheostat mounted on this second box and wired in the "A" minus lead will be very useful. All the resistance will be needed when the set is first turned on, but as the battery voltage starts to drop the knob must be turned down.

A HANDY PORTABLE

An outfit consisting of two such little boxes makes a fine portable set for the radio fan who travels frequently and who likes to listen in when he gets to a hotel in a strange town. The set works perfectly well on no aerial at all; with a 20-foot length of flexible wire stretched on the floor or thrown out of the window it will bring in practically everything in the short-wave channels.

For permanent use in the home this "Candy-Box Special" makes a good set for the man who has a complete broadcast receiver that he does not want to disturb and who wants to try his luck on the short waves. It represents very little of an investment; even if he has to go out and buy all the parts he won't have to spend more than five dollars. For such indoor service the best source of "A" current is three No. 6 dry cells—the good old-fashioned doorbell variety. When used with two 199-type tubes these batteries will last at least a month. The length of service depends, of course, on how often the set is used.

The operation of this short-wave receiver—or any short-wave receiver, for that matter—will not affect a broadcast receiver in another room in any way. The constructor may dabble with it in the kitchen or bedroom without causing the rest of the family to lose their evening's radio program.

The writer selected a tin box for his set because the metal itself forms a common "ground" and thus saves much wiring. For instance, when the tuning and regeneration condensers (C1 and C2) are mounted, the rotor plates are automatically connected together and to one side of the filament circuit. There will then be only one wire from

The parts before assembly: below, left to right, grid leak, grid condenser, rheostat, pin jacks, knobs; center, tube sockets, transformer, condensers; rear, coils, candy box.

each of these instruments, instead of two. Similarly, one of each pair of filament posts on each tube socket (including also the socket for the plug-in coil) may be "grounded" directly to the box. A soldering lug bridged from the terminal to one of the screws holding the socket itself down will do the trick.

LAYING OUT THE PARTS

Before drilling any holes in the box, it is a good idea to lay out all the parts to make sure there is room for everything. In the set shown on these pages the tuning condenser C1 was mounted first, on the front side of the box, with the rotor plates opening out to the left. The regeneration condenser C2 was placed in the right front corner, with its rotor plates opening toward the front side of the box.

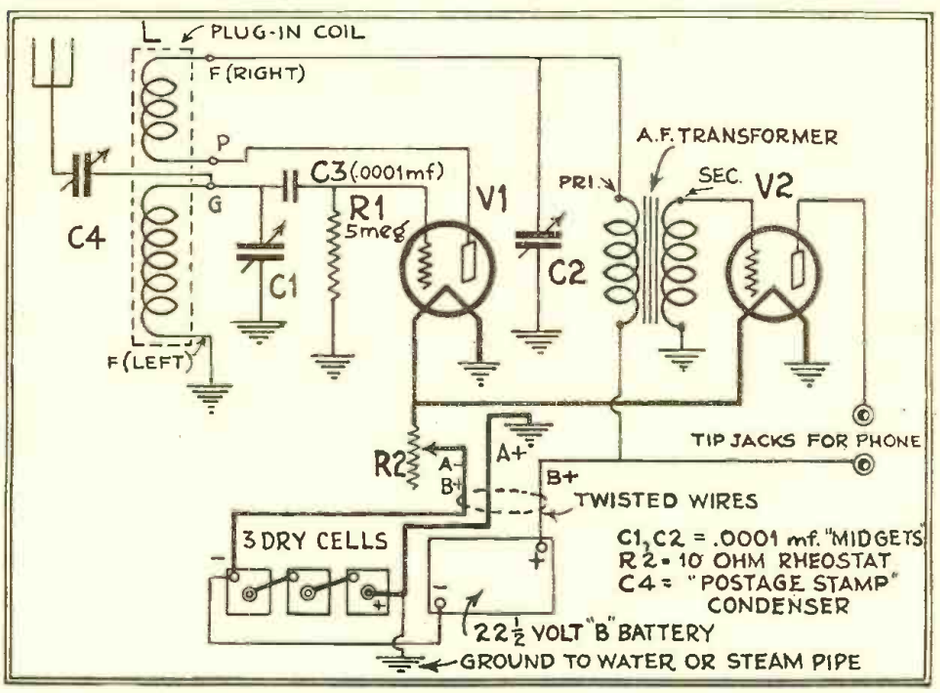
The audio transformer was pushed into the left rear corner, with its primary posts facing the back. If the terminals of the transformer you happen to have on hand are at the bottom of the instrument, solder five-inch lengths of wire to them before screwing the transformer down; otherwise you will have difficulty in soldering later. Use short machine screws for the actual fastening, with the nuts on the under side of the box. Twist the wire from the F post on the transformer under the head of one of the fastening screws, to ground it to filament.

The smaller the transformer you can find, the better. It need not be one of high quality, as you will be listening with earphones and the distortion in only one stage of amplification is not bad. Small transformers which are perfectly suitable for the purpose can be picked up for as little as 89 cents on "Radio Row," in large cities.

The socket for the detector tube V1 is placed against and to the right of the transformer. The socket for the amplifier tube V2 goes in the left front corner, in front of the transformer and to the left of the tuning condenser C1.

The two tip jacks for the phone connections are mounted on the left side of the box, near the top edge and above the socket for V2. These jacks must be carefully insulated from the metal box, as neither is to be grounded. The easiest way to insulate them is to drill the mounting holes about a sixteenth of an inch oversize, and to put thin fiber, heavy cardboard, bakelite or hard rubber washers over the holes. It may be necessary to loosen and remount the jacks several times in order to center the mounting studs in their holes, but this operation takes only a few minutes. Test the jacks against short circuit with the phones and a battery. If either jack is grounded the set will not work, because the "B" battery will be short-circuited to the filament either directly or through the phone windings, depending on which jack is touching the metal of the box.

The clip mounting for the grid leak R1 is screwed to the back of the box, on the inside, above the socket for the tube V1. It should be placed so that the leak, when in position, will be parallel to the bottom of the box. The clip on the left is grounded to the box by means of a soldering lug bridged to the mounting screw.



The circuit of the "Candy-Box" Special is a straightforward regenerative one, with a stage of transformer-coupled audio. It works very nicely with 199-type tubes and dry cells.

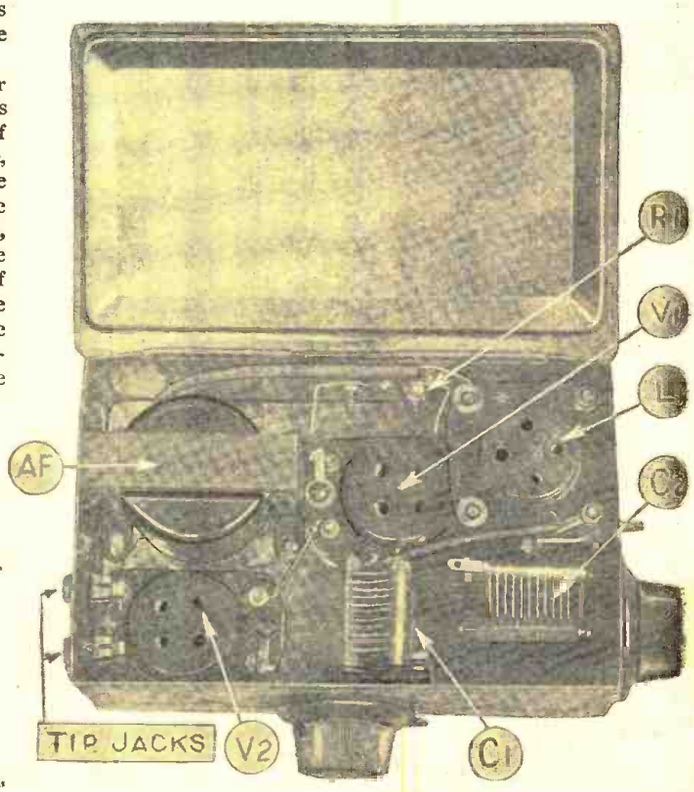
MOUNTING THE COIL SOCKET

The third tube socket, which accommodates the plug-in coils, is mounted just below the level of the top of the box, in the rear right corner. It is supported in this position by means of two simple L-shaped brass brackets, the size of which will depend on the particular socket. The socket is mounted this way, and not on the bottom of the box, in order to make room for the grid condenser C3, which is of .0001-mf. capacity. One end of this grid condenser should be connected by a short piece of wire to the G post on the socket for V1, and a three-inch length of wire soldered to the other end before the socket for the coils is mounted permanently. The free wire from the condenser is soldered to the stator terminal of condenser C1, and another wire run from here to the G post on the coil socket. The coil socket, by the way, should be turned so that the two filament posts face the back side of the box.

Another piece of wire should be soldered to the P post of the socket for V1, also before the coil socket is mounted, as this terminal will not be accessible later. The G and P posts of the socket for V2 should also have wires soldered to them before the socket is mounted, as they are rather close to the side of the box.

With all the parts installed, the wiring may now be completed in accordance with the accompanying schematic diagram. The battery wires are five-foot lengths of lamp cord, twisted together to form a cable. One wire, which forms the "A" minus "B" minus connection, is soldered to the free filament posts on the tube sockets, and runs to the minus side of the "A" battery, preferably through a rheostat (R2). The second wire is soldered directly to the metal box at any convenient point, and runs to the plus of the "A" battery and to the ground. The latter may be any nearby steam or water pipe. The third and last wire runs to the B post on the audio transformer and to one of the tip jacks. The other tip jack

(*Continued on page 876*)



Inside view of the set: R1, grid-leak mounting; V1, detector-tube socket; L, coil socket; C2, regeneration condenser; C1, tuning condenser; V2, amplifier socket; AF, transformer.

The Screen-Grid R. F. Tube as an Automatic Signal-Input Regulator

A Circuit Which Overcomes Swinging and Fading by Varying the Voltage on the Screen Grid

By Donald E. Learned

NOW that the screen-grid tube has been on the market long enough for most of the newness to wear off, and the "dyed-in-the-wool" fans have all tried their favorite theories on it, the author would like to add to the many uses developed for this versatile tube his bit—a scheme to control signal fading, within certain limits.

A little study with a milliammeter of the screen-grid tube will show that the plate current is under very direct control of the "screen-grid"; *i.e.*, variations of the potential supplied to this element will cause variations of current in the plate circuit of the tube, due to variation of the space charge. Therefore, the output of the screen-grid tube may be easily controlled by varying the potential on the screen-grid.

The subject of volume control by means of the carrier-frequency impulses has already been discussed in this magazine (See RADIO NEWS for April, 1928, page 1131); but a little review will doubtless do no harm.

While it is evident that the final (audio) output of a radio set might be employed to regulate the input of the set, and thus even up the volume of reproduction, a little consideration will show that this method is not entirely suitable; because it would not take into account the volume-shading of the performers before the microphone. *Fortissimo* and *pianissimo* portions of a selection would be rendered with almost equal volume, and the loud-voiced villain of the play might possess a milder voice than the very dainty heroine.

However, the carrier-frequency amplitude is affected very little by the efforts of the performers; the volume delivered to the microphone is expended chiefly on the sidebands. Consequently, if there were no fading, the strength of the received carrier would remain approximately constant, and the volume at the loud speaker would be a faithful copy of the original performance, at least as regards volume-shading.

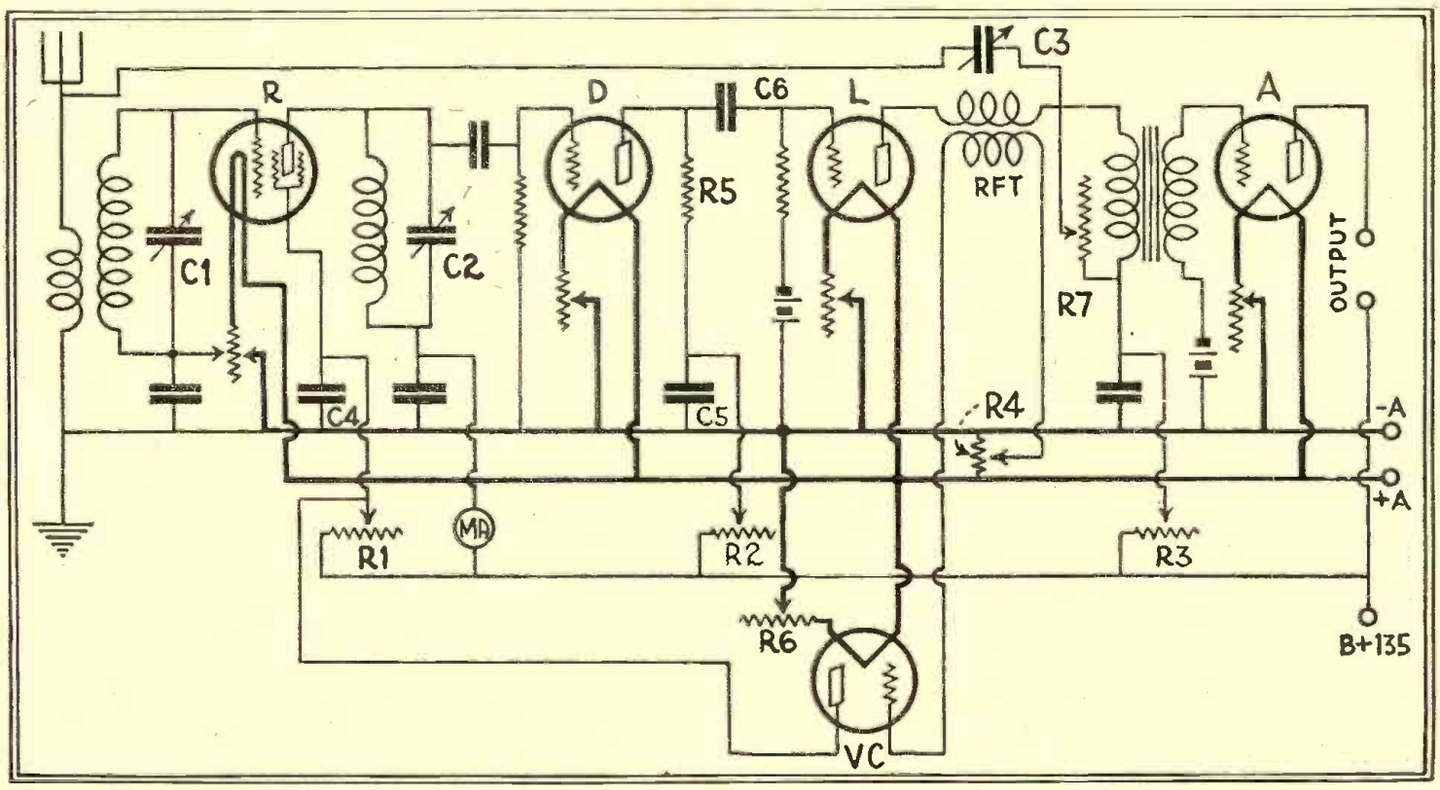
DISTANCE-EFFECTS

Unfortunately, fading intervenes, sometimes giving effects exactly contrary to those produced by the performers. Or a signal fades at the critical moment, losing an announcement, or the vital part of a speech. If, to offset this fading, we now adjust the set to give satisfactory volume while the signal is at a minimum, it may "raise the roof" when the signal returns to normal. (This is very offensive at 2 a. m. after everyone is soundly asleep except the DX hound.)

Now, all these fluctuations of received signal due to fading are more or less faithfully reproduced in the radio-frequency circuits of the set, diminishing and increasing in sympathy with the received signal, *if the set is tuned to the carrier-wave.*

Suppose a set tuned in to the carrier of a station. If the set has two or more radio-frequency stages, or their equivalent, there will be a sizable reproduction of the carrier-frequency current in the plate circuit of the detector stage. If, now, this amplified carrier current be tapped, and used to react on the input stage of the set in such a manner as *to diminish the amplification constant of the input tube in exact ratio to the signal increase*, signals varying greatly in strength of carrier wave will be handed on to the second tube with approximately the same signal strength. Stations large and small, near and far, will tune in with the same signal strength to the second tube; providing always that the received carrier does not fall below a certain critical value. Fading, so far as the speaker is concerned, would be absent.

Such an ideal is hard to obtain in practice; the author has, however, set up such conditions that the reproduced signals of nearby stations have actually been weakest from the speaker when strongest at the antenna, and *vice versa*. This demonstration is especially good when performed on KDKA, the "fadingest" station known in his locality (Columbus, Ohio).



This peculiar circuit will furnish many hours of interesting experiment. It is the first practicable arrangement for automatic volume control that has been made available for construction by the amateur. A similar scheme is used in a very expensive commercial receiver. The special coupler R.F.T. should be purchased; it is an iron-cored coil which the experimenter cannot well match.

A SPECIAL CIRCUIT

A circuit suggestion is shown in the accompanying diagram. Note the link stage L which, while providing a first audio stage, also amplifies the carrier-frequency component; this gives the equivalent of three R.F. stages to amplify the latter to a value at which it will be useful. An additional audio stage may be added to the circuit, if handled carefully. Additional radio-frequency stages may be added between the input stage R and the detector stage D, or regeneration may be introduced. The variable condenser C3, about .0001-mf. maximum, may be added as a regeneration control.

The other elements are as follows: R1 is a 0.3-megohm grid leak, fixed or variable; R2, 2,500- to 25,000-ohms, variable; R3, 12,000-ohm, fixed or variable; R4, 200-ohm (or higher) potentiometer; R5, 24,000-ohm fixed noiseless resistor; R6, 25-ohm rheostat; R7, 0- to 50,000-ohm variable. RFT is an aperiodic radio-frequency transformer (untuned, covering the entire frequency range of the set. The old Radio Corporation UV-1714 is very good here.) C1 and C2 are, of course, determined by the coils used; C4 and C5 are 1-mf. fixed condensers; C6 is 2-mf. It is desirable to place the volume-control tube VC near the link stage L to shorten radio-frequency leads; VC is preferably of the 240 type. A milliammeter will be very useful in non-oscillating sets, when tuning in; this should preferably have a total range of 5 milliamperes and should be located at MA in the input stage. The circuit, of course, should be tried only by experienced constructors.

The operation of such a circuit is as follows: the carrier-frequency current is amplified by the first three stages and is passed to the grid of the volume-control tube VC. Here it acts on the plate current of this tube, modulating it at carrier-frequency; this plate current thus becomes proportional to the amplitude of the received carrier-frequency signal; but (since R.F. plate current is derived from capacity C4, which is also supplying potential to the screen-grid element) the potential on the screen-grid is thus made to become less as the amplitude of the carrier-frequency signal becomes greater, and *vice versa*. Consequently, the plate current and the amplification of stage R are varied inversely as the input of the carrier.

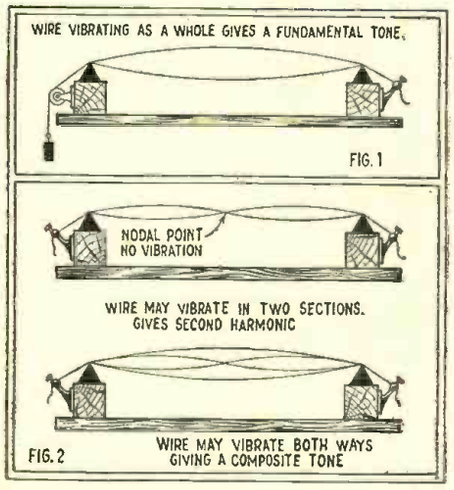
When using this set, all controls should be set to secure maximum results from some nearby, strong station, with tube VC turned off. The milliammeter will probably show from 1 to 2 milliamperes through tube R. Turn on tube VC; then cut down volume to a reasonable amount by means of resistor R7, watching the milliammeter meanwhile. If necessary, adjust the rheostat and the potentiometer on tube VC, and retune, until a marked reduction in the plate current of the input tube is shown by the milliammeter. With all controls set correctly, the meter will show a decided drop as the set is tuned to a carrier. Fluctuations in the carrier-wave may be readily followed by observing the milliammeter. When everything is apparently functioning correctly, make a final adjustment of resistor R7 for comfortable volume. Observe, also, that this resistor affects the milliammeter reading.

Once the above adjustments are completed correctly, the potentiometer and the resistor R7 will take care of any ordinary volume requirements.

"Harmonics"—the Cause of Phantom Short-Wave Stations

THE subject of harmonics in radio is probably one which causes more perplexity to the average fan, especially the short-wave fan, than any other. We have received innumerable letters from short-wave enthusiasts who have picked up with their short-wave receivers stations operating on the broadcast band. In many cases the set is blamed and the fan wishes to know how to fix his set so that these stations will not be picked up. One, in particular, received a station a number of times and was sure that he had heard short-wave transmissions from London, England. When he finally heard the call letters, he was disappointed to find that he had been listening to London, Canada, broadcasting on the wavelength of 329 meters.

Probably the best way to explain why these signals are picked up is to give a mechanical comparison, describing a similar action which can be more easily understood. Suppose we take a piece of piano wire and stretch it tightly between two blocks of wood about three feet apart. If we pluck the wire, it will vibrate and cause a "twanging" noise to be heard. On further examination we will find that the motion of the wires is between the limits of two curves, as in Fig. 1. Now, if we touch the wire lightly half-way between the two supporting blocks, and again pluck it, a higher tone will be heard; and the wire will be found to be vibrating in two distinct sections, as though a solid support had been placed at the middle. This effect is shown in Fig. 2. By touching the wire at distances from its support, equal to one-third, one-fourth, or one-fifth of its length, it may be made to vibrate in even shorter sections.



Transmitting-circuit oscillations may give a composite wave, as do vibrations of a string.

A MUSICAL COMPARISON

By using more complicated apparatus, it is found that the wire can be caused to vibrate in several different series of sections *at the same time*. For instance, it might be vibrating as a whole and also in three, five and seven sections. This is rather hard to picture, but it can be readily found by using the correct instruments. Photographs which illustrate this very well have been made by Prof. D. C. Miller, and will be found reproduced in *Elementary Principles of Physics* by Fuller, Brownlee and Baker.

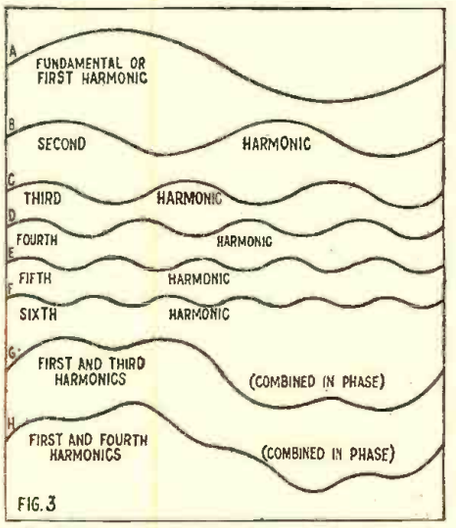
The "quality," "timbre," "tone-color," or characteristic combination of sounds in a note produced by a musical instrument is determined by the ability of the string or other sound-producing element to vibrate at *several simultaneous frequencies*. A difference will be observed when "A" is sounded on a violin and on a piano, or even on two violins; in the latter case, of course, the difference is slight and may escape any but highly trained ears. The characteristic quality is dependent on the presence and respective strengths of the higher-pitched tones produced at the same time as the principal and loudest tone, the *"fundamental"* which is due to the vibration of the string as a whole; these higher notes are the *"harmonics"* and "overtones."

If we consider the lowest tone, or fundamental, as the *first harmonic*, its *octave*, a tone of just twice the frequency or pitch, is the *second harmonic;* but there is possible an indefinitely long series of harmonics, third, fourth, fifth and so forth—corresponding to frequencies three, four, or five times that of the fundamental. This is because the frequency of the tone caused by the vibration of a section of the string doubles as its length is divided by two, and so forth. This we may compare to the radio rule that the frequency multiplied by the wavelength gives always the same number; we may therefore picture a radio aerial "vibrating" electrically with currents which flow from one end to the other, and also with currents which flow only back and forth in sections one-half its length, etc.

RADIO HARMONICS

A radio transmitter, therefore, may send out waves on frequencies higher than those of its fundamental, or carrier-wave frequency; though the lowest radio frequencies are higher than the highest audio frequen-

(*Continued on page* 882)



Harmonics are theoretically separate; in fact only "components" of curves like G and H.

A Connector Which Makes a Positive Contact

EXPERIMENTERS who have found difficulty in making a neat binding-post connection, when using stranded hook-up wire, will find this odd wrinkle a cheap method of making positive contact.

A number of eyelets, (obtainable at any stationery store), and a pair of pliers comprise the necessary equipment. First, twist the strands of the end of the wire to be connected, and loop this terminal about

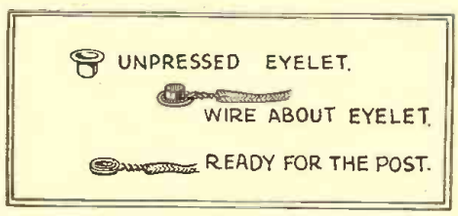


Fig. 1
A metallic eyelet of the type shown holds the strands of hook-up wire tightly in place.

one of the eyelets; clamp the eyelet firmly in the pliers, and it will be found that the end of the wire is being gripped between the two sides of the eyelet. The latter can then be slipped on and off the binding-post rapidly, and without danger of the wire being forced from under the head of the post, as often occurs when using stranded hook-up wire.—*Contributed by John R. Mullaney.*

A High-Resistance Insulator for a Nickel

HERE is a wrinkle for the amateur who desires a cheap and easily made stand-off insulator; this one can be had for the cost of one screw, three nuts, two washers and a small piece of brass strip. The basis of its assembly is the common plug fuse with glass base, selling for five cents in nearly all "5 & 10" stores. Buy one for each insulator wanted; unsolder the fuse wire where it is connected to the brass shell, and take off the shell. The porcelain tip with the fuse wire may then be removed and the fuse saved to replace any in the house which may be blown. So we have still a fuse worth a nickel and a glass base which has cost nothing but a little labor.

The next operation is to put a screw-hole through the bottom of the glass base and, for the benefit of the amateur who does not know how to accomplish this, here is how it is done. Take a three-cornered file and have it ground so that it is sharp on all three edges, with the end pointed at a blunt angle. This makes a very good drill for glass. Put a few drops of turpentine into the cup-shaped end of the fuse base and, with the file in a suitable brace, start drilling in the center of the base. A fairly heavy pressure may be maintained until the drill is about halfway through; then turn the base over, apply a few more drops of turpentine, and start from that side. A smooth hole will be the result and, as the glass is quite soft, it takes little time. The illustration (Fig. 2) shows two models which may be of use in special cases.—*Contributed by Clarence C. Waldrip.*

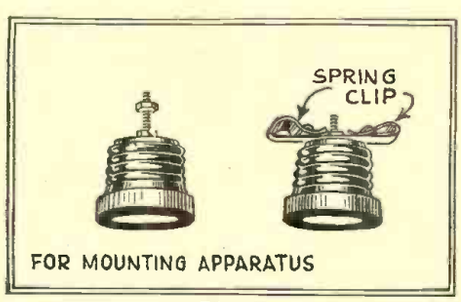


Fig. 2
The insulating base of an ordinary electric-light fuse makes a handy device for the experimenter who deals with high voltages.

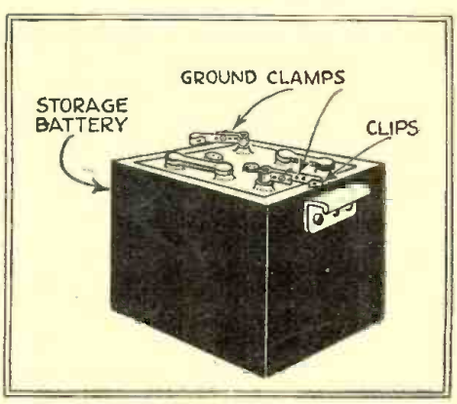


Fig. 3
The common or garden variety of ground clamp may be fastened upon a battery terminal to give a good low-resistance contact.

Battery Terminal Replacements Quickly Made

ONE contributor has found that a small ground-clamp, of the type equipped with a spring-clip binding post, makes an excellent substitute for the various components which make up the post of a storage battery.

These parts, as a rule, suffer badly from corrosion and finally break off or wear off, leaving nothing but a short, rounded shank to which a ground-clamp may be fastened. It must be remembered that the clamp has a tendency to corrode rapidly unless liberal coats of heavy oil or vaseline are applied. —*Contributed by Glenn W. Woodroffe.*

A Home-Made Knife Switch

A SIMPLE method of improving either a single-pole double-throw or a single-pole single-throw knife switch is presented by a wrinkle fan who, obviously, resides some distance from an electrical-appliance store. While it is true that all constructors living near the larger merchandising centers can obtain these switches cheap enough, their suburban cousins may find themselves in need of a switch of this type, but minus the shopping conveniences of the city experimenter.

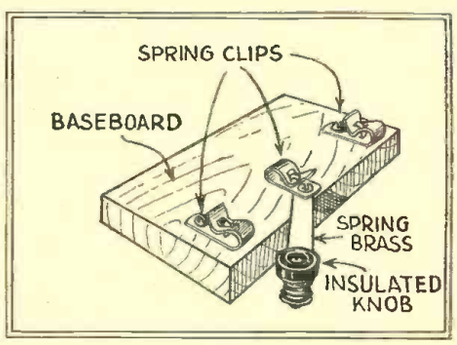


Fig. 4
The simple materials shown make a practical switch which will come in handy in a pinch.

The switch illustrated herewith (Fig. 4) is built from a block of wood 3½ x 2 x ⅜ inches, and the three spring-clip binding posts mounted thereon. Under the center spring clip is placed the knife of the switch, which may be a strip of brass, aluminum or copper about 2½ inches long and ½-inch wide. A rubber or wooden knob placed at the end of the knife completes the assembly.—*Contributed by Cecil Kuhn.*

An Adjustable Tickler for Home-Made Coils

ALTHOUGH as a rule ticklers now take the form of fixed windings on the same coil form which holds the secondary, there are occasions when an adjustable tickler is advantageous in a circuit. The wrinkle presented herewith makes use of a

(*Continued on page* 885)

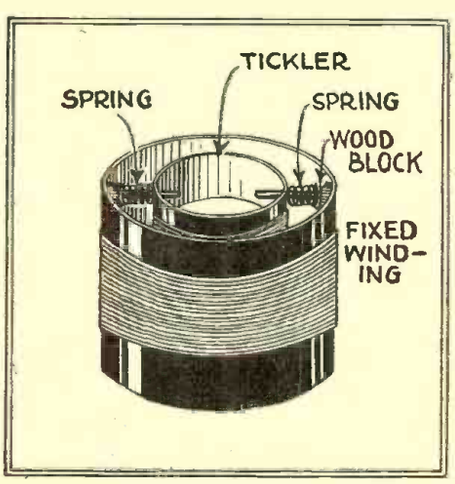
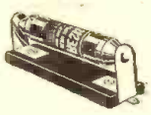
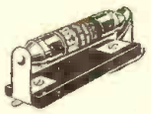


Fig. 5
For an adjustable tickler (or primary) the arrangement shown is simple and effective.

Figuring the Filament-Ballast Resistances



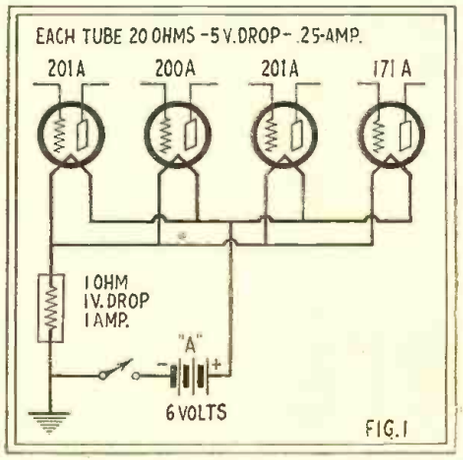
How the "A" Supply Is Tempered to the Needs of Tubes When Different Types Are Used In One Receiver, as in Many Circuits Now Popular, and What Resistors May Be Used



WITH the introduction of receivers employing several specialized types of tubes in their successive stages, the problem of regulating the filament voltages becomes more complicated than it was in sets of the older design in which general-purpose tubes were used throughout.

In the A.C. electric sets, this situation is met by the provision of a step-down transformer with several low-voltage secondaries, each calculated to furnish the voltage required for one type of tube. In this case, proper regulation of the input voltage on the primary (110-volt) winding of the transformer will insure a satisfactory "A" supply.

On the other hand, if direct-current tubes are used, either the 3-volt ("dry-cell") or the new 3.3-volt ("screen-grid") filaments will require special protection if they draw their current from the same source as the 5-volt ("storage-battery") tubes. For this purpose, resistors, commonly called "ballasts," are used; either of a self-adjusting type, which automatically change their resistance with their temperature, and consequently permit the flow of a certain

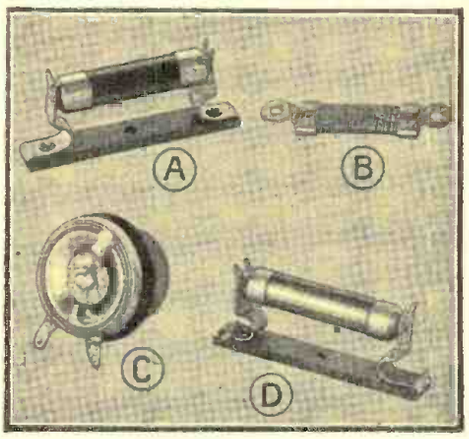


Above is a simple case; the filaments of the tubes require the same supply. One fixed resistor is sufficient, though the voltage falls as the battery discharges itself.

amount of current only, or fixed resistors which properly divide the voltage existing within the circuit and leave only the correct amount across the tube filaments. Such resistors are commonly inserted in the "A—" return leads from the "F—" socket terminals of amplifier tubes, in order to secure a negative bias on the grids of the tubes. (Properly, this is a positive bias on the filament, but it amounts to the same thing; the filament is kept above ground potential by the amount of the drop through its series resistor.)

The most satisfactory method, perhaps, is to connect to each tube, or group of similar tubes, its own resistor; then a master rheostat between all the tubes and the battery permits all voltages to be varied proportionately, if it is so desired.

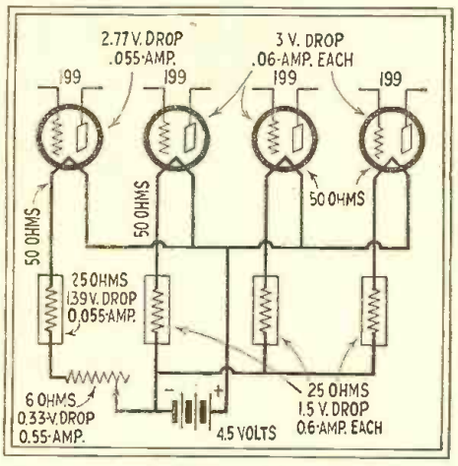
The filament resistance of the screen-grid (222-type) tube is a trifle more than that of the standard 5-volt tube (201A, 112A, 171A types); the former is 25 ohms and the latter 20. But if the 222 were put



Four types of filament resistors in common use. A is a self-adjusting resistor, which should not be used in series with a "manual"- (hand-) operated rheostat like C; B, a wire-wound resistor; and D, a metallized-glass fixed resistor hermetically sealed in the capsule shown.

across the "A" leads, even after the rheostat had cut the voltage down to 5, it would draw one-fifth of an ampere, or 200 milliamperes, instead of the 132 for which it is designed. Consequently, an additional resistance of about 13 ohms in series with the filament of the 222 will be required. In all cases, it will be found better to use a resistor reducing the voltage of the tubes slightly below their rating, rather than one which will permit an excess of current. The 120-type semi-power tube operates similarly to the 222.

The filament resistance of the 199-type tube, we find, is much higher than that of the foregoing—50 ohms—but its current-carrying capacity is very much less. With the 199-type tube across a 5-volt supply, about 33 1/3 ohms in series will be required to safeguard its filament; and 50 ohms if it is exposed to the full 6 volts of a storage battery.

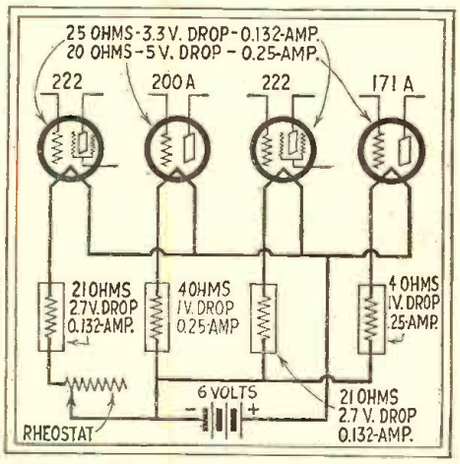


Here we have tubes requiring much greater voltage drop. When the rheostat is turned "down," as shown, it reduces the voltage across the first tube, and current, too.

FIGURING RESISTANCES

A very easy way to calculate the value of the filament resistor required to reduce the voltage of a given current source to that required for one or more tubes is simply to take *the difference in voltage between the supplied voltage and the required voltage* and divide that by the current drain of the tubes with which it is to be used. For instance, the difference between the 6 volts supplied by a storage battery and the 5 volts required by quarter-ampere tubes such as the 201A-type, etc., is one volt. If only one tube is to be used, the current drain is 0.25-ampere and the resistance required will be 1.00 divided by 0.25, or 4 ohms. If three tubes are to be used, the total current drain will be 0.75-ampere and in this case 1.00 divided by 0.75 equals 1 1/3, the number of ohms required.

If several tubes of the same type of filament are connected *in parallel*, their combined resistance is equal to that of any one of them, *divided by the number used;* and a single resistor in series with them must be divided in similar proportion to



This possible hook-up is more complicated. Each tube has its own ballast, adding just enough resistance to regulate the amount of heating current from the battery. The rheostat here is turned "up," out of the circuit.

the value required to protect a single one of them.

For instance, two 222-type tubes in parallel have only *half the resistance of one*—12½ ohms instead of 25. Consequently, the resistor which ballasts them, and passes twice the current, should have one half the resistance of that used with one tube, or 6½ ohms, to maintain the proper voltage across their filaments.

In the case of a filament-ballast resistor designed especially for a given tube or tubes, whether it is of the fixed or the self-adjusting type, the manufacturer's instructions should be read carefully, and the user should make certain that he has the correct type for the tube or tubes which it is to protect, before inserting the resistor in the circuit. A resistor designed for two or

(*Continued on page* 883)

On the Short Waves

ENGLAND'S SHORT-WAVE PIONEER

The most famous amateur phone station of the world, undoubtedly, is G2NM, Caterham, England, located a few miles to the south of London. Two views of its transmitting equipment appear on these pages. It is owned and operated by Mr. Gerald Marcuse, who is vice-president of the International Amateur Radio Union and acting vice-president of the Radio Society of Great Britain. Mr. Marcuse has been for many years well known among the "ham" fraternity of the world; although to broadcast listeners, of course, short-wave work was an unknown quantity until very recently.

The continuing demands for "overseas broadcasts" which rolled into Great Britain from the Dominions and Colonies in 1927 were met by the British Broadcasting Company with the uniform reply that short-wave technique had not advanced sufficiently to justify the necessary expense. This may be set down to conservatism, and the fear that listeners in other parts of the earth would expect local quality and certainty of reception; but it was evident that a need existed. Mr. Marcuse stepped forward and offered to undertake at his own expense a short-wave Empire broadcast service. This generous offer overcame official inertia; Mr. Marcuse started on this work, and the successful demonstration forced the hand of the B. B. C., which then undertook its short-wave transmissions from 5SW.

"After many years of experimenting on the various short waves," says Mr. Marcuse, describing his system in a letter to RADIO NEWS, "and finding that these signals were being received with such remarkable regularity and consistency in various parts of the world, I thought it would be an interesting experiment to attempt short periods of broadcasting. Unfortunately, private enterprise of this description in this country is not very favorably received by the various government departments concerned; but they realized that there was room for experimentation of this kind, and they accordingly granted me certain facilities which enabled me to carry out tests on a fairly extensive scale.

"I realized at the time that, in order to put out a stable signal free from 'frequency pull' in order to give the distant listeners the best possible signal, it was necessary to use crystal control. I therefore chose the 130-meter wavelength for the crystal; this frequency was doubled and redoubled, then amplified. The input to the final amplifier was 1200 watts, and the two special modulators handled also 1200 watts. This gave me a 60% modulation, free from distortion, which was sub-controlled by two 75-watt tubes in parallel.

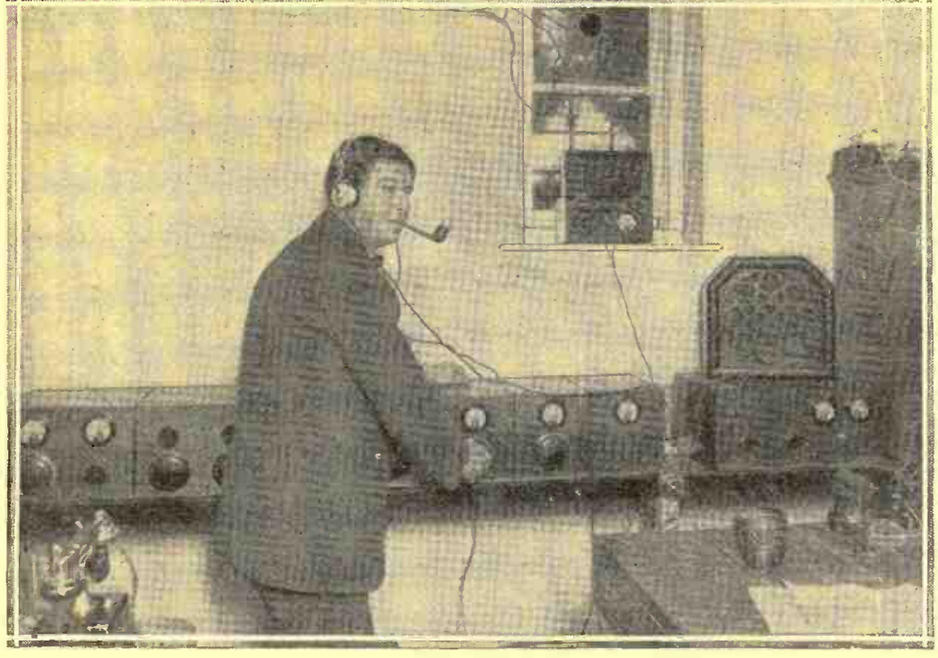
"These were connected by a private telephone line to the house of my assistant, Mr. Percy Valentine, about a mile away, where the control room and studio were situated. We were fortunate in having the use of a music room, complete with organ and piano, etc., for a studio; and inter-communication telephones were used throughout. The control room housed the note oscillators, early A.F. amplifiers, and broadcast receivers, used in rebroadcasting various programs.

"My wavelength throughout these experiments was 32.5 meters; the aerial a full-wave Hertzian, with Zeppelin feed, both feeders being tuned to give identical readings. One end of the aerial was attached to a mast 90 feet high, and the other to a mast on the house, about 60 feet high. The filaments of the tubes were fed from storage batteries of large capacity, separately housed. The plate power supply was available from either 50-cycle 240-volt alternating current, stepped up by a transformer and rectified by tubes, or from a motor-generator. Two separate voltages were available; 2000 for the crystal drive and amplifiers, and 4000 for the modulators and output amplifier. The total power used by the transmitter was 3500 watts.

"This station worked during the authorized six hours per week, with a few extra programmes thrown in, continuously for twelve months without a breakdown, except for an unfortunate accident at the first opening broadcast. The transmissions have been rebroadcast in Australia and Ceylon; one of my most interesting experiments was when I received a program from Sydney, Australia on 28 meters which I rebroadcast on 32.5. This was received back in Sydney satisfactorily and with practically no time-lag. Many artists have come forward and have greatly assisted in these experiments by giving their services freely.

"My present license expires on Nov. 30 and, owing to the international regulations coming into force on January 1, I am not able to say what the future of G2NM will be. My readers will realize the trouble and expense my assistant and I have gone to, to make these experiments successful, and they can readily imagine that we had very little spare time available after attending to the maintenance of the station. I would like my readers to understand, however, that this was purely an amateur effort and the only reasons for attempting these broadcasts were the same as exist in other amateur stations; namely, to try and find out something which has not been discovered before and also to prove that short-wave broadcasts are a really reliable proposition. After all, the British Empire is a large one, and I consider that it is England's duty to provide her scattered subjects with Empire programs."

When this was written, no subsequent information about schedules for the coming year was available; but it may be hoped that Mr. Marcuse's patriotic efforts will receive the same encouragement from official sources that they have been given by the British press, and that overseas listeners will continue to enjoy reception of G2NM.



Mr. Marcuse in the control room adjoining the studio of G2NM, about a mile from the transmitter. The shielded amplifiers are shown, and the monitor receiver and speaker. Lower right, a short-wave receiver; English and foreign broadcasts have been picked up here and relayed over G2NM. A telephone instrument of the English type is at the lower left.

FROM SENOR CESPEDES

Editor, RADIO NEWS:

I thank you for the insertion of my call letters among the short-wave broadcast stations of the world; an honor gained by the constancy of my regular amateur broadcasting. The work is well repaid every week when I receive letters from all America. This mail brought me four from the United States to show the DX my little station is giving. Mr. Charles J. Schroeder in another letter repeats my words, in Spanish and English, and reports reception R-8 (*Very good—almost loud-speaker strength*) of a special program I gave him on Nov. 3. He says it was "the night of nights," because of the marvelous clearness of my transmissions.

I am doing all I can, and hope that I will have soon a 75-watt amplifier in order to get more DX throughout the United States. I am glad to repay thus the education I have received in Uncle Sam's schools. I am on the air every night from 10:30 to 11:30, E.S.T., on 30.5 meters. I use 500 volts on the plate of a Ceco L-10 tube, modulated by two others of the same type. Cordially.

AMANDO CESPEDES MARIN,
Stations NRH, NR4AC, Apartado 40, Heredia, Costa Rica, Central America.

NO FREE VERIFICATIONS

Editor, RADIO NEWS:

The enclosed letter speaks for itself, for I wrote to 5SW for verification and got it and this letter. I use a Bremer-Tully short-wave set and find by mounting condensers on ⅛ sheet copper and grounding it to "A+" it works fine. I have also a piece of tin between transformers to prevent coupling, also grounded to "A+."

TERENCE BUCKLEY,
Taftsville, Connecticut.

(The enclosure was a form stating that the British Broadcasting Co. has received so many requests for verifications from overseas listeners that it has decided to charge for making them by mail; though answers would be made free only in a publication issued by that company, and which has considerable circulation in Great Britain.

In the early days, when short-wave broadcasting was more highly experimental and the only listeners were amateurs trained in short-wave work, all short-wave stations were glad to get letters and acknowledge them, in order to learn the definite limits within which transmissions at a given wavelength from a given point might be heard. In fact, by this means almost entirely, short-wave work has been made of such high commercial value that most of the high frequencies have been taken away from the broadcasters and the amateurs and allocated to public utility and other companies.

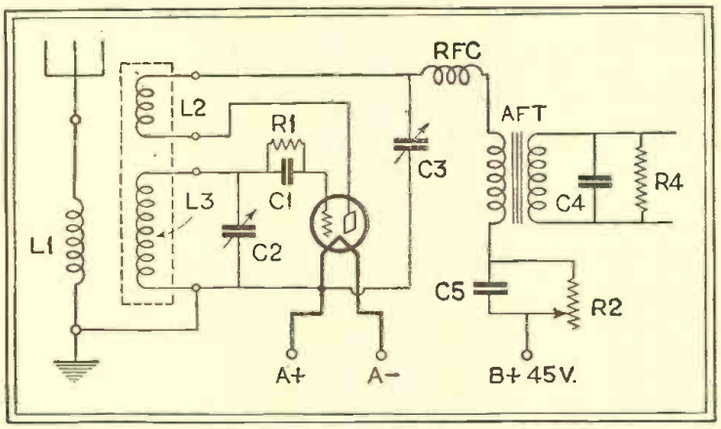
Now, since it has been found that, over large areas of the earth's surface, a high-power short-wave station "comes in like a local" almost anywhere at times (though it does not give the consistent "blanketing" that a commercial service area must have) and the number of broadcast listeners with short-wave sets is increasing enormously, it is undoubtedly onerous to such stations to answer all

thrill-seekers who wish merely to exhibit cards to their awe-stricken friends. Much, therefore, of the short-wave DX listening must now be its own reward. Very low-powered stations, of course, still welcome distant-reception reports; and the ultra-short transmissions (below 13.0 meters) are still so far in the condition of uncertainty that reports by skilled observers are valuable to the experimenters. —EDITOR.)

FOR DEAR, OLD SHORT-WAVES

Editor, RADIO NEWS:

Your short-wave department in RADIO NEWS has, I am sure, attracted much attention throughout the world. (*Right!*) Personally, I am deeply interested in the development of short-wave broadcasting; in fact, so much that I seldom, if ever, listen in any more between 200 and 600 meters. It may interest some of your readers, especially here in the southern states, to know that I have received the following foreign stations all with loud-speaker volume: EAM, 2NM, 5SW, CJRX, PCJJ, PCLL, RFN, 9RH, 2ME and 3LO, the latter station coming in from 5 to 7 A. M. with excellent volume and little fading.



Mr. Quimby used "Scotch" (tube-base) coils with 15-mmf. condensers. L2 has 37 turns of No. 28, 16 of 22, and 7 of 22 for 80-, 40- and 20-meter bands; L3 25, 20 and 10 respectively of No. 30 wire. The fan may use specifications on page 876 for condenser sizes there given. L1 is two turns of bell wire on the tube base. R2 is 0-50,000-ohm; C4 (.0005-mf.) and R4 (1/10-meg.) are to filter out noises.

I am using a hook-up as prescribed by P. H. Quimby in Q.S.T. of March, 1928, using detector and one stage of audio amplification in a cabinet 8 x 9½ inches; on top of this cabinet I use an Atwater-Kent two-stage audio amplifier which gives me three stages of audio with perfect control from 15 to 90 meters. This may account for the loud-speaker reception of the foregoing foreign stations. (*Not necessarily; a signal must be received before it can be amplified.*)

I trust this may help to further the short-wave art, and will be glad to hear from my fellow-listeners, especially in foreign countries. With every good wish for your short-wave department, I am,

RALPH E. HOWARD,
167 East Lake Terrace, Decatur, Ga.

CODE INTERFERENCE ON SHORT WAVES

Editor, RADIO NEWS:

I take the liberty to make some comments regarding short-wave transmissions. KDKA's 25.4-meter transmitter is practically on the same wavelength as some powerful foreign code station which causes their signals to be distorted. You cannot tune out this station, and its signals are always present when KDKA is tuned in. WGY's short-wave transmissions are also rendered distorted as a result of code stations surrounding their wavelengths.

Fading is the principal bugbear of short-wave transmission; but when you have to put up with code, it is almost hopeless to listen in. The time has come when some international agreement should be made whereby code should not be permitted to use wavelengths which interfere with the principal short-wave broadcast stations. The ultimate success of such transmissions is worth while, as a good overseas radio market could be established and manufacturers could extend their sales to tropical markets.

L. R. BOURNE,
The Palms, Cheapside, Barbados, B. W. I.

(*According to the international radio convention, effective Jan. 1, 1929, the bands from 50 to 48.8 meters, 31.6 to 31.2, 25.6 to 25.2, 19.85 to 19.55, 16.9 to 16.85, and 14.0 to 13.9, are reserved exclusively for broadcasting. On these waves there should be no commercial interference.*—EDITOR.)

RECORDS TO BE KEPT

Announcing that a 500-watt experimental license had been granted to the Bell Laboratories, 463 West St., New York, to operate between 50 and 200 meters, the Federal Radio Commission took the opportunity to announce that it will require monthly reports from all experimental transmitters as to frequencies used and power output. Hitherto no official record has been available as to what is actually going on over the short waves in this country; let alone foreign transmitters.

SHORT WAVES FROM AFRICA

An opportunity is available to short-wave listeners to hear 30-metre telephony transmissions from wildest Africa. We understand that, until further notice, Major Court Treatt is transmitting on this wavelength from Bahr-el-Arab, Southern Sudan, between 6 and 8:30 p. m. G. M. T., using the call-sign FXCT.—*Popular Wireless.*

BROADCASTS IN SUMATRA

A nautical correspondent, after a trip across the Indian Ocean, writes that, in addition to other stations we have previously listed, one at Medan, on the island of Sumatra, is sending out a 37.50-meter program on Mondays, Tuesdays, Thursdays, and Fridays, between the hours of 8 and 10 p. m. While it is not so stated, we presume this to be its local time, about 11½ hours later than Eastern Standard, or 6½ hours later than GMT.

"RADIO NEWS" TO THE ANTARCTIC

RADIOGRAM—The *New York Times* Radio Station, Times Square, New York. D 132 WFAT SS. *Eleanor Bolling,* Nov. 22, 1928 RADIO NEWS, New York City:

Please mail to catch SS. *Makura* leaving San Francisco November 28, October and November issues RADIO NEWS. Address Byrd Antarctic Expedition, care Tapley, Dunedin, New Zealand. We are not leaving Dunedin until arrival this mail about December 20. MALCOLM HANSON

Mr. HUGO GERNSBACK:

Please airmail these to Frisco.

MEINHOLTZ, *Times.*

(*The requested issues were airmailed accordingly to the Byrd Expedition, whose present address in Antartica, however, is not reached by the mails this summer* (.... ..). *Mr. F. E. Meinholtz, who transmitted the message, is manager of the Times station and has been, at times, in closer touch with Commander Byrd than with the Times, as a recent front-page article in that paper revealed. Mr. Meinholtz was sitting in his home in Queens Borough, New York City, listening to a dispatch from the City of New York, then in Antarctic seas, when he heard his own name mentioned: "Meinholtz, the Times wants you to hang up your telephone receiver so it can call you on the phone." The operator at the Times station in New York, unable to call his chief by phone, had requested that the message be relayed from the Byrd ship ten thousand miles away—and it was done successfully! See* "SCIENCE & INVENTION" *Magazine for March for full story.*)

EASTERN CANADIAN BROADCASTS

Station VAS (Louisburg, on Cape Breton, Nova Scotia), which is regularly operated in commercial work, is now transmitting on both the broadcast band and on short waves for the benefit of the Canadian Maritime and of fishermen at sea.

The 28-meter transmission, carrying weather forecasts, storm warnings, press dispatches, etc., begins at 11:18 p. m., Eastern Standard Time. Atlantic Time, used at the station, is an hour later.

SHORT-WAVE TIME SIGNALS

In addition to the numerous long-wave time signals, such as those from the Eiffel Tower, Paris, and NAA, Arlington, Virginia, there are short-wave signals which may be picked up and used for the correction of timepieces, determination of longitude, etc.

Chelmsford, England, sends out on 24 meters, daily except Saturday and Sunday two signals, at 1300 and 2100 GMT—8 a. m. and 4 p. m. Eastern Standard—of six dots at one-second intervals. The last begins the hour.

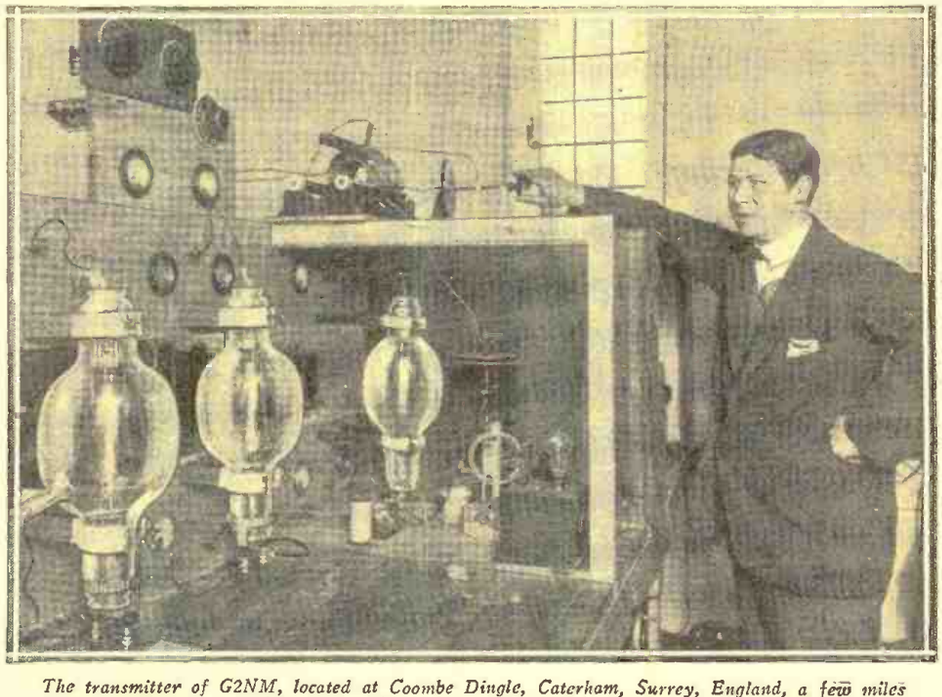
Arlington gives signals from the naval observatory at Washington; on 74.7 meters at noon and 10 p. m.; on 37.4 meters at noon, 10 p. m. and 3 a. m. every day. Elgin (Illinois) sends out a larger number on 33.5 meters from WNBT. These are at 1, 9 and 11 a. m., 1, 3, 5 and 7 p. m. except Saturday afternoon and Sunday. The 1 a. m. signal, which is given on Sunday also, is heard regularly in the Antipodes. These signals, like Arlington's, consist of dots sent out at intervals of one second, the 29th and the 55th to 59th being omitted from the series. They begin five minutes before the hour.

SHORT-WAVE CLUB IN ARGENTINA

Editor, RADIO NEWS:

I am enclosing copy of the *Buenos Aires Herald* announcing the organization of the English-Speaking Radio Club. Part of the aims of this organization includes broadcasting in English and we ask

(*Continued on page* 886)



The transmitter of G2NM, located at Coombe Dingle, Caterham, Surrey, England, a few miles to the south and west of London. This 1,200-watt station has been heard in all parts of the world. Its call was familiar to all amateurs long before Mr. Marcuse undertook short-wave broadcasting for the benefit of listeners throughout the British Empire—and incidentally others.

Radio News Laboratories

RADIO manufacturers are invited to send to RADIO NEWS LABORATORIES *samples of their products for test. It does not matter whether or not they advertise in* RADIO NEWS, *the* RADIO NEWS LABORATORIES *being an independent organization, with the improvement of radio apparatus as its aim. If, after being tested, the instruments submitted prove to be built according to modern radio engineering practice, they will each be awarded a certificate of merit; and that apparatus which embodies novel, as well as meritorious features in design and operation, will be described in this department, or in the "What's New in Radio" department, as its news value and general interest for our readers shall deserve. If the apparatus does not pass the Laboratory tests, it will be returned to the manufacturer with suggestions for improvements. No "write-ups" sent by manufacturers are published in these pages, and only apparatus which has been tested in the Laboratories and found of good mechanical and electrical construction is given a certificate. As the service of the* RADIO NEWS LABORATORIES *is free to all manufacturers, whether they are advertisers or not, it is necessary that all goods to be tested be forwarded prepaid, otherwise they cannot be accepted. Apparatus ready for, or already on, the market will be tested for manufacturers free of charge. Apparatus in process of development will be tested at a charge of* $2.00 *per hour required to do the work. Address all communications and all parcels to* RADIO NEWS LABORATORIES, *230 Fifth Avenue, New York City.* **Readers will be informed on request if any article has been issued a Certificate of Merit.**

A.F. TRANSFORMER

The "type A-100" A.F. transformer manufactured by the National Company, Inc., Abbott Street, Malden, Mass., is of modern design, incorporating a nickel-steel core of high permeability; the secondary windings are split, resulting in more efficient transformation. The turns-ratio of this transformer is 4 to 1; its amplification maintains almost constant its value from 32 to 5,000 cycles when used with a 201A tube. The transformer's metal case is 2¾ inches long, 3 inches high and 2¼ inches wide, and of a black crystalline finish.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2503.

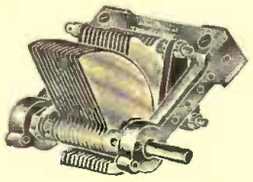
R.F. CHOKE COIL

The "Type 90" R.F. choke coil, submitted by the same manufacturer, has an approximate inductance value of 90 millihenries. and is designed for use in radio-frequency circuits operating on wavelengths up to 600 meters. Its D.C. resistance value, as measured, is 360 ohms. It is very compact, designed for mounting in the standard grid-leak mounting; its over-all length is 2 inches and it is ⅞-inch in diameter.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2504.

TUNING CONDENSER

The "type ET" tuning condenser shown, submitted by the same company, is of low-loss construction, with plates shaped to give a straight-line frequency tuning curve. The condenser has a maximum capacity of 500 mmf. with a minimum of 1.5 mmf. The rotor, which is supported by a die-cast aluminum frame of girder type, is of the floating type, allowing interchange of shafts or ganging of two or more condensers; the stator plates are accurately spaced and are supported from the girder frame by strips of hard rubber, which are placed out of the electrostatic field. This condenser requires back-of-panel space ¼ inches high, 3 inches wide and 3¼ inches long; it is provided with a rotor stop at maximum and minimum positions.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2505.

TONE FILTER

The tone filter manufactured by the same company is designed for use in coupling a loud speaker to a final audio stage, in which may be used a power tube of the UX-112, UX-171 or UX-210 type. The direct current for the plate supply flows through a choke which is designed to carry as much as 35 milliamperes without saturation; the A.C. component which it blocks is coupled to the loud speaker through a 2-mf. Tobe filter condenser. The latter prevents the passage of direct current through the windings of the speaker, guarding against overloading and saturation. The filter is 2⅝ inches wide, 4 inches deep, and 3¼ inches high. A five-foot phone cord is supplied for attachment to any set.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2506.

DYNAMIC SPEAKER

The "Peerless Model 19-AR-60." submitted by the United Reproducers Corp., Peerless Division, Rochester, N. Y., is an electrodynamic speaker of the single-turn moving-coil type. The input from the receiver is connected to a step-down transformer with but one secondary turn, which is connected by heavy copper strips to a single-turn coil on the apex of the cone. The cone, 9 inches in diameter, is anchored to a die-stamped supporting frame by thin chamois strips. The field winding is of the low-voltage type, supplied with current by a special step-down transformer and dry-rectifier element. The complete chassis assembly is very rugged, and of such construction that repairs or adjustments may be easily made. The chassis is housed in a Gothic mantel-type walnut cabinet which serves as a baffle for the low-frequencies. The cabinet is 14½ inches long, 16½ inches high and 10¼ inches wide. This speaker will handle tremendous power with remarkable fidelity in reproduction of music and speech.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2507.

DUPLEX CONE SPEAKER

The "Helios" duplex-cone speaker, submitted by Peter Grassman, Berlin SW68, Charlottenstr. 6, Germany, employs two individual floating cones which are driven by two reproducing units of the balanced-armature direct-drive type; they are enclosed in a cylindrical housing placed between the skeleton-frame cone supports. A rod extends from the units to allow adjustment of sensitivity. The small cone is 12 inches in diameter, and the large cone 16; the over-all height is 17½ inches, width 16¼ inches and depth 6½ inches.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2508.

MILLIAMMETER

The "type 200" milliammeter shown, submitted by Ferranti, Inc., 120 W. 42nd Street, New York City, N. Y., is of very rugged construction and designed to give a scale reading between 0 and 200 milliamperes of current. The meter is of the D'Arsonval type, the coil having a two-point suspension; the permanent magnet is of the annular ring type. In shunt with the moving coil is a wire-wound resistor. The indicator is of girder construction, rigidly fastened to the moving coil, and properly counterbalanced. The scale has a satin-silver finish accurately engraved. A fuse for protection of the meter is provided and may be removed by unscrewing a screw on the face of the meter; another screw is provided for setting the indicator at zero. The entire mechanism is enclosed within a black molded bakelite case; the diameter of the face is 3¼ inches, and that of the case 2⅞ inches. The depth of the meter is 1⅝ inches.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2510.

SHIELDED HOOK-UP WIRE

The shielded hook-up wire submitted for test by the Belden Mfg Co., 2300 S. Western Ave., Chicago, Ill., is of "Colorubber" stranded hook-up wire, over which has been placed a braided tinned-copper sheath. It has been designed especially for use in screen-grid R.F. sets in order to prevent feed-back through wiring. Normally, the stranded wire is used for connections, while the sheath is grounded and serves as a shield. It is supplied in rolls of 50 and 150 feet.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2516.

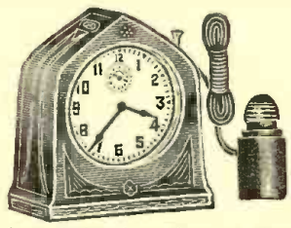
TELEVISION MOTOR

The "Type K113" television motor submitted by the Electric Specialty Co., Stamford, Conn., is of the induction type and operates directly from the 110-volt 60-cycle power supply circuit. It is rated at ⅛-h.p. and runs at 1,800 r.p.m. The motor is 6 inches high, 5½ inches wide and 8½ inches long; its rotor is of the "squirrel-cage" type. The motor is provided with a "starting" and a "running" winding; the former being cut out of the circuit automatically after a proper speed has been reached.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2517.

ELECTRIC-SWITCH CLOCK

The electric-switch clock submitted by the Nova Electric Corporation, 40 W. 17th Street, New York City, has been designed to close an electrical circuit at any predetermined time. It consists of a clock movement, provided with a switch of 750 watts (250-volt A.C. or D.C. rating) which is operated by the alarm mechanism of the clock. The clock movement and the electric switch are enclosed in a metallic housing of Gothic design, finished in foliage-green polychrome. A 10-foot extension cord with a special adapter is provided for the light socket or receptacle, with a socket provided for the device or appliance to be controlled. When desired, the circuit may be closed or opened manually by an independent control on the clock. Its dimensions are 6 inches high, 5½ inches long and 2½ inches wide.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2519.

A.C. RADIO RECEIVER

The "Model 34" 7-tube A.C. receiver shown, submitted by the Browning-Drake Corporation, 353 Washington Street, Brighton, Mass., is of the all-electric type and operates directly from 110-volt 60-cycle house current. Four tuned circuits are employed, with three stages of radio frequency using 226-type A.C. tubes, and the conventional 227 heater-type detector. The audio section consists of three stages, with two 226 tubes

and one 171 power tube. A power transformer, employing a full-wave rectifier of the 280 type in conjunction with a well-designed filter system, furnishes humless "B" power. The filaments of all tubes are supplied from low-voltage secondaries on the power transformer. A single tuning control operates four condensers, which are ganged on a single shaft; the scale is of the illuminated-drum type, with its knob directly under the scale. That of the oscillation and volume control is found on the right side of the panel, and the power switch on the left. The receiver and power unit are assembled on a die-stamped aluminum chassis enclosed within a polished walnut cabinet of pleasing design, 22 inches long, 12 inches wide and 10 inches high. Cord-tip jacks are provided for the loud speaker, while binding posts are terminals for the antenna and ground; a 10-foot extension cord provides for connection to the light receptacle. Ample sensitivity, without sacrifice of selectivity, was demonstrated with fidelity of reproduction.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2520.

PHOTOELECTRIC CELL

The "G-M Visitron Model 21," submitted by the G-M Laboratories, Inc., Grace and Ravenswood Ave., Chicago, Ill., is of the alkali metal-hydride type, and designed for use with a small beam of light where low electrostatic capacity is desired. The bulb of the cell is enclosed in a standard UX-type tube base; the "G" prong is the positive terminal, and the filament prong diagonally opposite the negative terminal. This photoelectric cell was found very sensitive.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2521.

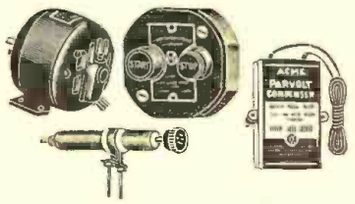
PHONOGRAPH PICK-UP

The "Truphonic No. 502" phonograph pick-up, submitted by the Alden Mfg. Co., Brockton, Mass., is of the electromagnetic type, designed to be placed on the tone arm of a phonograph, for electric reproduction of speech and music from ordinary phonographic records, and used in connection with an audio-frequency amplifier. It is of the balanced-armature type, adjusted in the factory. The mechanism is contained in a molded black bakelite case, designed with a flange, to fit over the phonograph's tone arm; it is 2 inches in diameter and 1⅝ inches thick. It is supplied with an adapter and extension cord for connection to the radio receiver.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2522.

TELEVISION MOTOR KIT

The television motor kit shown, submitted by the Master Electric Company, Dayton, Ohio, has been designed for television use; it operates directly from 110-volt 60-cycle A.C. circuit, and delivers 1/10-h.p. at 1,725 r.p.m. The motor is supplied with a starting and stopping switch, and with a condenser bank to suppress sparking; its speed is controlled by a heavy-duty carbon type rheostat



of rugged construction. The motor is 5½ inches high, 6 inches wide and 7½ inches long.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2523.

DRUM DIAL

The "SDW-1" drum dial shown here, submitted by the Hammarlund Mfg. Co., 424 W. 33rd St., New York City, is of the indirect-drive type, and consists of two parts, the drum scale and the rotating mechanism. The driving mechanism consists of a frame support, through which extends a ¼-inch shaft with special wind-up bushings. To the latter are fastened the ends of a cord that passes around a small cast drum, through which passes the gang shaft, and which is supplied with set screws for fastening to the gang shaft. The drum scale is 4-7/16 inches in diameter, and consists of an aluminum disc, to which is fastened the translucent celluloid scale. An escutcheon plate of pleasing design, a bracket and socket for the miniature lamp, and a mahogany molded-bakelite knob are supplied with the necessary additional hardware, template and instructions.

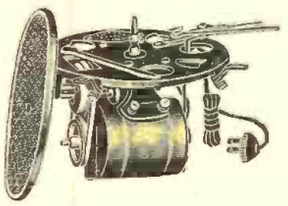
AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2524.

PHONOGRAPH PICK-UP AND MOTOR

The "Type B-4" phonograph pick-up, submitted by the L. S. Gordon Company, 1800 Montrose Ave., Chicago, Ill., is of the electromagnetic type, and in connection with an audio-frequency amplifier makes it possible to reproduce music and speech from ordinary phonograph records. It is of the balanced-armature type, enclosed in a metallic housing; a base with extension arm is supplied as a part of the mechanism. A volume control and adapters for either electric or battery receivers are also provided. The pick-up, arm, base and volume control housings are finished in gold. The instrument gave excellent reproduction in connection with an ordinary two-stage audio-frequency amplifier.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2526.

The electric phonograph motor submitted by the some company is of the A.C. induction type and operates directly on the 110-volt 60-cycle alternating current. The motor is suspended from a cast base frame and belted to a speed governor and a worm-gear which drives the turn-table shaft. A starting switch operated by a lever is fastened under the support base, and an additional lever which operates through a cam controls the rotating speed by placing friction on the governor disc. Lugs on the base are supplied for fastening to the motor board. A velvet-covered die-stamped turn table, 10 inches in diameter, and a 10-foot extension cord for connection to the 110-volt circuit, are supplied.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2527.

VOLTAGE REGULATOR

The "Antennavolt Type 98" and the "Resistovolt Type 99," submitted by the Insuline Corporation of America, 78 Cortlandt St., New York City, have been designed for use in the reduction of house-lighting voltages to the values recommended by tube and radio-receiver manufacturers. Each consists of a resistance element enclosed by a perforated metal housing which prevents excess heating. One end is provided with prongs for insertion into the light-circuit receptacles, and the other with a receptacle for the insertion of the extension cord from the radio receiver. The measured resistance was 10 ohms when operated under a load of 75 watts. The only difference is that the Antennavolt has a binding post, as illustrated, for connection to the aerial post of a receiver; the antenna of which is then formed by the lighting system.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATES OF MERIT NOS. 2528 AND 2529.

(*Continued on page* 893)

Reviews of Recent Radio Literature

By H. M. BAYER

FILTERETTES—A NEW DEVELOPMENT, BY TOBE DEUTSCHMANN. Published by Tobe Deutschmann Company, Canton, Mass. Pamphlet, 11x8½ inches. Photographs. Free distribution.

Whines, whirls, clicks, clacks, and other sundry bits of man-made static which are illegitimate by-products of the very essential wheels and motors of progress, can be done away with, according to the author of the above pamphlet. And, what is more, not only does he assure the reader that disturbances emanating from near-by motors can be suppressed, but invites those afflicted to write their troubles to him and he will do his best to offer a solution. From the technical reputation of the above publishers, the inquirer may rest assured that, if they can be of no assistance to him, his problem is certainly a very difficult one.

To their credit it must be said that they were the first to produce, as a catalogued item, an interference filter. Ever since then they have devoted a good deal of effort toward the development of electrical noise filters until, as evidenced by their pamphlet, they have succeeded in producing a line to meet as many emergencies as is possible, electrically.

Furthermore, their free problem service not only sounds alluring, but also is rather magnanimous, and incidentally is the answer to a radio editor's prayer.

THE ELECTRIC WORD: THE RISE OF RADIO, by Paul Schubert. Published by the Macmillan Company, New York City. 8½x5¾ inches, 311 pages; line drawings. Price $2.50.

To Mr. Schubert belongs the credit of jogging the radio industry into a pleasant awakening. That is, not exactly an awakening; for those connected with the industry and its allied enterprises have always realized that the science with which they are connected has another story beside those told with the aid of tables and equations. However, it remained for the author, a Naval Academy graduate who resigned a commission in the navy to enter the journalistic field, to find in the field of radio communication a story of scientific achievements, commercial attainments, political machinations and legal manipulations such as rarely has been found in the growth of other industries.

Paul Schubert has given us an excellently written, detailed history of the radio industry; starting with the promotion difficulties of the youthful apparatus-collector, Marconi, and leading up to and including the part played by radio in the recent presidential campaign. He has written the biography of a science and in doing so has avoided, as much as possible, the technicalities of radio which would have robbed the book of its romantic appeal. As it is, Schubert's work borders on the romantic; due, of course, to the political and commercial intrigues which accompanied the rise of radio, and due, also, in no small measure, to the excellent technique of his pen.

Perhaps it is in the first chapter that the author supplies "food" for the radio professional, and again brings up the question, "What are Marconics?" With Schubert's attempt (if we may consider it as such) to answer the "problem" we find a detailed narration of the actual work done by Marconi which led to the filing of his patent claims. It is interesting also to note the obvious attempts by the author to justify Marconi's priority claims. The fact that the data which makes up this book were obtained by the author through interviewing authorities in the industry casts a significant reflection on the first chapter; in fact, one would believe that Schubert was the recipient of conflicting views of the Marconi matter in the course of his researches. Or perhaps his notation in describing Marconi's use of the "coherer" was meant to air one side of the matter. "It," he writes, "was his 'detector' and it, too, had been the discovery of other men." (*Hughes, 1879—Branly, 1892—Popoff, 1893.*—EDITOR.)

However, *The Electric Word* should be read by everyone interested in radio; it is very well written, possesses the historical accuracy essential for a work of this type and proves most convincingly that radio is a great deal more than just an immense "I square R" loss.

(*Continued on page* 893)

List of Broadcast Stations in the United States

Radio Call Letters	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
KDKA	East Pittsburgh, Pa.	306	25000
KDLR	Devils Lake, N. D.	248	100
KDYL	Salt Lake City, Utah	232	1000
KEJK	Los Angeles, Calif.	240	500
KELW	Burbank, Calif.	384	500
KEX	Portland, Oregon	254	5000
KFAB	Lincoln, Nebraska	389	5000
KFAD	Phoenix, Arizona	484	500
KFBB	Havre, Montana	220	250
KFBK	Sacramento, Calif.	229	100
KFBL	Everett, Washington	219	50
KFBU	Laramie, Wyoming	500	500
KFCB	Phoenix, Arizona	229	100
KFCR	Santa Barbara, Calif.	200	100
KFDM	Beaumont, Texas	535	500
KFDY	Brookings, S. D.	545	500
KFEC	Portland, Oregon	219	100
KFEL	Denver, Colorado	319	250
KFEQ	St. Joseph, Mo. (day)	535	2500
KFEY	Kellogg, Idaho	248	10
KFGQ	Boone, Iowa	229	100
KFH	Wichita, Kansas	231	1000
KFHA	Gunnison, Colorado	250	50
KFI	Los Angeles, Calif.	468	5000
KFIF	Portland, Oregon	211	50
KFIO	Spokane, Wash. (day)	244	100
KFIU	Juneau, Alaska	229	10
KFIZ	Fond du Lac, Wis.	211	100
KFJB	Marshalltown, Iowa	250	100
KFJF	Oklahoma City, Okla.	204	5000
KFJI	Astoria, Oregon	219	50
KFJM	Grand Forks, N. D.	545	500
KFJR	Portland, Oregon	231	500
KFJY	Fort Dodge, Iowa	229	100
KFJZ	Fort Worth, Texas	219	100
KFKA	Greeley, Colorado	341	500
KFKB	Milford, Kansas (day)	265	5000
KFKU	Lawrence, Kansas	246	1000
KFKX	Chicago, Illinois	294	5000
KFKZ	Kirksville, Missouri	250	50
KFLV	Rockford, Illinois	213	500
KFLX	Galveston, Texas	219	100
KFMX	Northfield, Minn.	240	1000
KFNF	Shenandoah, Iowa	337	500
KFOR	Lincoln, Nebraska	248	100
KFOX	Long Beach, Calif.	240	1000
KFPL	Dublin, Texas	229	15
KFPM	Greenville, Texas	229	15
KFPW	Siloam Springs, Ark. (day)	224	50
KFPY	Spokane, Wash.	216	500
KFQD	Anchorage, Alaska	244	100
KFQU	Holy City, Calif.	211	100
KFQW	Seattle, Wash.	211	100
KFQZ	Hollywood, Cal. (Ltd.)	353	1000
KFRC	San Francisco, Calif.	492	1000
KFRU	Columbia, Missouri	476	500
KFSD	San Diego, Calif.	500	500
KFSG	Los Angeles, Calif.	268	500
KFUL	Galveston, Texas	232	500
KFUM	Colorado Springs, Colo.	236	1000
KFUO	St. Louis, Mo.	545	500
KFUP	Denver, Colorado	229	100
KFUR	Ogden, Utah	219	50
KFVD	Venice, Calif. (Ltd.)	428	250
KFVS	Cape Girardeau, Mo.	248	100
KFWB	Los Angeles, Calif.	316	1000
KFWC	San Bernardino, Calif.	250	100
KFWF	St. Louis, Missouri	250	100
KFWI	San Francisco, Calif.	322	500
KFWM	Oakland, Calif.	322	500
KFXD	Jerome, Idaho	211	50
KFXF	Denver, Colorado	319	250
KFXJ	Edgewater, Colo.	229	50
KFXR	Oklahoma City, Okla.	229	100
KFXY	Flagstaff, Arizona	211	100
KFYO	Abilene, Texas	211	100
KFYR	Bismarck, N. D.	545	500
KGA	Spokane, Wash.	204	5000
KGAR	Tucson, Arizona	219	100
KGB	San Diego, Calif.	220	250
KGBU	Ketchikan, Alaska	333	500
KGBX	St. Joseph, Mo.	219	100
KGBZ	York, Nebraska	322	500
KGCA	Decorah, Iowa (day)	236	50
KGCB	Enid, Okla.	219	50
KGCI	San Antonio, Texas	219	100
KGCN	Concordia, Kansas	211	50
KGCR	Brookings, S. D.	248	100
KGCU	Mandan, N. D.	250	100
KGCX	Vida, Montana	211	10
KGDA	Dell Rapids, S. D.	219	15
KGDE	Fergus Falls, Minn.	250	50
KGDM	Stockton, Calif. (day)	261	50
KGDP	Pueblo, Colorado	248	10
KGDR	San Antonio, Texas	200	100
KGDY	Oldham, S. D.	250	15
KGEF	Los Angeles, Calif.	231	1000
KGEK	Yuma, Colo.	250	10
KGER	Long Beach, Calif.	219	100
KGEW	Fort Morgan, Colo.	250	100
KGEZ	Kalispell, Montana	229	100
KGFF	Alva, Oklahoma	211	100
KGFG	Oklahoma City, Okla.	219	100
KGFH	Glendale, Calif.	300	250
KGFI	San Angelo, Texas	229	100
KGFJ	Los Angeles, Calif.	211	100
KGFK	Hallock, Minnesota	250	50
KGFL	Raton, New Mexico	219	50
KGFW	Ravenna, Neb.	211	50
KGFX	Pierre, S. D. (day)	517	200
KGGF	Picher, Oklahoma	297	500
KGGH	Cedar Grove, Ind.	229	50
KGGM	Albuquerque, N. M.	219	100
KGHB	Honolulu, Hawaii	227	250
KGHD	Missoula, Mont.	211	50
KGHF	Pueblo, Colo.	227	250
KGHG	McGehee, Ark.	229	50
KGHI	Little Rock, Ark.	200	100
KGHL	Billings, Mont.	316	500
KGHX	Richmond, Texas	200	50
KGIO	Idaho Falls, Idaho	227	250
KGIQ	Twin Falls, Idaho	227	250
KGIR	Butte, Montana	220	250
KGIW	Trinidad, Colo.	211	100
KGJF	Little Rock, Ark.	337	250
KGKB	Brownwood, Texas	200	100
KGKL	San Angelo, Texas	210	100
KGKO	Wichita Falls, Texas	526	250
KGKX	Sandpoint, Idaho	211	15
KGO	Oakland, Calif.	380	10000
KGRC	San Antonio, Texas	219	100
KGRS	Amarillo, Texas	213	1000
KGTT	San Francisco, Calif.	211	500
KGU	Honolulu, Hawaii	319	500
KGW	Portland, Oregon	484	1000
KGY	Lacey, Washington	250	10
KHJ	Los Angeles, Calif.	333	1000
KHQ	Spokane, Wash.	508	1000
KICK	Red Oak, Iowa	211	100
KIDO	Boise, Idaho	240	1000
KJBS	San Francisco, Cal (day)	273	100
KJR	Seattle, Wash.	309	5000
KKP	Seattle, Wash.	219	15
KLCN	Blytheville, Ark. (day)	232	50
KLDS	Independence, Mo. (Ltd)	316	500
KLRA	Little Rock, Ark.	216	1000
KLS	Oakland, Calif. (day)	208	250
KLX	Oakland, Calif.	341	500
KLZ	Denver, Colo.	535	1000
KMA	Shenandoah, Iowa	322	500
KMBC	See KLDS		
KMED	Medford, Oregon	229	50
KMIC	Inglewood, Calif.	268	500
KMJ	Fresno, Calif.	250	100
KMMJ	Clay Center, Neb. (day)	405	1000
KMO	Tacoma, Wash.	224	500
KMOX	St. Louis, Mo.	275	25000
KMTR	Hollywood, Calif.	526	1000
KNX	Los Angeles, Calif.	286	5000
KOA	Denver, Colo.	361	12500
KOAC	Corvallis, Oregon	535	1000
KOB	State College, N. Mex.	254	10000
KOCW	Chickasha, Okla.	211	100
KOH	Reno, Nevada	219	100
KOIL	Council Bluffs, Iowa	238	1000
KOIN	Portland, Oregon	319	1000
KOL	Seattle, Wash.	236	1000
KOMO	Seattle, Wash.	326	1000
KOOS	Marshfield, Oregon	219	50
KORE	Eugene, Oregon	211	100
KOW	Denver, Colo.	216	500
KPCB	Seattle, Wash.	248	100
KPFW	Westminster, Cal.	201	25000
KPJM	Prescott, Arizona	200	100
KPLA	Los Angeles, Calif.	526	1000
KPO	San Francisco, Calif.	441	5000
KPOF	Denver, Colo.	341	500
KPPC	Pasadena, Calif.	250	50
KPQ	Seattle, Wash.	248	100
KPRC	Houston, Texas	326	1000
KPSN	Pasadena, Calif.	316	1000
KQV	Pittsburgh, Pa.	217	500
KQW	San Jose, Calif.	297	500
KRE	Berkeley, Calif.	219	100
KRGV	Harlingen, Texas	238	500
KRLD	Dallas, Texas	288	10000
KRMD	Shreveport, La.	229	50
KRSC	Seattle, Wash. (day)	268	50
KSAC	Manhattan, Kans.	517	500
KSBA	Shreveport, La.	207	1000
KSCJ	Sioux City, Iowa	225	1000
KSD	St. Louis, Mo.	545	500
KSEI	Pocatello, Idaho	333	250
KSL	Salt Lake City, Utah	265	5000
KSMR	Santa Maria, Calif.	250	100
KSO	Clarinda, Iowa	217	1000
KSOO	Sioux Falls, S. D. (day)	270	1000
KSTP	St. Paul, Minn.	265	10000
KTAB	Oakland, Calif.	545	500
KTAP	San Antonio, Texas	211	100
KTAT	Fort Worth, Texas	242	1000
KTBI	Los Angeles, Calif.	231	1000
KTBR	Portland, Oregon	231	500
KTHS	Hot Springs, Ark.	375	10000
KTM	Santa Monica, Calif.	428	500
KTNT	Muscatine, Iowa (day)	256	5000
KTSA	San Antonio, Texas	232	1000
KTUE	Houston, Texas	211	5
KTW	Seattle, Wash.	236	1000
KUJ	Seattle, Wash.	200	10
KUOA	Fayetteville, Ark.	216	1000
KUOM	Missoula, Mont.	526	500
KUSD	Vermillion, S. D.	337	500
KUT	Austin, Texas	268	500
KVI	Tacoma, Wash.	224	1000
KVL	Seattle, Wash.	219	100
KVOO	Tulsa, Okla.	263	5000
KVOS	Bellingham, Wash.	250	100
KWBS	Portland, Oregon	200	15
KWCR	Cedar Rapids, Iowa	229	100
KWEA	Shreveport, La.	248	100
KWG	Stockton, Calif.	250	100
KWJJ	Portland, Ore. (Ltd.)	283	500
KWK	St. Louis, Mo.	222	1000
KWKC	Kansas City, Mo.	219	100
KWKH	Shreveport, La.	353	20000
KWLC	Decorah, Iowa (day)	236	50
KWSC	Pullman, Wash.	216	500
KWTC	Santa Ana, Calif.	200	100
KWWG	Brownsville, Texas	238	500
KYA	Seattle, Wash.	526	500
KXL	Portland, Oregon	240	500
KXO	El Centro, Calif.	250	100
KXRO	Aberdeen, Wash.	211	75
KYA	San Francisco, Calif.	244	1000
KYW	and KYWA See KFKX		
KZM	Oakland, Calif.	210	100
NAA	Arlington, Va.	434	1000
WAAD	Cincinnati, Ohio	211	25
WAAF	Chicago, Ill. (day)	326	500
WAAM	Newark, N. J.	240	250
WAAT	Jersey City, N. J. (day)	280	300
WAAW	Omaha, Neb. (day)	454	500
WABC	New York City	349	5000
WABE	Kingston, Pa.	208	250
WABI	Bangor, Maine	250	100
WABO	Rochester, N. Y.	208	500
WABY	Philadelphia, Pa.	220	50
WABZ	New Orleans, La.	250	100
WADC	Akron, Ohio	297	1000
WADP	Detroit, Mich.	200	100
WAGM	Royal Oak, Mich.	220	50
WAIU	Columbus, Ohio (Ltd.)	468	5000
WAIK	Willow Grove, Pa.	200	50
WAPI	Auburn, Ala.	283	5000
WASH	Grand Rapids, Mich.	236	250
WBAA	West Lafayette, Ind.	214	500
WBAK	Harrisburg, Pa. (day)	210	500
WBAL	Baltimore, Md.	283	10000
WBAP	Fort Worth, Texas	375	25000
WBAW	Nashville, Tenn.	201	5000
WBAX	Wilkes-Barre, Pa.	248	100
WBBC	Brooklyn, N. Y. City	214	250
WBBL	Richmond, Va.	219	100
WBBM	Chicago, Ill.	389	25000
WBBR	Rossville, N. Y. City	231	1000
WBBW	Norfolk, Va.	250	100
WBBY	Charleston, S. C.	250	75
WBBZ	Ponca City, Okla.	250	100
WBCM	Bay City, Mich.	213	500
WBCN	See WENR		
WBET	Boston, Mass.	220	500
WBIS	Boston, Mass.	244	500
WBMH	Detroit, Mich.	229	100
WBMS	Fort Lee, N. J.	207	250
WBNY	New York City	222	250
WBOQ	See WABC		
WBOW	Terre Haute, Ind.	229	100
WBRC	Birmingham, Ala.	322	500
WBRE	Wilkes-Barre, Pa.	229	100
WBRL	Tilton, N. H.	210	500
WBSO	Wellesley Hills, Mass. (Time limited)	384	250
WBT	Charlotte, N. C.	278	10000
WBZ	Springfield, Mass.	303	5000
WBZA	Boston, Mass.	303	5000
WCAC	Storrs, Conn.	500	250
WCAD	Canton, N. Y. (day)	246	500
WCAE	Pittsburgh, Pa.	246	500
WCAH	Columbus, Ohio	210	250
WCAJ	Lincoln, Neb.	508	500
WCAL	Northfield, Minn.	240	1000
WCAM	Camden, N. J.	234	500
WCAO	Baltimore, Md.	500	250
WCAP	Asbury Park, N. J.	234	500
WCAT	Rapid City, S. D.	250	100
WCAU	Philadelphia, Pa.	256	5000
WCAX	Burlington, Vt.	250	100
WCAZ	Carthage, Ill. (day)	280	100
WCBA	Allentown, Pa.	208	250
WCBD	Zion, Illinois (day)	278	5000
WCBM	Baltimore, Md.	219	100
WCBS	Springfield, Ill.	248	100
WCCO	Minneapolis, Minn.	370	15000
WCDA	New York City	222	250
WCFL	Chicago, Ill. (Ltd.)	309	25000
WCGU	Brooklyn, N. Y. City	214	500
WCLB	Brooklyn, N. Y. City	200	100
WCLO	Kenosha, Wis.	250	100
WCLS	Joliet, Ill.	229	100
WCMA	Culver, Ind.	214	500
WCOA	Pensacola, Fla.	268	500
WCOC	Columbus, Miss.	341	500
WCOH	Greenville, N. Y.	248	100
WCRW	Chicago, Ill.	248	100
WCSH	Portland, Maine	319	500
WCSO	Springfield, Ohio	217	500
WCX	See WJR		
WDAE	Tampa, Fla.	484	1000
WDAF	Kansas City, Mo.	492	1000
WDAG	Amarillo, Texas	213	1000
WDAH	El Paso, Texas	229	100
WDAY	Fargo, N. D.	234	1000
WDBJ	Roanoke, Va.	322	250
WDBO	Orlando, Fla.	484	1000
WDEL	Wilmington, Del.	268	250
WDGY	Minneapolis, Minn.	216	500
WDOD	Chattanooga, Tenn.	234	1000
WDRC	New Haven, Conn.	225	500
WDSU	New Orleans, La.	238	1000
WDWF	Cranston, R. I.	248	100
WDZ	Tuscola, Illinois	280	100
WEAF	New York City	454	25000
WEAI	Ithaca, N. Y. (day)	236	1000
WEAM	Plainfield, N. J.	219	100
WEAN	Providence, R. I. (day)	545	500
WEAO	Columbus, Ohio	545	750
WEAR	See WTAM		
WEBC	Superior, Wis.	234	1000
WEBE	Cambridge, Ohio	248	10
WEBG	Harrisburg, Ill.	248	50
WEBR	Buffalo, N. Y.	229	100
WEBW	Beloit, Wis. (day)	500	250
WEBC	Chicago, Ill.	248	100
WEBH	Erie, Pa.	211	30
WEEI	Boston, Mass.	508	500
WEHS	Evanston, Ill.	220	100
WELK	Philadelphia, Pa.	219	100
WEMC	Berrien Springs, Mich.	508	1000
WENR	Chicago, Ill.	345	25000
WEPS	Gloucester, Mass.	250	100
WEVD	New York City	231	500
WEW	St. Louis, Mo. (day)	385	1000
WFAA	Dallas, Texas	288	25000
WFAN	Philadelphia, Pa.	462	500
WFBC	Knoxville, Tenn.	250	50
WFBE	Cincinnati, Ohio	250	100
WFBG	Altoona, Pa.	229	100
WFBI	Collegeville, Minn.	210	100
WFBL	Syracuse, N. Y. (temporarily 201 meters, 1000 watts)	333	750
WFBM	Indianapolis Ind. (Ltd) (also 286 meters, 1000 watts, limited time)	244	500
WFBR	Baltimore, Md. (temp.)	236	250
WFBF	Pine Bluff, Ark.	299	100
WFI	Philadelphia, Pa.	535	500
WFIW	Hookinsville, Ky.	310	1000
WFJA	Akron, Ohio	207	500
WFKD	Philadelphia, Pa.	229	50
WFLA	See WSUN		
WGAL	Lancaster, Pa.	299	15
WGBB	Freeport, N. Y.	248	100
WGBC	Memphis, Tenn.	210	500
WGBF	Evansville, Ind.	476	500
WGBI	Scranton, Pa.	341	250
WGBS	New York City (Ltd.)	254	500
WGCM	Gulfport, Miss.	248	100
WGCP	Newark, N. J.	240	250
WGES	Chicago, Ill.	220	500
WGH	Newport News, Va.	229	100
WGHP	Mt. Clemens Mich.	242	750
WGL	Fort Wayne, Ind.	244	500
WGMS	See WLB		
WGN	Chicago, Ill.	416	25000
WGR	Buffalo, N. Y.	545	1000
WGST	Atlanta, Ga.	337	250
WGY	Schenectady, N. Y.	380	50000
WHA	Madison, Wis.	526	750
WHAD	Milwaukee, Wis. (day)	268	250
WHAM	Rochester, N. Y.	261	5000
WHAP	New York City	231	1000
WHAS	Louisville, Ky.	366	5000
WHAZ	Troy, N. Y.	231	500
WHB	Kansas City, Mo.	316	500
WHBC	Canton, Ohio	250	10
WHBD	Bellefontaine, Ohio	219	100
WHBF	Rock Island, Ill.	248	100
WHBL	Sheboygan, Wis.	213	500
WHBP	Johnstown, Pa.	229	100
WHBQ	Memphis, Tenn.	219	100
WHBU	Anderson, Indiana	248	100
WHBW	Philadelphia, Pa.	200	100
WHBY	West De Pere, Wis.	250	100
WHDF	Calumet, Mich.	219	100
WHDI	Minneapolis, Minn.	216	500
WHDL	Tupper Lake, N. Y.	211	10
WHEC	See WABO		
WHFC	Chicago, Ill.	229	100
WHK	Cleveland, Ohio	216	1000
WHN	New York City	297	250
WHO	Des Moines, Iowa	300	5000
WHOH	Gloucester, Mass. (day)	219	1000
WHPP	New York City	211	10
WHT	Chicago, Ill.	203	5000
WIAS	Ottumwa, Iowa (day)	211	100
WIBA	Madison, Wis.	248	100
WIBG	Elkins Park, Pa. (Sun.)	322	50
WIBM	Jackson, Mich.	219	100
WIBO	Chicago, Ill.	526	5000
WIBR	Steubenville, Ohio	211	50
WIBS	Elizabeth, N. J.	207	250
WIBU	Poynette, Wis.	229	100
WIBW	Topeka, Kans.	231	1000
WIBX	Utica, N. Y.	250	100
WIBZ	Montgomery, Ala.	200	15
WICC	Bridgeport, Conn.	252	500
WIL	St. Louis, Mo.	211	100
WILL	Urbana, Ill.	337	250
WINR	Bay Shore, N. Y.	248	100
WIOD	Miami Beach, Fla.	242	1000
WIP	Philadelphia, Pa.	492	500
WISN	Milwaukee, Wis.	268	250
WJAD	Waco, Texas	242	1000
WJAG	Norfolk, Neb. (day)	283	1000
WJAK	Kokomo, Ind.	229	50
WJAR	Providence, R. I.	337	250
WJAS	Pittsburgh, Pa.	232	1000
WJAX	Jacksonville, Fla.	238	1000
WJAY	Cleveland, Ohio	207	500
WJAZ	Chicago, Ill.	203	5000
WJBC	LaSalle, Ill.	250	100
WJBI	Red Bank, N. J.	248	100
WJBK	Ypsilanti, Mich.	219	50
WJBL	Decatur, Ill.	250	100
WJBO	New Orleans, La.	219	100
WJBT	See WBBM		
WJBU	Lewisburg, Pa.	248	100
WJBW	New Orleans, La.	250	30
WJBY	Gadsden, Ala.	248	50
WJJD	Mooseheart, Ill. (Ltd.)	254	20000
WJKS	Gary, Ind.	220	500
WJR	Detroit, Mich.	400	5000
WJSV	Washington, D. C.	205	10000
WJZ	New York City	395	25000
WKAQ	San Juan, Porto Rico	337	500
WKAR	East Lansing, Mich. (day)	288	500
WKAV	Laconia, N. H.	229	100
WKBB	Joliet, Ill.	229	100
WKBC	Birmingham, Ala.	229	10
WKBE	Webster, Mass.	250	100
WKBF	Indianapolis, Ind.	214	500
WKBH	La Crosse, Wis.	217	1000
WKBI	Chicago, Ill.	229	50
WKBN	Youngstown, Ohio	526	500
WKBO	Jersey City, N. J.	207	250
WKBP	Battle Creek, Mich.	211	50
WKBQ	New York City	222	250
WKBS	Galesburg, Ill.	229	100
WKBV	Brookville, Ind.	200	100
WKBW	Buffalo, N. Y.	204	5000
WKBZ	Ludington, Mich.	200	50
WKEN	Buffalo, N. Y. (Ltd.)	288	1000
WKJC	Lancaster, Pa.	250	100
WKRC	Cincinnati, Ohio	545	500
WKY	Oklahoma City, Okla.	333	1000
WLAC	Nashville, Tenn.	201	5000
WLAP	Louisville, Ky.	250	30
WLB	Minneapolis, Minn.	240	1000
WLBC	Muncie, Ind.	229	50
WLBF	Kansas City, Mo.	211	100
WLBG	Petersburg, Va.	250	100
WLBH	Farmingdale, N. Y.	211	30
WLBL	Stevens Point, Wis. (day)	333	2000
WLBO	Galesburg, Ill.	229	100
WLBV	Mansfield, Ohio	248	100
WLBW	Oil City, Pa.	238	500
WLBX	Long Island City N. Y.	200	100
WLBZ	Dover-Foxcroft, Me.	484	250
WLCI	Ithaca, N. Y.	248	50
WLEX	Lexington, Mass.	211	100
WLIB	See WGN		
WLIT	Philadelphia, Pa.	535	500
WLOE	Chelsea, Mass.	200	100
WLS	Chicago, Ill.	345	5000
WLSI	See WDWF		
WLTH	Brooklyn, N. Y.	214	500
WLW	Cincinnati, Ohio	428	25000
WLWL	New York City	273	5000
WMAC	Cazenovia, N. Y.	526	500
WMAF	So. Dartmouth, Mass.	220	500
WMAK	Buffalo, N. Y.	333	750
WMAL	Washington, D. C.	476	250
WMAN	Columbus, Ohio	248	50
WMAQ	Chicago, Ill.	447	5000
WMAV	St. Louis, Mo.	250	100
WMAZ	Macon, Ga.	250	250
WMBA	Newport, R. I.	200	100
WMBB	Detroit, Mich.	211	100
WMBD	Peoria, Ill.	208	500
WMBF	Miami Beach, Fla.	535	500
WMBG	Richmond, Va.	248	100
WMBH	Joplin, Mo.	211	100

THIS list of stations in the United States operating under licenses issued by the Federal Radio Commission is corrected to January 11, 1929. Powers shown are the night strength, or minimum.

Radio Call Letters	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
WMBI	Chicago, Ill. (day)	278	5000
WMBJ	Wilkinsburg, Penna.	200	100
WMBL	Lakeland, Fla.	229	100
WMBM	Memphis, Tenn.	200	10
WMBO	Auburn, N. Y.	219	100
WMBQ	Brooklyn, N. Y.	200	100
WMBR	Tampa, Fla.	248	100
WMBS	Harrisburg, Pa.	210	500
WMC	Memphis, Tenn.	384	500
WMCA	New York City	526	500
WMES	Boston, Mass.	200	50
WMMN	Fairmont, W. Va.	337	250
WMPC	Lapeer, Mich.	200	30
WMRJ	Jamaica, N. Y. City	211	10
WMSG	New York City	222	250
WMT	Waterloo, Iowa	250	100
WNAC	See WBIS		
WNAD	Norman, Okla.	297	500
WNAT	Philadelphia, Pa.	229	100
WNAX	Yankton, S. D.	526	1000
WNBF	Binghamton, N. Y.	200	50
WNBH	New Bedford, Mass.	229	100
WNBJ	Knoxville, Tenn.	229	50
WNBO	Washington, Pa.	250	15
WNBQ	Rochester, N. Y.	200	15
WNBR	Memphis, Tenn.	210	500
WNBW	Carbondale, Pa.	250	5
WNBX	Springfield, Vt.	250	10
WNBZ	Saranac Lake, N. Y. (day)	232	10
WNJ	Newark, N. J.	207	250
WNOX	Knoxville, Tenn.	535	1000
WNRC	Greensboro, N. C.	208	500
WNYC	New York City	526	500
WOAI	San Antonio, Texas	252	5000
WOAN	Lawrenceburg, Tenn.	500	500
WOAX	Trenton, N. J.	234	500
WOBT	Union City, Tenn.	229	15
WOBU	Charleston, W. Va.	517	250
WOC	Davenport, Iowa	300	5000
WOCL	Jamestown, N. Y.	248	25
WODA	Paterson, N. J.	240	1000
WOI	Ames, Iowa (day)	535	3500
WOKO	Peekskill, N. Y.	208	500
WOL	Washington, D.C. (day)	229	100
WOMT	Manitowoc, Wis.	248	100
WOO	Philadelphia, Pa.	200	100
WOOD	Grand Rapids, Mich.	236	500
WOQ	Kansas City, Mo.	492	1000
WOR	Newark, N. J.	422	5000
WORD	Chicago, Ill.	203	5000
WOS	Jefferson City, Mo.	476	500
WOV	New York City (day)	265	1000
WOW	Omaha, Neb.	508	1000
WOWO	Fort Wayne, Ind.	258	10000
WPAP	New York City	297	250
WPAW	Pawtucket, R. I.	248	100
WPCC	Chicago, Ill.	526	500
WPCH	New York City (day)	370	500
WPG	Atlantic City, N. J.	273	5000
WPOR	See WTAR		
WPRC	Harrisburg, Pa.	250	100
WPSC	State College, Pa. (day)	244	500
WPSW	Philadelphia, Pa.	200	50
WPTF	Raleigh, N. C.	441	10000
WQAM	Miami, Florida	242	750
WQAN	Scranton, Pa.	341	250
WQAO	See WPAP		
WQBC	Utica, Miss.	220	300
WQBJ	Clarksburg, W. Va.	250	65
WQBZ	Weirton, W. Va.	211	60
WRAF	LaPorte, Ind.	250	100
WRAK	Erie, Pa.	219	50
WRAW	Reading, Pa.	229	100
WRAX	Philadelphia, Pa. (day)	246	250
WRBC	Valparaiso, Ind. (day)	242	500
WRBI	Tifton, Ga.	229	20
WRBJ	Hattiesburg, Miss.	200	10
WRBL	Columbus, Ga.	250	50
WRBQ	Greenville, Miss.	248	100
WRBT	Wilmington, N. C.	219	50
WRBU	Gastonia, N. C.	248	100
WRBW	Columbia, S. C.	229	15
WRC	Washington, D.C.	316	500
WREC	Memphis, Tenn	500	500
WREN	Lawrence, Kansas	246	1000
WRHM	Minneapolis, Minn.	240	1000
WRJN	Racine, Wis.	219	100
WRK	Hamilton, Ohio	229	100
WRNY	New York City	297	250
WRR	Dallas, Texas	284	5000
WRUF	Gainesville, Fla.	204	5000
WRVA	Richmond, Va.	270	5000
WSAI	Cincinnati, Ohio (Ltd.)	375	5000
WSAJ	Grove City, Pa.	229	100
WSAN	Allentown, Pa.	208	250
WSAR	Portsmouth, R. I.	207	250
WSAZ	Huntington, W. Va.	517	250
WSB	Atlanta, Ga.	405	10000
WSBC	Chicago, Ill.	248	100
WSBT	South Bend, Ind.	244	500
WSDA	Brooklyn, N. Y.	214	500
WSEA	Norfolk, Va.	384	500
WSGH	See WSDA		
WSIS	Sarasota, Fla.	297	250
WSIX	Springfield, Tenn.	248	100
WSM	Nashville, Tenn.	461	5000
WSMB	New Orleans, La.	227	750
WSMD	Salisbury, Md.	229	100
WSMK	Dayton, Ohio	526	200
WSPD	Toledo, Ohio	224	500
WSRO	Middletown, Ohio	211	100
WSSH	Boston, Mass.	211	100
WSUI	Iowa City, Iowa	517	500
WSUN	St. Petersburg, Fla.	333	1000
WSVS	Buffalo, N. Y.	219	50
WSYR	Syracuse, N. Y.	526	250
WTAD	Quincy, Ill.	208	500
WTAG	Worcester, Mass.	517	250
WTAM	Cleveland, Ohio	280	3500
WTAQ	Washington., Wis.	225	1000
WTAR	Norfolk, Va.	384	500
WTAW	College Station, Tex.	268	500
WTAX	Streator, Ill.	248	50
WTAZ	Richmond, Va.	248	15
WTBO	Cumberland, Md.	211	50
WTBQ	Wilmington, Del.	200	100
WTFI	Toccoa Falls, Ga.	207	500
WTHS	Atlanta, Ga.	229	100
WTIC	Hartford, Conn. Permit 283 meters. 50,000 watts.	500	250
WTMJ	Milwaukee, Wis.	484	1000
WWAE	Chicago, Ill.	250	100
WWJ	Detroit, Mich.	326	1000
WWL	New Orleans, La.	353	5000
WWNC	Asheville, N. C.	526	1000
WWRL	Woodside, N. Y.	200	100
WWVA	Wheeling, W. Va.	258	5000

LIST OF CANADIAN BROADCAST CALLS

CFAC	Calgary, Alta.	434	500
CFBO	St. John, N. B.	337	50
CFCA	Toronto, Ont.	357	500
CFCF	Montreal, Que.	411	1650
CFCH	Iroquois Falls, Ont.	500	250
CFCL	See CKCL		
CFCN	Calgary, Alta.	434	1800
CFCO	Chatham, Ont.	248	25
CFCT	Victoria, B. C.	476	500
CFCY	Charlottetown, P. E. I.	312	100
CFJC	Kamloops, B. C.	268	15
CFLC	Prescott, Ontario	297	50
CFMC	Kingston, Ont.	268	20
CFNB	Fredericton, N. B.	248	50
CFQC	Saskatoon, Sask.	329	500
CFRB	Toronto, Ont.	312	1000
CFRC	Kingston, Ont.	268	500
CHCA	See CJCJ		
CHCK	Charlottetown, P. E. I.	312	30
CHCS	Hamilton, Ont.	341	10
CHCT	See CKLC		
CHGS	Summerside, P. E. I.	268	25
CHLS	See CKCD		
CHMA	Edmonton, Alta.	517	250
CHML	Mount Hamilton, Ont.	341	50
CHNC	See CKNC		
CHNS	Halifax, N. S.	322	500
CHRC	Quebec, Quebec	341	5
CHWC	Regina, Sask.	312	15
CHWK	Chilliwack, B. C.	248	5
CJBC	(Uses several Toronto stations). 517, 357 or	312	
CJBR	See CKCK		
CJCA	Edmonton, Alta.	517	500
CJCJ	Calgary, Alta.	434	250
CJGC	London, Ont.	329	500
CJGX	Yorkton, Sask.	476	500
CJHS	Saskatoon, Sask.	329	250
CJOC	Lethbridge, Alta.	268	50
CJOR	Sea Island, B. C.	291	50
CJRM	Moose Jaw, Sask.	297	500
CJRW	Fleming, Sask.	297	500
CJSC	See CKCL		
CKAC	Montreal, Que.	411	1200
CKCD	Vancouver, B. C.	411	50
CKCI	Quebec, Que.	341	23
CKCK	Regina, Sask.	312	500
CKCL	Toronto, Ont.	517	500
CKCO	Ottawa, Ont.	434	100
CKCR	Brantford, Ont.	297	50
CKCV	Quebec, Que.	341	50
CKFC	Vancouver, B. C.	411	50
CKGW	Bowmanville, Ont.	312	5000
CKLC	Red Deer, Alberta	357	1000
CKMC	Cobalt, Ont.	248	15
CKMO	Vancouver, B.C.	411	50
CKNC	Toronto, Ont.	517	500
CKOC	Hamilton, Ont.	341	100
CKOW	See CFCA		
CKPC	Preston, Ont.	248	25
CKPR	Midland, Ont.	268	50
CKSH	St. Hyacinthe, Que.	297	50
CKUA	Edmonton, Alta.	517	500
CKWX	Vancouver, B. C.	411	100
CKX	Brandon, Man.	556	500
CKY	Winnipeg, Man.	384	5000
CNRA	Moncton, N. B.	476	500
CNRC	See CFAC		
CNRE	See CJCA		
CNRM	See CHYC, CKAC, or CFCF		
CNRO	Ottawa, Ont.	434	500
CNRQ	See CKCV		
CNRR	See CKCK		
CNRS	See CFQC		
CNRT	See CFCA		
CNRV	Vancouver, B. C.	291	500
CNRW	See CKY		
VAS	Louisburg, Nova Scotia	434	

LIST OF SHORT-WAVE STATIONS OF THE WORLD

(Some calls may have been altered under new international regulations.)

Radio Call Letters	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
	AFRICA		
AIN	Casablanca, Morocco	51.00	
8KR	Constantine, Tunis	42.80	
JB	Johannesburg, U. S. Africa	32.00	
7LO	Nairobi, Kenya	33 50	2,000
	AUSTRALIA		
2BL	Sydney	32.50	
2FC	Sydney	28.50	
2ME	Sydney	28.50	
3AR	Melbourne	55.00	
3LO	Melbourne	32.00	
6AG	Perth, West Australia	32.90	
6WF	Perth	104.50	
	AUSTRIA		
DHK2	Vienna	70.00	
EATH	Vienna	37.00	
	Vienna	22.20	
	BELGIUM		
EB4A2	Brussels	42.00	300
	CANADA		
CF	Drummondville, Quebec	32.00	
CJRX	Winnipeg, Man.	25.60	2,000
VAS	Louisburg, N. S.	28.00	
	COSTA RICA		
NRH	Heredia	30.30	7½
	DANTZIG		
EK4ZZZ	Dantzig	40.00	
	DENMARK		
D7MK	Copenhagen	32.05	500
D7RL	Copenhagen	42.12 and 84.24	250
	ENGLAND		
SSW	Chelmsford	24.30	15,000
2NM	Caterham	32.50	
GBS	Rugby	24.40	
	FINLAND		
	Helsingfors (Helsinki)	31.50	
	FRANCE		
F8GC	Paris ("Radio LL")	61.00	500
F8AV	Nogent	80.00	500
Radio Vitus	Paris	37.00	1,500
Eiffel Tower	Paris (time signals)	32.50	
YR	Lyons ("Radio Lyon")	40.20	250
	Agen	30.75	
YN	Lyons	58.00	3,000
	Nancy	15.50	500
FW4	Ste. Assise	24.50	
	GERMANY		
AFI	Konigswusterhausen	14.00	
AFL	Hamburg	70.00 and 52.00	
AFT	Konigswusterhausen	14.00	
AFU	Konigswusterhausen	14.00	
AFK	Berlin (Doberitz)	37.56	75.36
HEA	Nauen	11.00	
AGC	Berlin	17.20	
AGJ	Nauen	56.70	
AGK	Nauen	11.00	
LA	Langenberg	43.90	
POF	Nauen	11.00	
POZ	Nauen	18.10	
	Stuttgart	41.00	
	HOLLAND		
PCJJ	Eindhoven	31.4	30.000
PCKK	Kootwijk	16.00	
PCLL	Kootwijk	18.00	32,000
PCMM	Ymuiden	46.50	
PCPP	Kootwijk	16.50	
PCRR	Kootwijk	37.00	
PCTT	Kootwijk	21.00	
PCUU	The Hague	37.00	
	ITALY		
IIAX	Rome	20 00. 40.00	300
IAY	Placenza	20.00, 45.00	50

THIS list of the short-wave broadcast stations throughout the world is not complete, although we have endeavored to list every station of whom we have heard reports; since in many cases reliable information about the programs, wavelength and power of the stations cannot even be obtained from the stations themselves. (See page 844.)

	JAPAN		
JFAB	Taipeh, Formosa	39.50	
JHBB	Ibarakiken (Hirasio)	37.50	2,000
JIPP	Tokio	20.00	
JKZB	Tokio	20.00	
JOAK	Tokio 30.00, 60.00, 35.00.	70.00	500
JAA	Iwatsuki	40.00	
	JAVA		
ANE	Bandoeng	15.93	
	MEXICO		
XC51	Mexico City	44.00	
	MOROCCO		
AIN	Casablanca	51.00	
	NORWAY		
LCHO	Oslo	33.00	
LGN	Bergen	31.25, 30.00	
	U. S. S. R. (RUSSIA)		
RDRL	Leningrad	28.50	
RDW	Moscow	83.00	
RFM	Khabarovsk (Siberia)	70.20	12,000
RFN	Moscow	50.00	
RA19	Tomsk (Siberia)	37.00	
	SPAIN		
EAM	Madrid	30.70	
EAR55	Barcelona		
	SWEDEN		
SAS	Karlsborg	52.50	
SAA	Karlskrona	44.40	
	Motala	41.45	1,000
SAJ	Karlsborg	47.00	
SMHA	Stockholm	41.00	
	SWITZERLAND		
H9OC	Berne	32.00	
H9XD	Zurich	85.00 and 32.00	
	UNITED STATES		
KDKA (W8XK)	East Pittsburgh, Pa.	62.50	40,000
	(W8XS, W8XP-portable)	42.75	
		25.40	
KEJK (W6XAN)	Los Angeles, Calif.	105.90	250
KEWE	Bolinas, Calif.	14.10	
KFPY (W7XAB)	Spokane, Washington	105.90	100
KFQU (W6XBH)	Holy City, Calif.	31.00	50
KFQZ (W6XAL)	Hollywood, Calif.	108.20	50
KFVD (W6XBX)	Culver City, Calif.	105.00	50
KFWB (W6XBR)	Los Angeles, Calif.	105.00	50
		40.00	
KFWO (W6XAD)	Avalon, Calif.	53.07	100
KGER (W6XBV)	Long Beach, Calif.	48.86	
KGB	San Diego, Calif.	65.18	
KGDE	Barrett, Minn.	40.00	50
KGO (W6XAX, W6XN)	San Francisco, Calif.	10 to 40	10,000
KHJ (W6XAU)	Los Angeles, Calif.	104.10	50
KJBS (W6XAR)	San Francisco, Calif.	61.00	50
KJR (W7XC, W7XD)	Seattle, Washington	105.20	250
KMOX	St. Louis, Mo.	49.00	15
KMTR	Los Angeles, Calif.	108.20	250
KNRC (W6XAF)	Santa Monica, Calif.	108.20	100
KNX (W6XA)	Los Angeles, Calif.	107.10	100
KOIL (W9XU)	Council Bluffs, Iowa	61.06	500
KWE-KEWE	Bolinas, Calif.	14.10	
KWJJ (W7XAO)	Portland, Oregon	53.54	100
WAAM (W2XBA)	Newark, N. J.	65.18	50
WABC (W2XE)	Richmond Hill, N. Y.	58.50	500
WAJ	Rocky Point, N. Y.	22.48	
WBRL (W1XY)	Tilton, N. H.	109.00	250
WBZ	Springfield, Mass.	70.00	
WCFL	Chicago, Ill.	37.24	
WCGU (W2XBH)	Brooklyn, N. Y.	54.00	150
WCSH (W1XAB)	Portland, Maine	63.79	250
WCX	Pontiac, Michigan	32.00	75
WEAJ	Rocky Point, N. Y.	22.48	
WEAO (W8XJ)	Columbus, Ohio	54.02	25
WGY (W2XAF)	Schenectady, N. Y.	31.40	
(W2XAD)	Schenectady, N. Y.	21.96	
		5.00	
WHK (W8XF)	Cleveland, Ohio	66.04	500
WJR-WCX (W8XAO)	Pontiac, Michigan	32.00	
WIZ	New Brunswick, N. J.	43.45	
WJZ (W3XL)	New York, N. Y.	59.96	30.000
WLW (W8XAL)	Cincinnati, Ohio	52.02	250
WNAL (W9XAB)	Omaha, Neb.	105.00	50
WNBT	Elgin, Ill. (Time Signals)	35.50	500
WND	Ocean Township, N. J.	46.48	
WOR (W2XAQ)	Kearny, N. J.	65.40	50
WOWO	Fort Wayne, Ind.	22.80	1,000
WRNY (W2XAL)	New York, N. Y.	30.91	500
WSM (4XD)	Nashville, Tenn.	31.43	
WTFF	Mt. Vernon, Va.	56.00	

(Several short waves are used for transatlantic telephony. This is private business, not broadcasting.)

The Radio Constructor's Own Page

Wherein Custom and Home Set Builders and Experimenters All Over the World Swap Experiences and Suggestions About Hookups and Accessories

A DIRECT-COUPLED A.C. SET

Editor, RADIO NEWS:

The enclosed diagram is that of a direct-coupled radio receiver using A.C. 22-type tubes and satisfying, I believe, Mr. Sydney O'Rourke's definition of a direct-coupled radio receiver. Any method of volume control may be used; but that indicated by arrows varies the grid bias and, if the filament voltage on the R.F. tubes is adjusted correctly, works very well. Also, plate rectification is used on the detector, which requires some adjusting of plate and grid voltages for best results. Still, the conventional grid leak and condenser can be used, and will allow a reduction of 50 volts "B" supply; as the plate tap can be dropped to the same point as the last R.F. plate, since the detector grid may be isolated from the latter.

It is needless to say that all R.F. circuits must be well shielded and (while the diagram does not show this) the resistor strip used in a power unit must be well by-passed by condensers at each voltage tap. Over-all voltage is obtained from a 281 rectifier; it is necessary to by-pass considerable current to keep the resistor stable.

The first tuning unit is a modified band-pass filter, the R.F. energy is passed through a tuned circuit inductively coupled to the second tuned circuit, and this in turn to a third tuned circuit, at the filament end. The choke RFC, of 200 turns, is inserted at the lower end of the grid coil, to bias the grid and keep the R.F. energy from leaking to ground. The first two tuned circuits consist of two standard solenoid coils, mounted side by side, one-half inch from each other. The third coil is of the same construction and, if not shielded, should be mounted at right angles to the first and second and about three inches away. Each coil and its associated condenser is contained in an aluminum can.

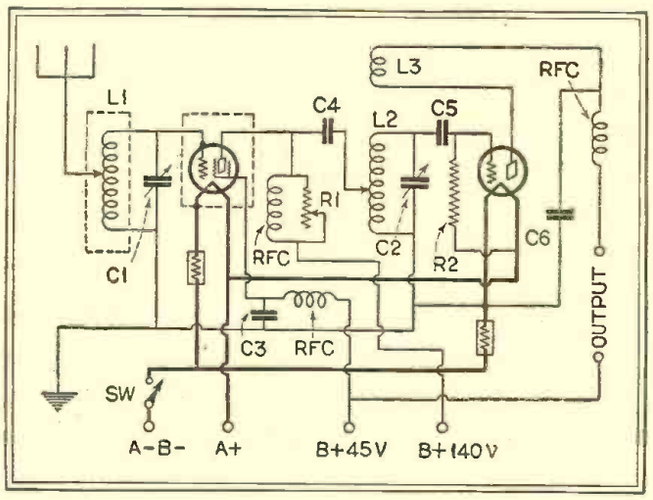
In the plate circuit of the detector and first audio, I am using two Thordarson autoformers. I am contemplating substituting two "Z" couplers between these two stages. The power resistor is the standard one supplied with an Amertran 210 power pack. The volume control is composed of two sliding contact arms connected by an insulating strip so that they slide together, altering the plate and grid bias together on the first two R.F. tubes. All plate taps are by-passed with 1-mf. condensers to "B—". From the detector on, high-voltage condensers should be used; as the voltage and current keeps increasing toward "B+550." While most of the tapped voltages are not critical, the approximate values are indicated.

All the condensers in the tuning circuits, of course, must be insulated from each other, both rotors and stators. I use individual condensers connected together by bakelite condensers and bell cranks. The selectivity is very good, and I believe this circuit will be interesting to the *advanced* experimenter.

W. M. JACOBS,

3225 Franklin Boulevard, Sacramento, Calif.

(This direct-coupling method has found some favor in England as a method of operating a receiver on 220-volt D.C. house lighting mains; it is, we believe, the device of Mr. J. F. Johnston. The special merit claimed for it is that the ripple in the voltage supply tends to balance out in each tube; the apparatus used is simple. For a receiver using the customary American number of high-voltage tubes, however, 220 volts is inadequate. Mr. Jacobs' hook-up, while it will probably not be imitated by many, will appeal to enterprising constructors by its ingenuity.—EDITOR.)



A NOVEL ANTENNA

Editor, RADIO NEWS:

Your magazine has saved me money from time to time in finding the proper accessories and equipment, as well as in suggestions from readers. I feel that I am greatly indebted to you for much valuable information and better radio reception.

Perhaps my combination ground and antenna will be of interest. I used for a core form a plain, smooth half-gallon bottle wrapped with paper, around which I wound a hundred feet of No. 14 cotton-covered armature wire; the end of which I soldered to 36 inches of lead-covered cable. I then enclosed the coil in an air-and-watertight can, about 14 inches long, made of sheet copper about the thickness of ordinary stovepipe.

I found that this made a better ground than the water pipe and greatly strengthened the signals. Then, connecting to the water pipe as a ground, I used the buried can as an "aerial" and brought in distant stations throughout the summer without static. This can is buried in moist earth—I never have to pour water around or touch it—and is nearly fifty feet away from the set.

W. A. DENT,

826 West Grace St., Richmond, Virginia.

THE "MILK SHAKER" CURDLED

Editor, RADIO NEWS:

I built your "Milk-Shaker Special" which I found unsatisfactory from a selectivity standpoint; the volume was fair, and tone quality very fine, however. By rearranging the circuit as shown herewith I increased the selectivity and volume about double that offered by the original model. Following the original diagram, L1 and L2 are wound on 2-inch forms, 90 turns of 26 D.C.C. wire; L3 is the tickler which is wound with the same wire on a similar form, adjusted once and left fixed; RFC are the radio-frequency chokes; R1 is a 500,000-ohm variable resistor for volume and oscillation control; C3 is a 1-mf. by-pass condenser; C4 a ¼-mf. by-pass condenser, and C6 a .002-mf. fixed condenser. I found no advantage in shielding the second coil.

Mr. Lowther finds this an efficient rearrangement of the "Milk-Shaker Special."

R. P. LOWTHER,

1025 Riverside Drive, South Bend, Ind.

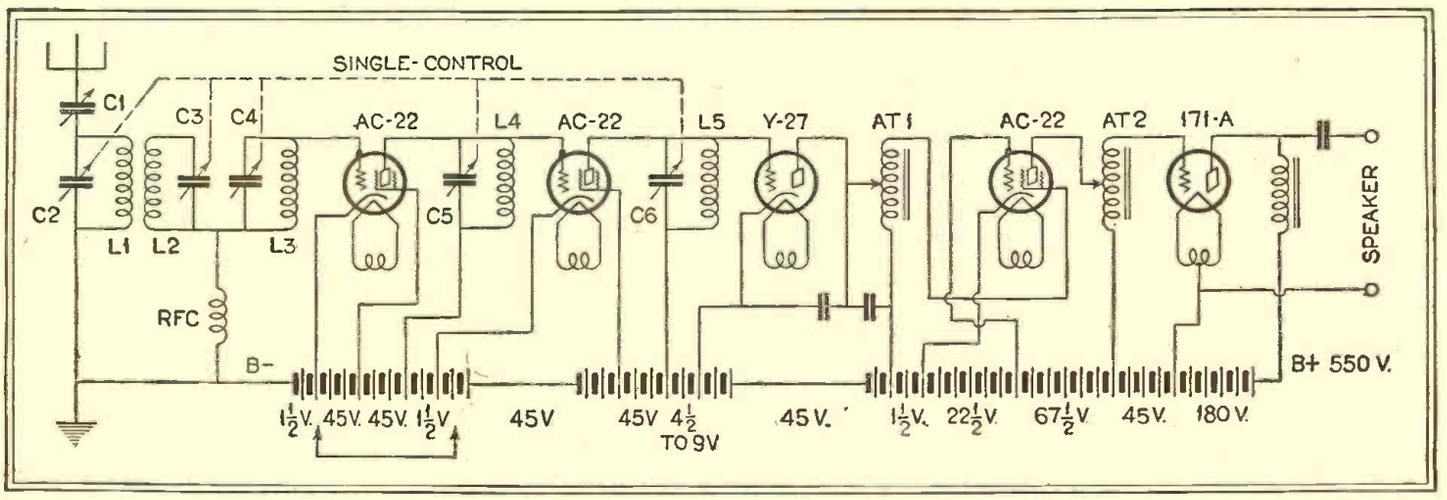
(The circuit described by Mr. Lowther is a very close adaptation of our old friend, the Browning-Drake circuit and as such, is still an excellent circuit for the constructor. As a rule, if there is local interference, it is preferable to shield the second coil.)

DISCOUNTS AND THE SET BUILDER

Editor, RADIO NEWS:

In the December Constructor's Page, Mr. Alber. E. Gleason says that the practice by parts supply

(*Continued on page* 887)



The first impression of the reader will be "what's wrong with this diagram?" However, the apparent high positive biases on the grids are not such; the progressive tapping of the battery supply (as built, a power-unit resistor) puts a bias on each cathode, more positive than on the grid; and a positive voltage on each plate, compared with the cathode. Mr. Jacobs does not state how the heaters are connected; though each should be positive compared with its cathode.

Conducted by C. W. Palmer

Important Notice to Correspondents

BECAUSE of the large influx of mail, RADIO NEWS now finds it necessary to discontinue answering free of charge, all inquiries to this department. With several hundred letters received daily by this department, the editors have been taxed so severely in answering the present mail that the magazine has begun to suffer. Hereafter, therefore, only letters accompanied by our standard fee (which, by the way, covers only the actual writing of letters and stenographic help) can be considered. Kindly note these simple rules, now in effect:

(1) Correspondents asking answers by mail must enclose 25c for each separate question. Simple radio problems will be answered, but for this nominal charge we cannot make long calculations or thorough investigations.

(2) We cannot give blueprints or layouts for commercial apparatus, or data which the manufacturers have kept secret.

(3) We cannot advise, *even confidentially*, on the respective merits of trade-marked apparatus or "what make to buy."

(4) We cannot send either replies, blueprints, books or magazines C.O.D.

(5) When in doubt, please inquire as to the cost for our services, before remitting.

(6) Be brief. Typewrite or write legibly in ink, on one side of the sheet only. *No attention can be paid to pencilled matter.*

A.C. MILK-SHAKER SPECIAL

(2329) Mr. B. G. Till, Toronto, Ont., writes:

(Q.) "I am desirous of building the "Milk-Shaker Special" receiver, described in your October, 1928 issue, but using A.C. tubes and an audio-frequency amplifier. I will appreciate it, if you advise me of the necessary changes in the circuit."

(A.) We have received a great number of requests for information about this set, and many fans would like to build it, substituting an A.C. screen-grid tube for the D.C. type specified. A few changes will be necessary in the apparatus and wiring; but these are very easy to make, and we believe that no one will encounter serious trouble in effecting these alterations.

By referring to the diagram (Fig. Q. 2329) you will see that the grid-return leads must be changed and that it is necessary to use five-prong (UY) sockets in place of the usual four-prong type. A 227-type tube is employed as the detector and, since the filament voltage required for this tube is the same as for the screen-grid tube, the two filaments can be heated from the same transformer winding. The other parts for the set should be arranged in the same manner as for the original circuit. All the parts shielded in the original should be shielded in the A.C. model also.

The grid bias for the radio-frequency amplifier must be obtained in a different manner from that used in the D.C. model, as it is not possible to use the voltage drop across the filament resistor. By connecting a resistor of correct value in the lead from the cathode to the "B—" post, the cathode will be given a positive bias with relation to the grid, which is connected directly to the negative terminal of the "B" battery. The resistor required for this purpose should have a value of 1000 ohms, to give the required voltage drop of 1½ volts at 1½ milliamperes, which is the plate current consumed by the tube. In order to provide a low-resistance path for the radio-frequency currents, a half-microfarad by-pass condenser (C7) is connected across the resistor.

The connections to the detector also are changed, to use a five-prong socket for the 227-type tube in the detector circuit. The cathodes and the by-pass condensers in all of the circuits are connected to the common terminal which serves as a ground connection and "B—" lead, *but is not connected to the filaments.* Twist all the filament wires, to prevent the hum from being excessive; and keep all of the grid and plate wires as far as possible from these filament wires, to further reduce this possibility.

Any good audio-frequency system can be employed with the set. A suitable amplifier using one stage of transformer coupling and one of push-pull, which is designed to operate from an A.C. supply with a "B" power unit, was described in the "I Want to Know" columns of the June, 1928, issue of RADIO NEWS.

REFLEX WITH REGENERATIVE DETECTOR

(2330) Mr. M. Gayman, Beamsville, Ontario, Can., asks:

(Q.) "Will you supply me with the diagram of a receiver using a stage of reflexed amplification and a regenerative detector? I have a one-tube set using a capacity-controlled regenerative detector and I would like to improve it. I believe that the reflex system would be the most suitable, as it is not practical to use many tubes here on account of the necessity of using dry batteries. I am an old reader of RADIO NEWS, and I am certainly pleased with the "new" magazine. It is a great improvement over the old system."

(A.) We are printing, as Fig. Q2330, the diagram of a set of the type that you desire. In order to obtain the best service, the radio-frequency amplifier must be neutralized or stabilized and, for this reason, a double primary coil is employed. The coil L2 which you are using in your present set will be satisfactory as a R.F. coupler if you remove the primary winding and replace it with a double winding. This is done by taking two pieces of wire of the same length and gauge and winding them together on the coil; the correct length in this case is the same that is used in the primary at present.

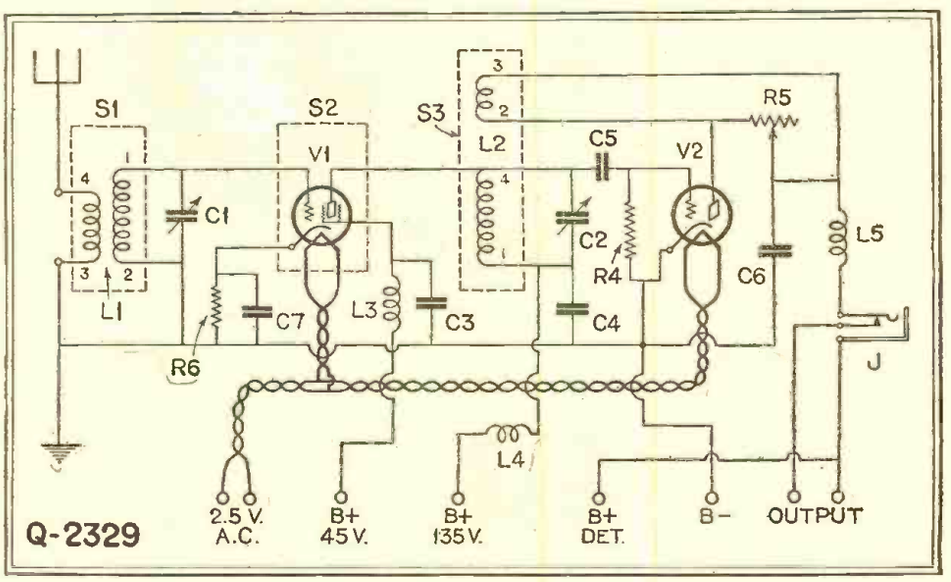
The aerial coil L1 is wound on a tube of the same size as the detector coupler and similar to it, with the same size of wire, etc. The primary is placed on the same tube, about ¼-inch away from the secondary, and contains 8 to 10 turns of wire.

The other apparatus, needed for the double-purpose amplifier, is as follows:

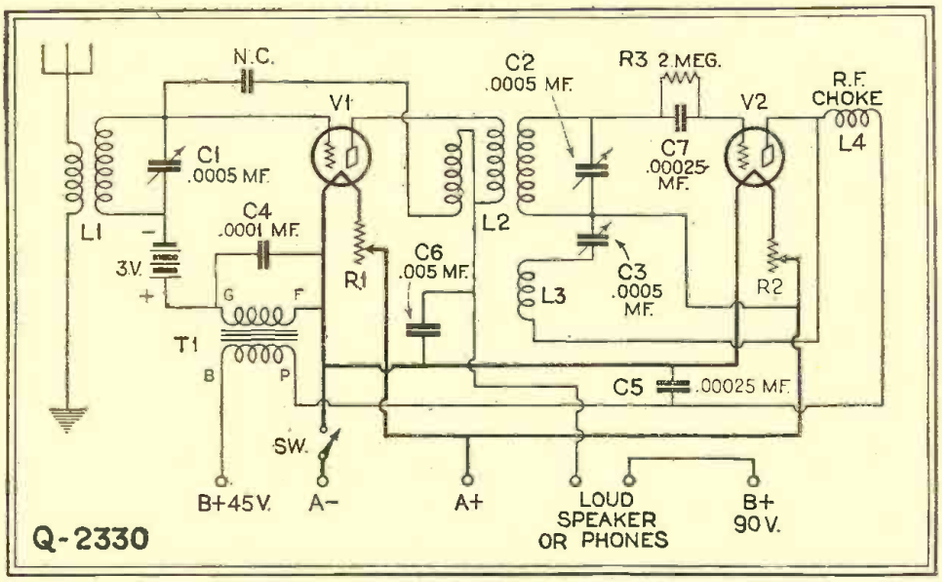
One .0005-mf. variable condenser C1;
One audio-frequency transformer (about 3:1 or 4:1 ratio) T1;
One 3-volt "C" battery (or two flashlight cells in series;
One neutralizing condenser (about 20-mmf. capacity) NC;
One dry-cell tube V1, and socket;
One .005-mf. fixed condenser C6;
One .00025-mf. fixed condenser C5;
One .0001-mf. fixed condenser C4;
One 30-ohm rheostat R1;
One radio-frequency choke (about 85 millihenries) RFC;
Binding posts, wire, etc.

Place the two coils at right angles and as far apart as possible to prevent any interaction, and keep all the grid and plate wires away from each other. If the set does not operate correctly when first tried, reverse the connections to the primary of the A.F. transformer to obtain the correct relation between the various circuits. The neutralizing condenser is adjusted until the amplifier does not oscillate; first connecting a pair of phones in the plate lead of the detector tube and turning off the rheostat in the radio-frequency amplifier. Then, adjust the neutralizing condenser until the signals fade out or are at minimum volume. The regeneration in the detector should be suppressed, so that the detector will not oscillate while adjusting the amplifier. Then remove the phones from the detector plate lead and the set is ready for operation. During the neutralizing of the amplifier, the two phone or loud-speaker binding posts should be connected together, so that the plate circuit will be complete; or the loud speaker should be left connected to these binding posts.

Diagram appears on the following page.



Here is the circuit of a "Milk-Shaker Special," using an A.C. screen-grid tube in the first stage. Several changes in the circuit will be necessary, however, from the battery model.



The reflex two-tube receiver shown here (see preceding page for description) adds one tube to a single-circuit regenerator and makes a "bloopless" circuit with R.F. and A.F. stages.

VOLTAGE-REGULATOR TUBES

(2331) Mr. N. B. Johnson, Cleveland, Ohio, writes:

(Q.) "I have a "B" power unit in which I would like to use a voltage-regulator tube. The unit has two variable output taps and a maximum tap for the power tube; the last gives about 180 volts, and the variable taps supply voltages between 20 and 150 volts. I understand that a tube of this type can be incorporated without changing the internal wiring of the power unit. Can you help me to solve my problem?"

(A.) The use of voltage-regulator tubes in "B" power units should be of interest to a number of fans, as it is of great assistance in cases of variation in the voltage in the unit; whether they are due to line-voltage changes or to current changes in the load which cause corresponding changes in the voltage. Such tubes operate by absorbing from the power unit all output current which is not being used by the receiver at any instant. Thus the output voltage is maintained at a constant value; the receiver, or load, receives exactly the power that it requires and the regulator tube takes the remainder.

The tubes are designed in such a way that their resistance is automatically decreased with any increase in the applied voltage. If, on the other hand, the voltage decreases, the resistance increases; so that whether more or less current is passed through the regulator tube depends on the voltage input and the amount of current consumed by the set. The commercially-available tubes are made so that their output voltage is kept at 90; in a power unit supplying a constant output in watts, the voltage-regulator tube will take sufficient current to keep the output voltage practically constant within the limits of the tube. Of course, if its input voltage is increased over the rated maximum-current value of the tube, since it will take only its maximum amount of current the terminal voltage will be accordingly increased.

A voltage-regulator tube may be inserted between the negative terminal and the 90-volt tap of a power unit of almost any type, without disturbing the unit in any way. Fig. Q2331A shows the necessary hook-up for such a tube in a unit with two variable taps, as used in a number of commercial units. If the tap is provided with a by-pass condenser, the only additional connections are those from the tube to the "B+ Amp" tap and the negative terminal. Fig. Q2331B shows connections for a unit using the potentiometer, or series, output arrangement. The voltage at the terminal should be somewhat over 90 volts without the tubes; so that some current will flow through the tube and enable it to operate correctly.

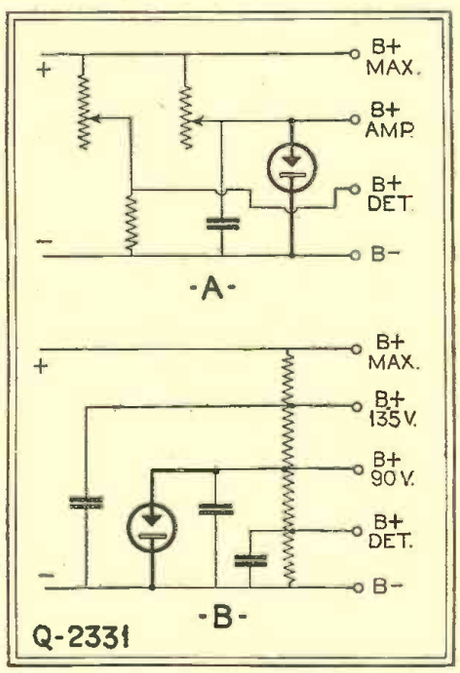
Two voltage-regulator tubes may be connected in series for the output of a 180-volt supply, as shown in Fig. Q2331C. In this case, the output voltage will be maintained at 180, even though the input from the rectifier and filter is increased above this value. By connecting the tubes in this way, the output of the complete unit will be maintained at a practically constant voltage. The maximum-variation voltage range also will be higher than with a single tube, so that greater voltage-variations can be accommodated.

Tube Operation

There is one drawback in the use of "glow" tube; that is, in order to have the tube operate correctly, it must be supplied with about 125 volts for an instant, in order to make it glow. This can be done by turning on the power unit before switching on the receiver; as soon as the set is switched on, the voltage drops to 90 volts, which is the correct value. It is also necessary to connect the tube correctly; if the polarity is right, the glow will be noticed around the large circuit plate. If the tube is incorrectly connected, the glow will be around the small terminal; no damage will result from a temporary reversal of the connections, but the tube should not be left in this condition for any length of time. In some cases, it is advisable to connect a 1000-ohm resistor in series between the 90-volt tap and the tube, to prevent an excess of current from flowing through the tube.

Another tube, called a "ballast" tube, is often used to keep the receiver's power supply constant; being connected in series with the primary of the power transformer. Its operation controls the current supplied to the power unit. After this tube it is necessary to use a special transformer with a primary designed for 65 volts, instead of 110 to 115. If the line-voltage averages 115 volts, the transformer should be designed to take, under load, 1.7 amperes at 65 volts, the remaining 50 volts being dropped in the tube. If the line-voltage drops or rises 10 volts, the voltage across the tube will correspondingly change, but the transformer primary voltage will remain constant at 650.

The "ballast" tube requires about ten minutes to heat up fully, and the voltage drop increases rapidly for the first few minutes, after which it increases up to the final temperature; the "glow" tube mentioned previously functions instantaneously, as soon as the glow is seen. The "ballast" tube is equipped with a special screw base; while the voltage-regulator tube uses the standard four-prong UX base of the type used for receiving tubes.



The voltage-regulator tube across a power-unit tap maintains its output at 90 volts.

FILAMENT TRANSFORMER

(2332) Mr. Arthur F. Clark, San Antonio, Texas, writes:

(Q.) "I am a constant reader of your magazine and I have been looking for some time for instructions for making a transformer for lighting the filaments of A.C. tubes. I have been disappointed, however, since I have never seen the details for making a transformer of this type. I have also looked in your latest edition of "1001 Radio Questions and Answers" but I do not find the instructions in this book, either. Will you give me these?"

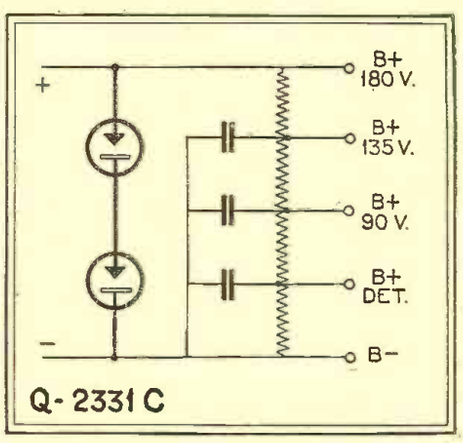
(A.) The diagram (Fig. Q2332) shows the core of a suitable transformer for 60-cycle current. The core is made of strips of silicon steel .014-inch thick and 1¼ inches wide, which are cut to two lengths; the longer are 4¼ inches, and the shorter pieces 2¾ inches long. The strips are cut from sheet metal and the corners are filed to prevent any rough edges from protruding; after the laminations have been cut they are shellacked or varnished on at least one side to insulate them. About 170 of each size will be required; the insulating coat should be thin and evenly spread.

The coils are made by preparing a block of wood 1 5/16 inches square and about 5 inches long; this is wrapped with several layers of heavy paper and a piece of fiber 2¾ inches wide over the paper. Two pieces of fiber 3¼ inches square are also prepared and a hole 1 5/16 inches square is cut in the center of each; the two washers thus formed are placed over the ends of the fiber strip which has been wound on the wooden block. This will provide a spool made of the pieces of fiber, into which the transformer windings are to be placed; the washers are glued firmly in place to make it secure. The spool is 2¾ inches wide and may readily be slipped over one of the long segments of the core.

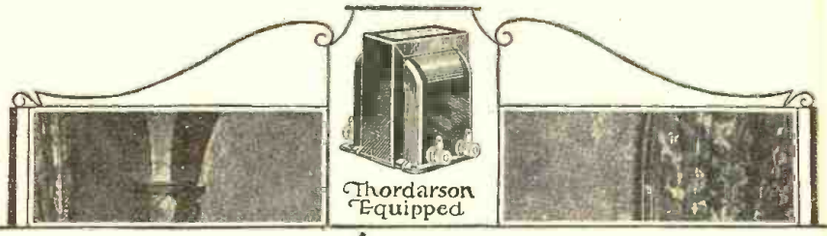
Next, the primary winding is placed in the spool; it contains 528 turns of No. 22 D.C.C. wire, layer-wound. (The easiest way to wind this is to fasten the block in some manner to the chuck of a hand drill, or of a lathe if one is available.) A layer of varnished cambric, or several layers of heavy paper, is placed over this winding, after the two ends of the wire have been brought out through holes in the end of the spool; and the first of the secondary windings is placed over the primary. Between each successive pair of the windings, a layer of varnished cambric or paper must be placed, to insulate the windings more thoroughly.

A winding to give 15 volts across its ends will need 72 turns, and one for 7½ volts 36 turns, of No. 14 D.C.C. wire. A 5-volt winding contains 24 turns of the same wire; a 3-volt winding contains 15 turns and a 2½-volt winding 12 turns. For a 1½-volt winding, 8 turns of wire are sufficient,

(*Continued on page* 890)



Two voltage-regulator tubes in series, as above, fix the "B+Amp" value at 180 volts.



Thrilling Tone Purity
"Radio's Richest Voice"

We have now been using Thordarson transformers for some four years, which should be proof conclusive that we think them capable of maintaining the high quality of Sparton Radio Receivers, which we so jealously guard.

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The Sparks-Withington Company

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THORDARSON
RADIO TRANSFORMERS

SUPREME IN MUSICAL PERFORMANCE

Real "Radio Mysteries"

(*Continued from page* 811)

at once clipped and mailed the item to this office. It relates that a Santa Barbara (Calif.) housewife heard the voice of a radio announcer and the strains of music coming from a pot of vegetables cooking on an electric range. Whether or not the sound emanated from the range, the metal of the pan, or the boiling water, we cannot be positive; although one of our readers contributed a discussion of the possible action of the salts to produce an electrolytic rectifier in a suitable magnetic field.

MUSIC BURST FORTH FROM ELECTRIC RANGE

Santa Barbara Woman, Stirring Beans, Is Astonished by Melody —Experts Puzzled.

SANTA BARBARA, Cal., Dec. 16 (AP).—There may be sermons in stones and books in the running brooks, but it was left for a Santa Barbara woman to reveal today that there is a Schubert melody in a pan of boiling vegetables.

As the hoarse voice of a radio announcer burst through the kitchen steam of a quiet home here and the strains of "Ave Maria" filtered from a pan of beans simmering on the electric range, the housewife might have been excused had she exhibited a touch of nervousness, because there was not a radio set anywhere in the house. But she did.

She approached the range and stirred the beans vigorously. In answer a whole chorus burst into a hunting song, followed by a crooning plantation melody.

Radio experts admitted they were baffled by the phenomenon, but pointed out that radio music had been heard in hot air shafts connected with electric furnaces. The bottom of the pan might have acted as a diaphragm and reproduced a radio program, picked up inductively by the electric power line, they added.

A news dispatch which thousands of our readers have already seen.

IN CITIES OF STEEL

However, this fact has been ascertained—that an imperfect metallic contact of high resistance may have *"unilateral conductive properties,"* and consequently act as a detector. (This was explained in Radio News for September, 1927, in an article by Professor H. Pelabon, of Lille, France, who showed that the effect is obtained with steel more readily than with metals of better conductivity.) In addition to this, in steel building construction a multiplicity of resonant circuits must occur, as well as in pipe systems, wiring systems, etc. The flow of a slight, perhaps not measurable R.F. current in any of these circuits would escape observation under ordinary conditions; but it is sufficient to prevent the use of certain costly antenna systems in large cities for broadcast transmitters of certain wavelengths. Not only that, but when a group of buildings absorbs, partially or entirely, the signals broadcast in their direction from a nearby powerful transmitter, it is evident that in their metal parts there must be certain minute "eddy currents" capable of being detected. A systematic survey of a modern steel building with a delicate wave-

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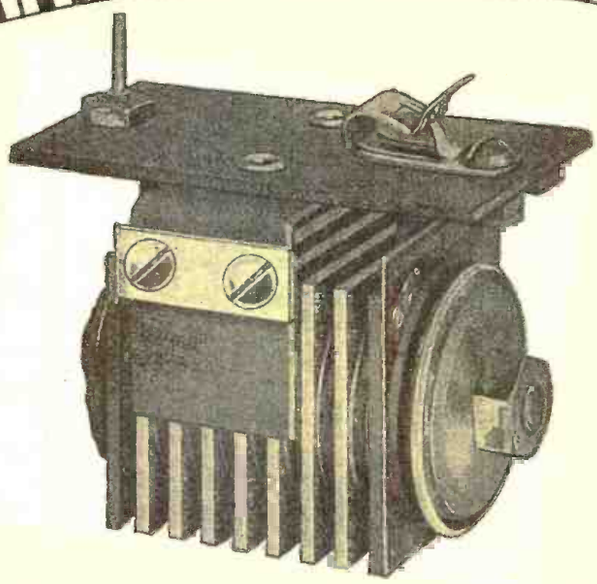
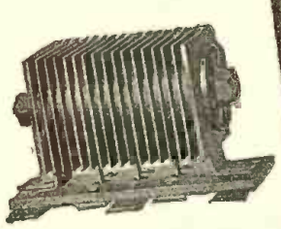


Type BNK for replacing the acid jars in Balkite Types N and K Trickle chargers.

Type BJ for replacing the acid jars in Balkite Type J chargers



Type M-16 for replacing the rectifiers in 11 makes of "A" Eliminators and 3 Ampere chargers

Type V-4 for replacing the rectifiers in 6 makes of Trickle chargers.

THIS new Elkon all-dry metallic rectifier Type U-P-8 is so designed that it replaces the wet jar rectifiers designated as Philcatron A and Philcatron AA used in Philco Trickle Chargers, Philco "A" Powers and Philco A and B combinations.

Very simple to attach, two wires to connect. May be done in a minute by anyone. No liquids to bother with—no attention—just satisfaction.

Do not be surprised at its small size—for in its sturdy couples are packed thousands of hours of perfect service. Its compactness is one of the reasons for its efficiency.

The U-P-8 is a fitting member of the Elkon family of dry-metallic rectifiers.

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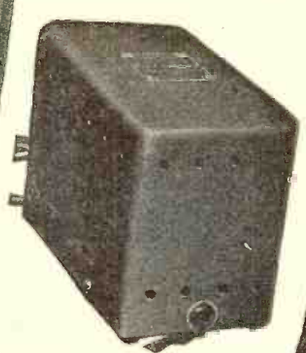

3 Ampere Charger. Dry, noiseless, no moving parts. Has tapering feature—long life. For radio or auto batteries.

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Address .....

meter might produce some interesting results. So, also, when we find that power lines, steel rails, etc., are absorbing a large part of a station's power in one direction (see RADIO NEWS for July, 1927, page 12) we know they are carrying the signals.

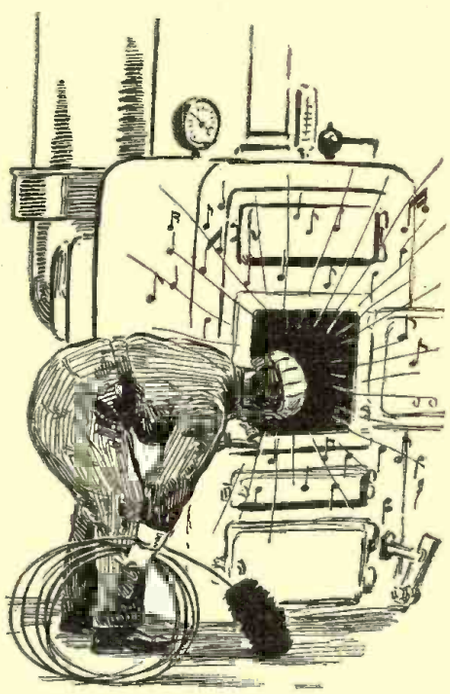
We find, also, that metallic objects not intended for the purpose may serve as audio-frequency reproducers. One of our correspondents heard sounds from his *tuning condenser* when at resonance with a high-power station a few hundred feet away—indicating the effect utilized in the electrostatic speakers which we described last month.

In addition to the above news dispatch, sent to us from so many sources, we publish the letters describing "mysteries" which have reached us immediately after publication of the January editorial above mentioned; and will give our readers others as they are received. (This magazine is made up some four to six weeks in advance of publication, to allow time for printing and distribution, and therefore correspondents can never see a letter in "the next" issue.)

A CHIMNEY TALKS

Editor, RADIO NEWS:

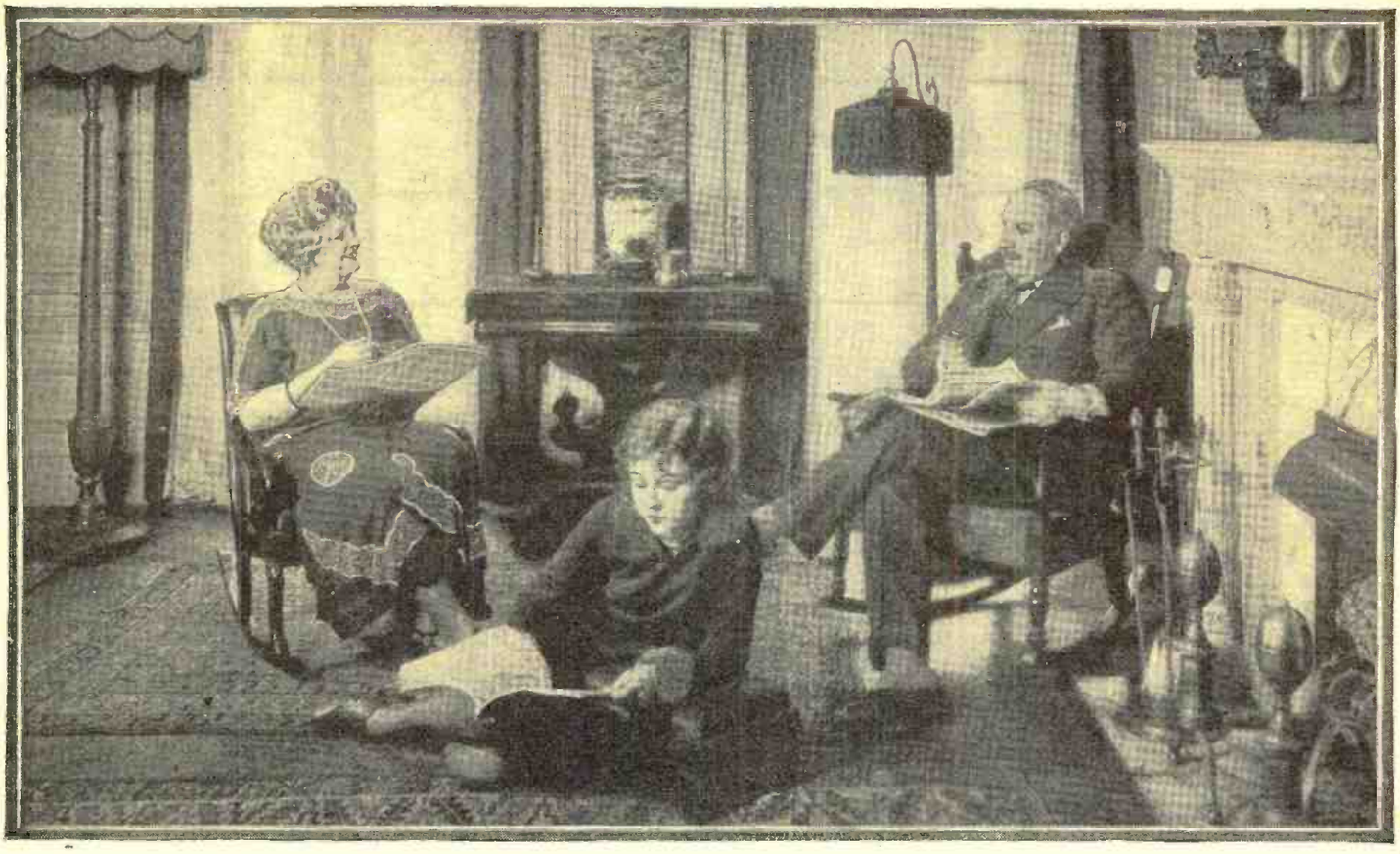
I was employed for several years in the Cottage Bakery at Springfield, Ohio, and looked after a boiler. One morning in the year 1922 or 1923 (I cannot be exact as to the date) as I was cleaning the flues, I heard a band playing. I thought at first it



A boiler that not only turns itself into a horn speaker, but picks up more than local distance is a good "mystery," we must agree with Mr. Woolfe.

was outside, but almost instantly, to my amazement, I heard a voice say, *"This is KDKA, Pittsburgh, Pennsylvania"* very plain and clear. This continued for fifteen minutes or more; the music, though low, was as clear as a bell, not muffled or periodic. There were a few times when it would cease, but when it did so, it did not fade away. It would stop all at once, then come on and remain with full volume for five minutes or more. It appeared to come out of the boiler stack.

The boiler was so constructed that the fire went back under the shell and returned



I Make Sure That My Entire Family Reads "YOUR BODY"---There's a Reason

"INVARIABLY, every time I bring home the new issue of YOUR BODY, my daughter makes a rush to capture it. I don't stand a chance of getting it back until she has digested its entire contents. Of course I have to be reasonable. I realize that, much as I want to read it, the contents of YOUR BODY is of great value in teaching her the real truths of life. I know that each issue is practically an endless source of information on sex, prevention and care of diseases, the senses and the normal functions of nature as related to our bodies. All of this worth-while knowledge is of great importance in forming a basicly firm character in adolescent children. That is the reason I willingly share my newspaper with my wife and wait patiently until Madeline, having read every page, grudgingly hands it back. However, in the future, I have a little scheme that will make it possible for both of us to read YOUR BODY at the same time. I am going to buy two copies; then I won't have to wait."

* * * *

This is the story that just one of our readers tells. We know that there are many more homes throughout the country where the same condition prevails. Our readers have found a world of valuable knowledge in each page of YOUR BODY. They know that it is a medium devoted to the welfare of the human body and that it is to their advantage to read carefully every page. Sex, psychology, treatment of all maladies, the senses, our instincts, all are fully explained in the plainest of untechnical language. In YOUR BODY there is a section for every member of the family, mother, father, brother and sister. Go to the newsstand today and get your copy of this valuable magazine. Over 112 pages—fully illustrated—large magazine size.

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AT ALL NEWSSTANDS OR WRITE DIRECT

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Please say you saw it in RADIO NEWS

to the stack through the tubes. So, when I opened the door to clean the flues, the opening to the stack was in front and above my head. The stack was probably thirty feet high and when I opened the doors there was more or less upward draft.

I mustered up courage enough to tell some of the boys what I had heard; I knew they would "kid" me, because I was a radio fan. On this particular morning, there was no one I could call to hear it. But, in a few days the same thing took place; I then called some of the boys and they, too, heard it, but thought it nothing unusual, as they had often heard "cross-talk" on a telephone. I tried to explain that this could not be the case here, but that in some unaccountable way something was converting R.F. into audio waves.

This happened twice more, not on successive mornings, but during probably two weeks. There was no radio in the bakery, nor a private residence near it where a radio could have been playing so that it could be heard. Soon after, the boiler was repaired and the stack replaced, so that I never heard it after that.

CARL R. WOOLFE,
Oregonia, Ohio.

A STEAM PIANISTE

Editor, RADIO NEWS:

I had the pleasure of visiting New York City the week before Christmas and, knowing that I would have some time to spare, purchased the January RADIO NEWS at a stand on the evening of December 20. My companion and I were occupying room 521 in the Hotel York, on Seventh Avenue at Thirty-Sixth Street. I sat down in this room, by the steam radiator, and started to read your article on the "'Mysteries' of Radio"; the time was 5:50 p. m. I had just about finished the article and was musing on the wonders of radio, when my dreams were arrested by the music of a piano.

Ordinarily, I would have paid no attention to it; but, thinking that possibly it was something unusual, I listened more closely for the music—*which seemed to come from the radiator.* My peculiar action arrested the attention of my companion, for he inquired the reason. I asked him if he heard any music, and he replied that he heard a piano. I got up and opened the window, only to hear the noise that comes from Seventh Avenue at the rush hour; listened at the door communicating with the next room; went into the hall, finding nothing. I returned to the room and listened again to the strains evidently coming from the radiator.

I asked the clerk at the desk in the office if there were a piano in the hotel, or a radio; he replied in the negative and did not take my account seriously. I returned to the room, but the music had ceased. We heard it no more that evening and retired about 10:30, tired from a strenuous day. I fell asleep immediately; my companion at 11 o'clock woke me to say that the radio was going again. It continued for about five minutes.

At 6:00 o'clock next morning (the 21st) nothing could be heard. Our train left at 8:35 and at 7:30 we had called a taxi and put on our coats, ready to leave, when our piano again started and again lasted for about five minutes. We will give a sworn statement as to these facts, and would be pleased to hear if you find out any more about this.

C. E. SUMMY, D.D.S.,
Primghar, Iowa.

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This FREE CATALOG is literally a most valuable ENCYCLOPEDIA—YOU cannot well afford to be without one—and, you do not have to. Your request for one is all that is needed! A day or two later, it is in your possession. Surely, a TEST OF OUR PROMPTNESS PLEDGE!

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98W PARK PLACE, NEW YORK

Please say you saw it in RADIO NEWS

(The sounds heard by Dr. Summy seem to bear some relation, in the manner of their conduction, to others which have been heard in odd places. In this case, however, there is nothing to indicate from what broadcast station, if any, they came. There are, however, several transmitters comparatively close to the location indicated.)

THE LAMP LISTENS IN

Editor, RADIO NEWS:

The effect described here is one not mentioned in the article on "'Mysteries' of Radio," and perhaps not described before. One night this winter I was in the attic, using a three-tube regenerative set, and speaker. A kerosene lamp furnishing light was sitting on the same table about a foot from my audio end. I placed a fixed condenser across the "P" and "F—" terminals on my first audio transformer. To my surprise, the lamp burned brighter; the flame rose about a quarter of an inch. I tried it several times with the same result, and my companion, Harold Vanzant, and I laughed about it. The set had to be oscillating. I tuned in a number of stations, and then picked up the condenser again and placed it across the same terminals. Do you think that light would do it again? And all that had been moved was the dials. I was using a 6:1 Erla and a 3:1 Thordarson. Music creeps out of my transformer without a speaker.

G. D. BETTELON,
R. F. D. 1, Dayton, Ohio.

(It is difficult to tell here whether an R.F. or an A.F. vibration was producing the effect upon the lamp, from the description. An oscillating tube might generate R.F. current which would find some resonant circuit in the parts of the lamp; though it is difficult to see how.)

NOT SO MYSTERIOUS

Editor, RADIO NEWS:

The circuit to which I am introducing you is startling, amazing and mystifying; it needs nothing but a set of headphones, although I assure you that an aerial and ground will decidedly increase the volume. Whenever I want to receive the same station that my neighbor is receiving, I have but to stick one phone tip in my mouth and hold the other tip in my hand; and I get 'em quite a few miles distant, too. But the volume is increased to a marked degree when the phone tips are connected to the aerial and ground. I would be glad to hear from a fellow fan who has tried the "Parasitic Pauper," more properly termed "Saddler's Super Simpledyne."

OWEN L. SADDLER,
548 Taylor Street, Wilmington, Del.

(Unfortunately, we fear Mr. Saddler cannot raise much gooseflesh with this radio ghost, or patent his new circuit. As Christopher Columbus remarked, apropos of the egg he had just stood on end, "It's no mystery when you know how it's done." The same effect was described in an article, "Wireless Radio Dancing," in RADIO NEWS *for February,* 1926 *(page* 1120*), in which the editor of this magazine suggested a means for employing it as parlor entertainment. To call it "parasitic," as Mr. Saddler does, is quite correct. The phones pick up the* audio *field of the neighboring set. This effect, however, cannot be detected at any great distance, owing to the low frequency, as explained on page* 640 *of* RADIO NEWS *for January,* 1929. *Nor can the phones detect* radio *waves, from either a transmitter or a rerodiating set.*—EDITOR.)

What These Have Done YOU CAN DO!

"Since I have been studying with your school I have been appointed chemist for the Scranton Coal Co., testing all the coal and ash by proximate analysis."
—Morlais Couzens.

"I also have some news for you. I have been made assistant chemist for the concern I am working for."
—A. G. Delwarte.

"I am now cleaner and dyer for the above named company. My salary is almost double what it was when I started the course."
—E. H. Lasater.

"Your training has opened things to me that otherwise I would probably be years in acquiring. I now enjoy comforts that before I had to do without. It enabled me to have a wonderful little home, a fine laboratory of my own, and gave me a respected position in one of the foremost textile concerns in the country."
—J. J. Kelly.

"If it weren't for your course I wouldn't have the job I've got now."
—George Daynes.

"Since beginning your course of study I have received an increase in my pay check, and as I progress my work becomes lighter through a better understanding."
—M. G. Cole.

"I am mighty glad I took this course. My salary has been increased several times, and different industrial plants are coming to me for a little advice on different things, netting me a fair side income."
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"It's in the Location!"

(*Continued from page* 813)

I have heard rumors that large corporations holding patents will not permit the more rapid development of long-range receivers; also that manufacturers are far too busy on production of low-priced jobs to bother about the minority who are interested in DX.

Perhaps a word from you in your magazine will bring forth suggestions that will prove of very great interest. There must be thousands of people who, like myself, are anxious to get away from the general run of receivers and try out something—even though it may prove a little costly—that will bridge the gap between the stations we have been listening to for years, and the stations we have hoped to get with every new receiver built.—R. B. TIMBERLAKE, 1636 *St. Catherine Street West, Montreal, P. Q., Canada.*

THE CRITICAL POINT

It is true that commercial considerations bring about the production of more receivers designed especially for local reception, than of those intended for great distance; nevertheless there are available to the constructor who builds his own, as to the set owner who is willing to commission a custom builder to construct a set to his liking, receivers with power sufficient to bring up to auditorium volume any signal that can be received. And it is not necessary to put up $1,800 for the purpose.

But note that a signal *must be received* before it can be amplified. That is to say, the impulse picked up by the antenna must give a distinct radio-frequency voltage, separate from all the other million-and-one electrical components which are chasing back and forth in the antenna system, to modify (through the grid-bias fluctuations) the plate current flowing in the first radio-frequency tube. There is a great deal said, in every issue of every radio publication, about the necessary sensitivity of the detector tube. But no signal that does not impress itself unmistakably *on the first R.F.* stage will ever get to the detector, or issue from the loud speaker.

Theoretically, we can calculate the field strength of any broadcast station anywhere in the world. And, theoretically, any of the high-power stations could be heard anywhere in the world—with a set of high sensitivity and amplification, of any of several types available today—if its waves did not encounter an atmosphere charged with electricity and an earth full of metals and minerals which absorb and reflect waves. The conditions of the atmosphere are at present unpredictable, except that we know unusual electrical disturbances make reception unusually difficult. The radio reactances of the earth will undoubtedly be some day thoroughly surveyed, and much more learned about its mineral resources, as the demands on them increase.

We have seen, in last month's RADIO NEWS, that surveying of mineral deposits is possible because each bed of conductive minerals sets up a counter-force when a radio wave encounters it. This is measured at short range; but when the waves of a powerful broadcast station are passing through a thousand or two thousand miles of mineralized earth—even if they penetrate comparatively but a few feet—they must be

subject to strange deflections. There are places where the radio waves seem to converge, and reception is good, from many directions; there are others in the shadow, as it were, of the earth's radio shields, where few if any stations can be heard.

WHAT RADIO ENGINEERS DO

Some years ago, when WEAF's 5,000-watt transmitter was located in downtown New York City, there were "dead spots" in this city where that station could not be picked up with a sensitive receiver. Two or three miles away the tall steel structures of midtown New York and the rocks of Central Park formed a barrier to waves that could be received—at times—in Australia. In every large city today we have freaks of reception. The disturbing element in this case is comparatively obvious; we know its nature, at least, if we cannot pick out the particular pile of steel that is causing trouble in a single case. But the effect of the subsurface minerals is still an open field for investigation, and would well repay the establishment of a radio survey.

It is rather notorious that an island in the sea, for instance, is a better place for reception, from stations on the other shores, than is a valley in the mountains for reception, from the other sides of the peaks. (Of course, there may be some "freak" locations that will turn this rule upside down.) Reception across the ocean, other things being equal, is more favorable than reception overland; but a small lake is not necessarily reason for good reception.

But to the point; if distant reception were simply a question of receiver design, why should the Radio Corporation and others engaged in radio communication as a business spend large sums on receiving stations? They must be able to pick up distant signals regularly, regardless of weather, of time of day; it is a matter of dollars and cents. They spend thousands of dollars in test work, sending engineers from point to point along the seacoast, determining what places are most favored for radio reception. They acquire huge tracts of land and erect aerial systems, costing many thousands of dollars, for reception purposes. If it were possible to receive as satisfactorily by adding to a receiver, say four screen-grid stages, at a cost of less than a hundred dollars, would it not be madness to go to the expense which these companies incur to find locations and put up suitable antennas?

ANTENNA PROBLEMS

Some of our readers are of the opinion that the antenna makes little difference; "a good outdoor aerial and a good water-pipe ground," and the rest is left to the eight- or ten-tube receiver. Some can even bring in (with phones, it is true) all that any DX listener can possibly obtain, and on two, three or four tubes! They have "good location."

The ten-tube set of modern design has an enormous reserve of power; in a good location it is impossible to use the whole of its amplification on a signal. If the number were doubled to twenty tubes, there would be no added gain in reception. A signal must be received at the aerial *in sufficient strength to be heard above its natural and artificial interference.* If it is not above the "noise level," nothing can be done with it; because the noise amplifies with the signal. There is, however, a possibility of obtaining clearer signals by limiting *directional* interference; as with the loop. The trouble is

that, to be practicable, the loop is now made small, and the signal voltage across it thereby lessened. If set owners could use loops of, say, twenty to forty feet on an edge, made of a single copper tube with low-loss construction, they might considerably improve reception; but, as we commented last month, such loops are not well adapted to kitchenette apartments.

The tuned aerial, resonant to signals, has a considerably greater pick-up, especially on feeble distant signals, than the ordinary "semi-aperiodic" type. A set, however, using such an aerial, requires care and skill in operation. It cannot be snapped on like the parlor lights and left to function by itself during the entire evening's entertainment.

You cannot buy "location" at the radio store; you must have it on the premises. You can't buy distance and have it installed in quartered oak; you have to work for it—even though, if you are favored with location, it will come a good deal more easily and at more frequent hours. But it may be remembered, also, that some men have found rich mines in their back yards, while others, less favored by good luck, have not been able to raise even a good dish of radishes by their sweat. It is a partial and prejudiced old planet we live on, and nothing proves it more fully than the inequitable manner in which she parcels out sites for radio reception.

Soil Materials Affect Lightning

THE old proverb, that there is no telling where lightning will strike next, lost something of its application with the discovery of the lightning rod. It has been further limited by the discovery, according to a correspondent of *Wireless Age* (London), that French tests have shown that limestone soils are less visited than rocky or mineralized areas. This is attributed to the fact that the air over the latter is more highly ionized; and this may also have its effect on vagaries of radio reception at different locations.

A RADIO PHILOSOPHER

"A hook-up is just like a woman. When you know everything's all right—it isn't!"
—Der Deutsche Rundfunk, Berlin.

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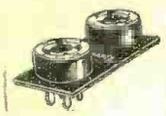

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More Duplicate Broadcasts

THE endeavor to increase the field area of a powerful station by operating two synchronized transmitters on the same wavelength and program, to cover the "dead spots" which attend reception in any modern city area, has led to the licensing of a supplemental three- to five-kilowatt transmitter for KYW, Chicago. This is owned by the Westinghouse Company, which has operated WBZ at Springfield, Mass., and WBZA at Boston for three years on this plan; and is evidently satisfied with the general results obtained. WGN has also been authorized to use a one-kilowatt transmitter to supplement its present 15-kw. station near Elgin, Ill., covering the Chicago territory.

"Stand-By" Announcements

DID you ever find the set quite dead, and wonder whether to start "fault-finding," as our British cousins say, or to wait an hour or so for the stations to resume after, presumably, an SOS? If there were only one broadcast station in the state, the question would be even more pertinent. The Wellington, New Zealand, Radio Society recently took up the question of asking their local, 2YA, to hoist a red light on an aerial mast whenever the transmitter unexpectedly shuts down; but one humorist suggested, instead, that a cannon be fired for the benefit of the listeners out of sight of the towers (2YA is a five-kilowatter).

Mineral-Water Static

OTHER forms of static having exhausted their possibilities, seemingly, it is reported from Wiesbaden, Germany, that crackling noises and rumblings in radio reception are due to the action, electrical or radioactive, of the mineral waters under that city which have made it famous as a health resort; and that such disturbances are especially strong after sunset.

All the Comforts of Jail

GOVERNMENT utilities sometimes work with a fair degree of co-operation in foreig countries. Where railways, telegraph and telephone systems, post-offices and broadcast stations are operated under the same auspices, there is opportunity for this. In Hungary, for instance, railway passengers find attached to each seat a pair of headphones which have been sealed in a sanitary wrapper. A rental of 12 cents an hour obtains the radio programs from Budapest to while away the monotony of the trip.

If Kerry Doesn't Mind

HONGKONG'S new broadcast station, it is reported, is to work on 300 meters, using the call GOW, as Hongkong is a British colony. In addition to local programs, the plan is to relay London programs transmitted by 5SW, Chelmsford, England.

"Miniature Music"

(*Continued from page* 815)

homes. This argument may at first sight appear unanswerable, but in reality has no weight whatever. First of all, it seems obvious that the masters would have liked to have everyone enjoy good seats (and certainly not to listen from the vestibule, unless as a penalty for late arrival!). Secondly, it is rather futile to argue that they would not have used something new had it been available to them, merely because they did not know of it. I personally would bet pretty heavily that most of them (and the greatest were all innovators in their day, remember!) would have jumped at the idea of bringing to the home their music "in miniature" rather than an illusion of being in the vestibule at a concert hall.

It would be interesting to have the comparison made before a body of musicians, between "miniature music" and the "vestibule illusion," but only on the condition that they divest themselves of all ideas as to the so-called "naturalness" of the reproduction and listen with unprejudiced minds to the "miniature music."

The Wings of Death

(*Continued from page* 817)

thy Golden; but her cry was unheeded in that tense moment of activity.

The plane became suddenly visible in the beam of the huge searchlight. It was but a few hundred feet away. Even as it swooped downward in a long swift glide, Scott snapped the switch that started the projection machine. Dorothy uttered a piercing shriek and collapsed in a dead faint. Courageous Harold Dare caught her in his arms.

The plane's nose dipped—downward, still downward, directly toward the window where Harold Dare awaited it, coolly, unflinchingly, fearlessly.

In the glass of the photoelectric cells was reflected a score of tiny images of the dreaded death's head which had sped the Dare organization to its utmost endeavors.

With a roar, the plane picked up speed. It shot ahead; its nose lifted, and it swooped upward—clearing by a few scant feet the top of the magnificent laboratories building. It turned in a slow spiral, climbed—and beautiful Dorothy Golden opened her eyes to see the dread bird of ill omen disappear whence it had come, over the distant housetops.

In a few fleeting moments came a faint trembling in the air, and a dull, sullen roar was heard from the direction of the departed plane. Throbbing motors and distant sirens were heard far off, hurtling toward a faint red glow which grew momentarily larger and brighter.

A soft, sibilant sigh broke the tension in the little group of watchers, and Dorothy Golden, from the safe haven of Harold's arms, cried triumphantly, "The fiend is finally foiled; the wings of death are clipped!"

* * * * * *

The morning's papers told how Dandy Diavolo, while waiting to hear the explosion which was to signify the end of his hated rival's triumphant career, was caught in the

explosion ensuing when his radio-controlled aerial torpedo proved a boomerang. He was taken to a specially guarded room in the general hospital, where he was kept pending the preparation of criminal charges against him by Federal authorities.

"A great deal of the credit," said Harold Dare, in a personal statement, "belongs to Scott and his men. We realized that quick action was imperative. Since the signal controlling the plane was upon the same wavelength as our short-wave transmitter, we sent out a signal which, being more powerful, overrode Diavolo's signals. The death's head was the televisor's version of the signal causing the plane to head downward. Naturally the opposite signal would cause the plane to rise, and this was given by reversing the film, which contained a record of the signal, and projecting it back into a television transmitter. The reversed signal caused the plane to take a course opposite to that which brought it, and naturally brought retribution upon the heads of Diavolo and his henchmen. Thus (as Dorothy Golden phrased it) the wings of death were clipped, and right triumphed over wrong. May this be a lesson to Diavolo, and to all of my great public as well!"

What's New in Radio

(*Continued from page* 819)

are plugged, as shown at the left of Fig. F. Like the interchangeable windings, it is supported by an insulating film and a hinge is used to allow a variation in the coupling, which is particularly helpful in overcoming the "dead spots" often encountered. These dead spots are often caused by the receiver being tuned to either the fundamental frequency of the aerial or one of its harmonics. At these frequencies, the coupling is greatly increased, resulting in absorption of considerable energy; this effect can be reduced by loosening the coupling between the primary and secondary.

The kit of three coils is designed to cover with a 125-mmf. condenser, approximately 15-30; 27-59; 52-107 meters; while other coils are available extending the range down to 8 and up to 215 meters. The exact range of each coil, of course, depends on the maximum and minimum capacity of the tuning condenser, and the stray capacities between the apparatus and wiring.

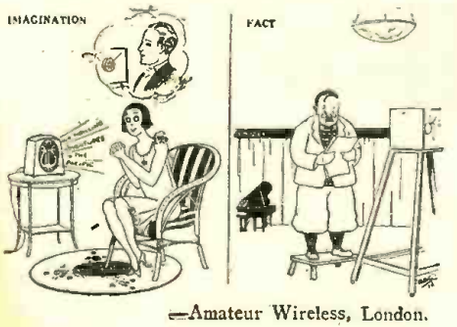
Manufacturer: *Hammarlund Manufacturing Co., Inc., New York City.*

HAR DU SNUS?

LARS: "Aye tank aye bane got Los Anyeles last night."

OLE (*pulling out snuff box*): "Hoh, dat not bane so mooch. Aye yoost tap das faller, an' aye get Copenhagen!"—*John Strejeck* (Alaska).

"VOICES ARE SO DECEPTIVE"



—Amateur Wireless, London.

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The Radio Beginner---Filters

(Continued from page 821)

cancel or balance each other at the same frequency; while a third element L3 is common to both circuits. The third element (which may be a coil as shown, or a condenser) has a reactance small in comparison with that of the two reactive couples.

The functioning of the circuit may be explained somewhat as follows: At some particular frequency F1 (at which the reactances are balanced) the overall reactance of the circuit including L1-C1, L2-C2, will be zero; current will circulate through that circuit without going through L3, and the system will have *zero reactance* at this frequency. At any other frequency, the reactive couples L1-C1, L2-C2 will not be balanced within themselves and there will be a voltage across (difference of potential between) the ends of L3. If the given frequency is lower than F1, the reactances of L1-C1 and L2-C2 will be "capacitive" or due to their condensers. L3 will then tend to neutralize the unbalanced capacities, provided that their combined reactance is not greater than that of L3. The width of the band frequencies passed depends on the relation of the value of L3 to the other two reactances of the circuit. If L3 is a coil, the width of the band depends on the ratio of its inductance to the inductances L1 and L2. If it is a condenser, the band's width depends on the ratio of its capacity to those of C1 and C2.

In designing the coils, the coils and condensers L1-C1 and L2-C2 are so selected that they will cover the wavelength range required; and L3, whether a coil or a condenser, is then designed to regulate the required frequency band. The coils L1 and L2 may be changed if desired, but it will be necessary to follow the specifications exactly for L3. The coils should be shielded very carefully in order to get the best satisfaction, so that L1 and L2 *will not be coupled except through L3.*

A MULTIPLE FREQUENCY-FILTER

Another very interesting application of the band-pass filter is the Somersalo tuned filter, which was described in our February, 1928, issue. Here a different method of procedure is used to approach the ideal tuning characteristics. By referring to Fig. 6 it will be seen that the filter is coupled, as in the Vreeland system, in front of a broadly tuned or untuned radio-frequency amplifier, whose output is detected and amplified at audio frequencies in the usual manner. The filter consists of three tuned coils L1, L2, and L3; the coupling from the aerial coil L1 to L2 is made solely through the capacity between the primary and secondary of L2 since the primary of that coil is open at one end. In actual construction, this capacity is made very high by using a very large primary coil.

The explanation given of the operation of this filter is as follows: The capacity between the primary and secondary of each coil forms a condenser which is charged by the current circulating in the preceding tuned circuit; and the charge is directly proportional to the current. There is consequently a current continually flowing in the open coil, which is transferred to the next circuit (secondary) through the comparatively large capacity between these coils. The advantages claimed for this

method of tuning are that the tuning devices are entirely separate from the amplifying circuits so that both may be made as efficient as possible. Because of the number of individual sections of the filter, the band characteristic is sharply defined, as explained under band-pass filters.

The construction of the coils for the Somersalo filter may be as follows: The primary and secondary may be wound on a single tube, with about 1/16-inch between. The primary should contain about 200 turns of No. 30 enameled wire closely wound, and the secondary about 100 turns of the same wire, spaced at 60 turns per inch. The tubing in this case is 1½ inches in diameter and about 4½ inches long. Each coil is placed in a copper or other suitable shield, large enough so that a space of about an inch is left between the coil and the shield. The coils are made alike except that the primary of the first (L1) is grounded to the shield. The tuning condensers for these coils should be ganged together and a midget condenser should be shunted across each section.

The radio-frequency amplifier is either untuned, or each stage should be tuned rather broadly, so that the advantage of selectivity with sensitivity gained by the use of the filter will not be lost. It is desirable to shield the complete set in a metal cabinet or by using individual shields for each stage, to prevent a pick-up in the coils or a feed-back between the various stages; the coils of the filter proper must be shielded individually, even though the rest of the set is unshielded.

Although this article does not cover the actual design of filters of the various types, it may give a good general idea of what type must be used for a given purpose, and also help the beginner to understand just how and why a coil or a condenser is used to filter mixed currents in a radio set. The rules for figuring the values of inductance and capacity necessary are beyond the scope of this discussion. The various formulas and equations can be obtained from Circular No. 74 of the Bureau of Standards, or from an electrical engineer's handbook.

Tube Characteristics

(*Continued from page* 823)

22-type (15-volt A.C.)

Use, voltage amplifier (not power);
Socket, UX-type;
Filament voltage 15 raw A.C.; current 0.35-ampere;
Plate voltage 135; current 1 mla.;
Grid bias, control-grid 1 volt, screen-grid 30;
A.C. plate resistance 700,000 ohms;
Amplification factor 400 (theoretical).

"OVERHEAD-FILAMENT" A.C. TUBES

Still another type of A.C. tube is familiar to many because of its distinctive "overhead" construction; the terminals of its cathode heater are brought out from the tube through a bakelite top; while, though four prongs are in the base of the tube, only three of these are employed electrically. One is connected to the grid, a second to the plate, and the third, which provides the grid return for the circuit, to the heater-filament. These tubes differ from the others which have been described in that they require a three-volt A.C. supply for the filament.

401-Type (Overhead Filament)

Use, detector-amplifier (not power amplifier);
Socket, UX-type (filament connection through special cable);
Filament voltage 3 raw A.C.; current 1 ampere;
Plate voltage 150;
Grid bias 4½ to 9 volts.

403-Type (Overhead Filament)

Use, power amplifier;
Socket, UX-type (filament connection through cable);
Filament voltage 3 raw A.C.; current 1.5 amperes;
Plate voltage 180;
Grid bias 40 volts.

RECTIFIER TUBES

Rectifier tubes are divided into three classes; the first, gas-filled, filamentless, full-wave rectifiers; the second, high-vacuum, electron-emitting-filament rectifiers, comprising two half-wave and two full-wave rectifiers. With the latter, it is necessary to provide a supply of current (usually from a low-voltage secondary on the power transformer) to heat the filaments; this is unnecessary with the first type. The third comprises gas-filled tubes with filaments.

Three types are offered in the first (gaseous) classification, all using UX sockets; the first is a moderate-power full-wave filamentless, rectifier designed to supply plate voltage for a standard radio receiver using no tube of heavier duty than the 112A-type. This is known as the "B" type and has an output rating of 60 milliamperes at 150 volts, with a maximum allowable input A.C. voltage of 275 per "anode" (positive electrode).

The next in this class is the "BH" type, a heavy-duty full-wave rectifier having an output of 125 milliamperes at 300 volts. This tube will rectify sufficient current to supply the plate requirements of a standard receiver using the 171A-type amplifier in the last audio stage. The transformer-secondary A.C. voltage may be as high as 325 per anode.

The third rectifier in this series was designed to supply "A," "B" and "C" voltages to series-filament receivers using quarter-ampere tubes; its rating is 350 milliamperes at 200 volts. Known as type "BA," this tube has a maximum allowable input A.C. voltage of 350 per anode.

FILAMENT-TYPE VACUUM RECTIFIERS

In this class, the high-vacuum, filament rectifiers, are found four types, the 280-type, a full-wave rectifier, the 281- type, a half-wave rectifier; the 213-type, a full-wave rectifier for a full-wave circuit; and the 216B-type, a half-wave rectifier for a half- or a full-wave circuit.

213-Type (Full-Wave Rectifier)

Socket, UX-type;
Filament voltage 5, current 2 amperes;
Plate voltage 220 A.C. maximum (per plate);
D.C. output (both plates) 65 milliamperes maximum; 170 volts at maximum current, as applied to average filter.

216B-Type (Half-Wave Rectifier)

Socket, UX-type;
Filament voltage 7.5; current 1.25 amperes;
Plate voltage 550 A.C. (maximum);
D.C. output 65 milliamperes (maximum); D.C. output 470 volts at maximum current as applied to average filter.

280-Type (Full-Wave Rectifier)

Socket, UX-type;
Filament voltage 5; current 2 amperes;
Plate voltage 300 A.C. maximum (per plate);
D.C. output 125 milliamperes maximum (both plates); 260 volts at maximum current, as applied to average filter.

281-Type (Half-Wave Rectifier)

Socket, UX-type;
Filament voltage 7.5; filament current 1.25 amperes;
Plate voltage 700 A.C. (maximum);
D.C. output, 65 milliamperes recommended; 85 milliamperes maximum; voltage maximum 620, as applied to filter of average circuit.

FILAMENT GASEOUS RECTIFIER TUBES

These are of the hot-cathode gas-filled rectifier type containing, at low pressure, the inert gas *argon* (found in small quantities in the atmosphere) which is *ionized* by the electrons emitted from the incandescent filament. This ionized gas acts as the principal current-carrier, with the result that the bulb operates with a very low voltage-drop (3 to 8 volts) and is capable of passing a current of several amperes; the current limit depending on the design and size of the tube. Two elements make up the internal construction of the tube; the cathode (lower electrode) consists of a filament of small tungsten wire coiled into a closely wound spiral, and the anode (upper electrode) is graphite of relatively large cross-section.

The tube rectifies because, on the half-cycle when the graphite anode is positive, the emitted *electrons* from the heated filament are being pulled toward the anode by the voltage across the tube. They collide with the gas molecules and ionize them; that is, make them conductive in the direction from anode to cathode. During the other half of the cycle, when the anode is negative, any electrons that are emitted are driven back to the filament; so that the gas in the bulb is non-conductive during that half-cycle.

These tubes have been designed primarily for heavy-duty work such as storage-battery chargers, rectifiers for "A" power units and commercial needs. They are available in both half-wave and full-wave types; the former, which has been described above, is in most common use and is produced in three current ratings; the smallest is a 0.6-ampere type designed for trickle chargers using a half-wave rectifier circuit. It requires a filament current of 6 amperes, and a transformer-secondary "pick-up," or "starting" voltage of 8 to 12; it requires a transformer the secondary of which must deliver at least 25 volts for a 6-volt storage-battery load.

The 2-ampere type requires a filament

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current of 12 amperes, a "pick-up" voltage of 9.5 to 15, and a transformer-secondary minimum of 30 volts at 6-volt storage-battery load. The 5-ampere type requires a filament current of 18 amperes, a "pick-up" voltage of 11 to 16, and a transformer-secondary minimum of 30 volts at 6-volt storage-battery load. Both 2- and 5-ampere tubes are of the half-wave type.

The full-wave-rectifier tube differs from the half-wave type only in the addition of another graphite anode; thus giving an internal construction consisting of a heavy tungsten-wire filament and two graphite anodes. However, this tube is used on rare occasions and so may be difficult to obtain. All the above-mentioned tubes make use of the standard 110-volt screw-lamp socket for the base through which the filament leads are brought out. The anode is brought out through the top of the glass bulb in the form of a projection of heavy wire, to which connection is made by means of a spring-clip binding post, which is in turn connected to a flexible lead.

REGULATOR TUBES

The 874-type tube is a voltage-regulator tube designed to maintain constant *voltages* supplied by "B" power units at different current drains. The tube has two elements, an anode and a cathode, and contains a low-pressure mixture of gas. It maintains a constant potential of 90 volts to the radio receiver. (See page 852.)

The 876- and 886-type tubes, on the other hand, are designed for maintaining constant the *current* to radio sets operated from A.C. house lighting circuits; the former 1.7 amperes and the latter 2.05 amperes. The useful property of these tubes is that, within their rated voltage range, the current through them remains approximately constant. Such a tube should be used only in a circuit especially designed for it, and *must never be placed in a lamp-socket on the house-lighting line.*

874-Type (Voltage-Regulator)

Socket, UX;
D.C. rated voltage, 90;
Starting voltage, 125;
Maximum current (direct) 50 milliamperes.

876- and 886-Types (Current-Regulator)

Socket, large ("Mogul") screw type;
Operating amperes, 876-type, 1.7; 886-type, 2.05;
Voltage range, 40 to 60.

TELEVISION LAMPS

Under this head come the tubes used in reproducing televised images at the receiver; they were formerly known as "neon-gas glow-lamps," but the new designation was decided upon by the Television Committee of the Radio Manufacturers Association. These tubes should be used in the plate circuits of 171- or 210-type tubes, in order to obtain best results; also, they require a series resistor to prevent excessive current from reaching them, and a minimum direct-current voltage of 180, independent of the plate voltage applied to the last tube in the audio amplifier. Gradual blackening of the bulb indicates an excess of direct current passing through the lamp.

Television Lamp

Socket, UX-type;
Plate 180 volts D.C.; maximum current 20 mla., while 10 is recommended. (Current is generated by output of amplifier, not by television lamp.)

PHOTOELECTRIC CELLS

These tubes may be considered the "eyes" of the television transmitter; for it is their

function to convert into electricity the fluctuations of light reflected from the subject being televised and send them on to the transmitter, where they are converted into radio waves and sent out like voice or music. These impulses, by now familiar to many listeners, when received on the loud speaker sound very much like dot-and-dash code signals with very rough notes, except that they are all dashes. In mechanical form the cell usually comprises a light-sensitive coating on the inside surface of the glass, and a metal electrode facing this coating. While no light is shining on the cell, no current will pass between the coating and the metal; but, as soon as the cell is excited by light, an electron-stream, the intensity of which depends upon that of the light, will pass from the coating to the metal element, thus closing the circuit.

This description of the action of the photoelectric cell explains its use in light-recording apparatus, fire-alarm systems and other commercial applications where light is required to operate a mechanism. These cells are manufactured in two types; those of the high-vacuum type require a high voltage, about 600 volts D.C. for best results. The proper voltage for the gas-filled type is found by exposing the cell to the maximum light to be used and gradually increasing the applied voltage until "ionization" occurs. This voltage is noted, and a potential about ten lower is selected as the optimum to be applied. One stage of audio-frequency amplification is required for experimental operation of the cell; the requirements for commercial application depend upon the duty of the photoelectric apparatus. As the manufacture of these cells is not yet standardized, characteristics are not given here.

The "Candy-Box Special" Short-Wave Receiver

(*Continued from page* 839)

goes to the P connection on the socket for the audio-amplifier tube V2. These three wires are led out through a hole in the back of the metal box.

Insulated wire should be used for all the connections inside the box, to avoid short circuits against the metal. It may be a bit difficult to solder some of the wires, because of the cramped arrangement of the parts, but if the wires are held in place with a pair of long-nosed pliers the work can be accomplished successfully.

THE PLUG-IN COILS

In the matter of coils the constructor has some choice. The writer happened to have on hand a set of four factory-made coils consisting of two-inch lengths of molded bakelite tubing 1¼ inches in diameter and equipped with four prongs to fit a standard UX-type tube socket. Coils of this type are widely sold, and are very cheap. If the reader can obtain blank forms of approximately these dimensions, he can wind his own coils, using the data contained in a sketch on this page. The coils illustrated herewith are designed to cover the usual short-wave bands with a .0001-mf. tuning condenser.

If the constructor wants to follow the original "Junk Box" idea, which has proved immensely popular, he can use tuning and regeneration condensers of 32-mmf. capacity and coils wound on the bases of old vacuum tubes. For the benefit of those who missed the articles on the Junk Box or haven't the blueprints on hand, the coil data for .000032-mf. condensers are given as follows:

Coil 1: Grid and tickler windings, each 7 turns; wavelength range approximately 19 to 25 meters.

Coil 2: Grid and tickler windings, each 10 turns; range 25 to 35 meters.

Coil 3: Grid and tickler windings, each 15 turns; range 35 to 45 meters.

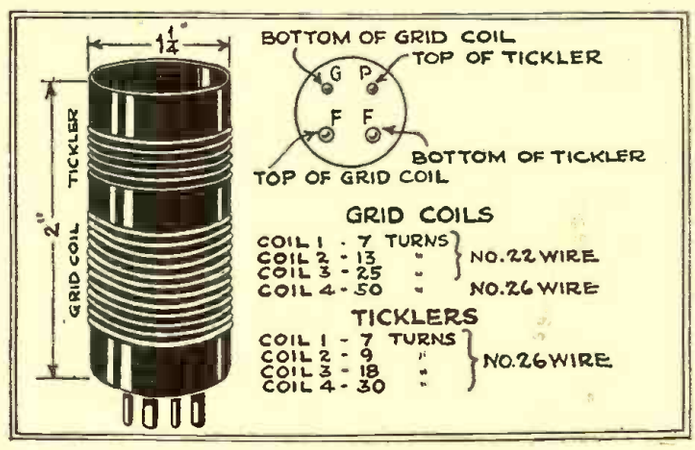
Coil 4: Grid and tickler windings, each 22 turns; range 45 to 64 meters. Tickler wound double-layer to save space.

Coil 5: Grid and tickler windings, each 40 turns; range 62 to 110 meters. Tickler also double layer. The tube base itself is too short for this coil, but may be made to serve the purpose if it is wound with a few layers of thick paper to form a tube about two inches long. The wire is then wound over the paper and will hold it in place.

The grid coils are all wound with No. 24 wire, and the ticklers with No. 26 or 28. It makes no difference whether the grid coil is near the prong end of the tube base (as in the coils illustrated on these pages) or near the top. If the former arrangement is used, the start or bottom of the grid winding is soldered to the G pin of the tube base, and the end of this same winding goes to the left F post. The start of the tickler winding (which is spaced about a quarter of an inch from the end of the grid coil) goes to the other F post; and the end of the tickler to the P post.

ANTENNA COUPLING CONDENSER

In the schematic diagram an antenna series condenser, C4, is indicated. This may be of the "postage stamp" variety, such as used for neutralizing purposes in sets of the neutrodyne type. It may be screwed to the back or right side of the box, and once adjusted, requires no further attention.



The coils shown here are for use with .0001-mf. condensers only. They will not cover the specified bands with midget condensers.

Another idea in antenna coupling is to connect the aerial wire to the cover of the box, and to bring the cover toward the plug-in coil. The capacity between the metal and the coil will, in most cases, be sufficient to form an excellent coupling medium.

The operation of the "Candy Box Special" is exactly like that of any short-wave receiver, and all the detailed directions on short-wave tuning published in the past few issues of RADIO NEWS should be observed. The operator should use his left hand for turning the tuning condenser and his right for the regeneration condenser. In the absence of vernier dials, the knobs will require rather careful adjustment, but broadcast and code stations can be tuned in without trouble.

The tickler coils specified for the tube-base coils are rather large, but are made so deliberately to insure a good regenerative action. With any one coil in place, and with the tuning condenser set at maximum capacity, the set should fall into oscillation as the regeneration condenser is turned up to maximum capacity. If the set oscillates long before the latter position is reached, remove a turn at a time from the tickler until it does work in this manner. It will then regenerate and oscillate smoothly at lower wavelength settings without the controls being unduly critical.

A grid leak of five megohms is shown. This is usually the correct value, but of course it is a good idea to try others of both higher and lower resistance.

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Meters the Fan Needs

(*Continued from page 825*)

still in use) a separate D.C. voltmeter reading from 0 to 8 volts is very desirable. With this meter you can make more accurate measurements, and determine whether or not individual tubes are receiving their proper voltages. A voltmeter like this is essential when 199-type tubes are being handled; as small voltage-differences seriously affect the operation of these tubes, which are rated at three volts and 60 milliamperes of filament current.

SPECIAL DEVICES

There are on the market a number of special radio set testers and "analyzers" that are literally worth their weight in gold to the bona-fide service man who has the gold to pay for them. They consist for the most part of two or three meters, each of which performs several duties at the turn of a special switch or the pushing of certain buttons on the case. One meter is usually a three-range A.C. voltmeter, 0-4, 0-8 and 0-150 volts; the other a combination high-resistance D.C. voltmeter and D.C. milliammeter, with two, three or four voltage scales and two current scales. In some types of testers there are three meters, one A.C. and two D.C.

Practically all these testers are equipped with test cords and adapters which allow the operator to determine all the operating conditions of a radio receiver of any kind in from ten to twenty minutes. All these tests may be made by using the regular voltages normally supplied to the set by its batteries or power units, and without disturbing any of the normal connections. On the more flexible instruments, any one of the meters provided for its multiple purposes is available for external use; as perhaps for experimental work. Connections are made to the proper binding posts after the proper "multipliers" or shunts have been put into the circuit. These analyzers represent something of an investment, but they pay for themselves very quickly.

No Patents in Australia

PATENT problems in the radio field have caused much disturbance in the industry outside of the United States. In Great Britain it appears that more or less success has been shown along the line of collecting royalties directly from set builders—a procedure which would be attended with some difficulties in the United States. In addition to this, it would appear that a patent cannot be withheld from public use; but a license under it may be demanded, on payment of a royalty deemed adequate by administrative officers, subject to court review. The Australians, however, seem to have cut the patent knot. Practically all patent rights on major radio inventions on that continent were owned by Amalgamated Wireless, Ltd., which operates the principal radio stations. After long negotiations, an arrangement was reached between the company and the Australian government, whereby all those patents are thrown open freely to public use by dealers, broadcasters and listeners. In lieu thereof, the company receives three shillings (75 cents) a year from the proceeds of each listener's license. It is believed that this will result in a considerable growth of radio activity in that Commonwealth.

RADIO NEWS BLUEPRINTS Nos. 76 and 77

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Radio Echo from Space

(*Continued from page* 814)

sometimes a luminous spot, called the *"gegenschein"* and referred to the refraction of the sun's rays by the earth's atmosphere. We may therefore conclude that the sun either emits or collects particles of minute size, yet capable of reflecting light, into an area in which the smaller planets at least move. He, therefore, has also belts like Saturn, but of low visibility.

REFLECTION FROM THE LAYER

Consideration of the earth's magnetic field indicates that it also must have attending belts, possibly dimly visible from other planets. A field of electrons, however, is quite invisible, as they are too small to intercept the waves of visible light, though they may refract them. The longer waves of even a short-wave radio transmission, however, are quite readily acted upon by even a weak magnetic field, if it be of sufficient extent. It is suggested that even twenty or thirty million electrons to the cubic inch would be sufficient — though almost an electrical vacuum by earthly standards—if properly located in space.

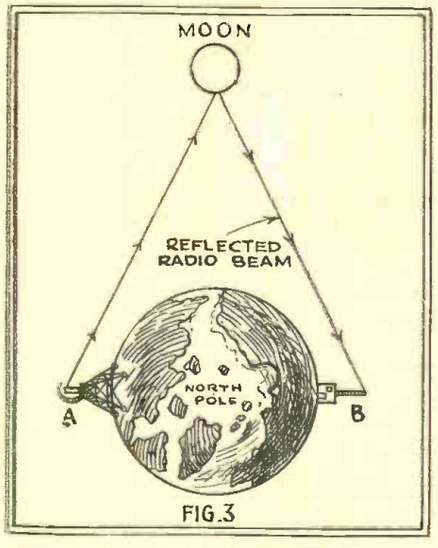


FIG. 3

This represents a suggested method of sending a radio wave to the moon and back; to determine by the reception of the reflected wave the permeability of the Heaviside layer. It was proposed in Radio News *for February,* 1929. *by H. Gernsback, the editor.*

However, if this layer can reflect signals so that they pass back over a path of even 480,000 miles and arrive at a point on earth with one-twentieth or more of the strength of the original signal—as heard at 400 miles from the transmitting station—its reflecting properties must be very good; and if, from a distance of over a million miles, it can concentrate reflected broadcast signals on the earth in recognizable form, it would seem that it must be as sharply defined as the surface of the mirror in a reflecting telescope. This is hard to reconcile with the rapid variations in the time of the echoes—from three to twelve seconds, with sometimes two echoes at four-second intervals. Further experiment, however, will doubtless result in data on which a more complete theory will be based.

However, if the Heaviside layer, so long claimed to be radio-proof, has been pierced by radio transmissions, only to have them

turned back a million miles further on, we are still a long ways from being able to get through that "message to Mars."

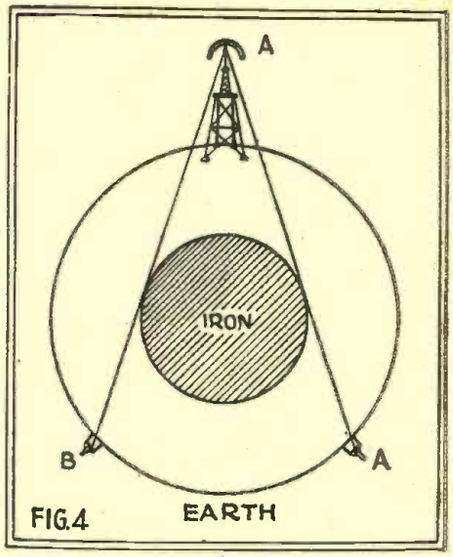
FROM ABOVE—OR BELOW

It is interesting, however, at this point to consider another possibility. We may refer to an article (which appeared in RADIO NEWS for February, 1927) entitled "Can We Radio the Planets?" by Hugo Gernsback, editor of this magazine. Two illustrations from it are reproduced here, as Figs. 3 and 4.

The proposition was there made that, since longer waves are turned back from the Heaviside layer, thereby increasing reception strength on earth at the expense of that on other planets (fortunately for the sponsors of commercial broadcasts who have no retail distribution on the moon), ultra-short waves are desirable for a test of interplanetary reflection, if not communication. It was suggested that a transmitter with a wave of less than two meters (which could be directed like a searchlight) should be used to send a beam directly at the moon, which is presumably a body of considerable reflective power (See Fig. 3). Such a transmitter would be particularly useful with which to test the effect produced on its transmissions by the earth's "space charge," to compare our planet to the *grid* of a tube whose *filament* is the sun.

However, let us consider Fig. 4, also reproduced from the article last quoted; the use of the same transmitter in a downward direction might settle very quickly the possibility of an alternative solution to the problem of the radio echo.

A radio wave moving in empty space which is non-magnetic moves with "the speed of light"—that maximum speed of about 186,000 miles a second which figures in all rough calculations—but *in a magnetic field it is more or less retarded.* When it is passing through material more or less susceptible to magnetic and electrical effects, it loses strength by the setting up of counter-currents in the material. Therefore, a radio impulse might take as long to pass through several hundred or thousand miles of the earth's crust, if it were strong enough to find its way through, as to leap out a million miles into empty space and return. Is there a possibility that the radio echoes are effects coming *up* from the magnetic core of the earth, from which they have been reflected, rather than *down* from the invisible regions which lie between us and the other planets? The beam transmitter of Fig. 4 would tell, perhaps; if directed, not to one side of the core, but *against* it, to measure, not the time of passage, but *the time of descent and reflection.*



A companion of Fig. 3 suggested that the metallic core of the earth might be outlined by the method illustrated. Query: how long will it take a wave to pass through the mineral layers above the core, and return?

Harmonics Cause of Phantom Short-Wave Stations

(*Continued from page* 841)

cies. The harmonics of broadcast stations, beginning with one having half the wavelength (twice the frequency) of the carrier, must fall in the short-wave band—except, of course, for the first harmonic of a station on 400 meters or over. They must, therefore, be picked up by short-wave receivers which are tuned to them, *exactly as if they were the broadcasts of a short-wave station of equal power.* As with the vibrating wire, it will be found that some of the harmonics are stronger than others in the broadcasts from a radio transmitter; and that the *odd-numbered* harmonics, such as the third, fifth, seventh, etc., are sent out much stronger than the even-numbered ones such as the second, fourth, sixth, etc. The higher harmonics, however, continually decrease in strength; so that it is rare to pick up frequencies higher than the seventh or ninth at any great distance from the transmitter.

Another question which has been asked is whether a station can transmit a signal or harmonic at a lower frequency or a longer wavelength than that of the fundamental. By referring again to the vibrating wire, it will be seen that the lowest tone which can be produced is that sounded by the wire vibrating as a whole. For a similar reason, a radio transmitter cannot emit a harmonic at a higher wavelength than the first harmonic or fundamental. Some rare cases have been noted where a signal has been picked up on a longer wave; but these are not due to harmonics, but merely to waves produced by some body of metal or other conductor which has been "shocked into oscillation," therefore "re-radiating" the signal at a wavelength equal to its own *natural resonant frequency.*

COMPLEX FREQUENCIES

It must not be assumed by the reader that the fundamental tone or wave, either of a violin string or a radio transmitter, and its harmonics exist entirely separate and distinct, having individualities like a mother and her children; though this is an idea which might be conveyed by the usual method of dealing with the subject. As a matter of fact, when the fundamental is issued together with one or more harmonics, the latter are merely *modulations* of the fundamental.

Fig. 3 shows the bigger members of a harmonic family. It will be observed that their *"nodes"* or neutral points (corresponding in radio waves to the point where the voltage is about to change polarity) show many coincidences; and so do their points of maximum voltage.

If we create a note or wave whose lowest

component frequency corresponds to, say, that of B in Fig. 3, it is not a *harmonic;* it is then a *fundamental,* and D and F then correspond to its second and third harmonics.

But, as said above, the thing to bear in mind is that a musical note or radio wave does not usually have a simple form, such as the "pure sine waves" shown in the first six curves. If a wave contains simply a fundamental and its third harmonic, we get a complicated wave such as that shown at G, which is the *resultant* of two *components.* If we combine the fundamental and the fourth harmonic, we get such a shape as we find at H; and the combination of a note and several of its harmonics at once will give a wriggly line which cannot be identified, at first sight, as having any relation to any one of them.

But with a wave of this form, a receiving apparatus tuned to *either* the fundamental or any of the harmonics contained in the curve will be sensitive to its modulations. Suppose that the fundamental wave is a million cycles—300 meters, and carries a strong third harmonic—100 meters. It is modulated with a 1,000-cycle note. If we tune it in with a set whose R.F. circuits are set at 300 meters, we shall get the 1,000-cycle note. But we shall not be bothered with the 3,000,000-cycle note, *which is also there,* because we can't hear it.

On the other hand, if we have a short-wave receiver, tuned to 100 meters, the same signal will also come in, and we shall detect and hear, not the 1,000,000-cycle note which is there, but only the 1,000-cycle note.

It is only in such a complex wave as those caused by the interference of two broadcast stations which are fairly near together—within twenty kilocycles, at least—that an undesired audio note can be created by their "heterodyning." The harmonics do not set up a heterodyne, in the ordinary sense, with their fundamental, but they do create a wave capable of being received at several frequencies. Also, one harmonic component of a wave may interfere with the wave of another transmission at a frequency from which it does not differ greatly. Thus the second harmonic of a transmission on 670 kilocycles might cause a whistle in a receiver set to the wave from a 1,335- or 1,345-kilocycle transmitter. It was this consideration which caused the Radio Commission to veto the proposition to split up wave channels into 5-kilocycle and smaller strips to accommodate more broadcast stations.

Figuring Filament Ballasts

(*Continued from page* 843)

more tubes in parallel would allow an unduly high flow of current through one of the same type; and it can be seen why it is undesirable to have any tubes out of their sockets when the battery switch is turned on. This risk is eliminated when each tube has its own resistor.

The use of a reliable voltmeter, it need not be said, is as desirable in skillful set operation as that of a steam gauge in the operation of a steam engine. For this purpose, the higher its resistance, the more reliable its readings, as a rule; for a low-resistance voltmeter is a load on the circuit it is testing and, by drawing additional current, makes its readings deceptively low.

The figures below indicate the resistances necessary to reduce the "A" supply to the specified working voltages, and consequent

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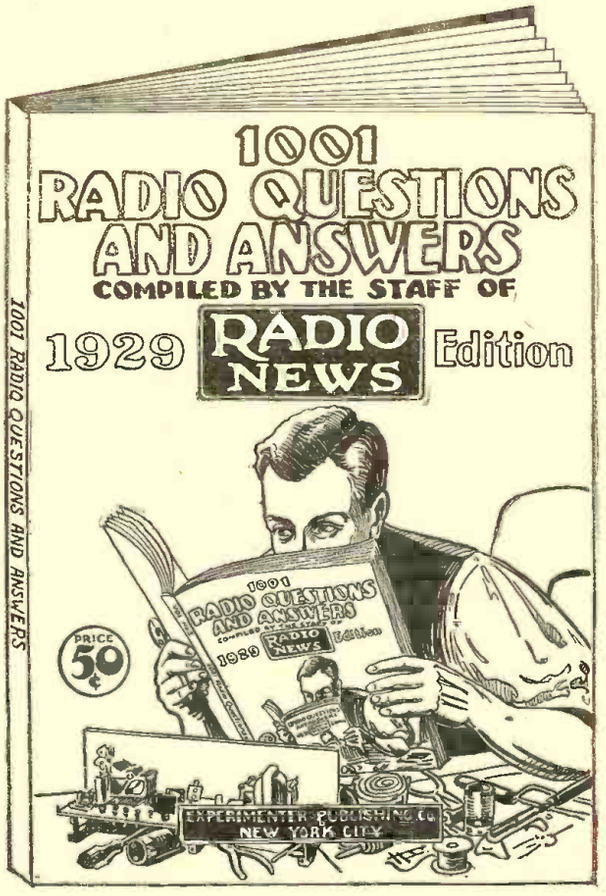

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proper flow of current, through tubes of the types given.

Type of Tube	*Series Resistor Ohms*
6-volt "A" supply	
One 201A (or other ¼ amp., 5-volt tube)	4
One 199 (or other 60-milliamp., 3-volt tube)	50
One 199 (at 3.3 volts)	43
One 222 (at 3.3 volts)	21
(If the filament circuit of several tubes in parallel returns through one resistor, divide the above resistance by the number of tubes.)	
*One 201A, one 222	2 3/5
*Two 201As, one 222	1 3/5
*Three 201As, one 222	1 1/7
*Two 201As, three 222s	1 1/7
*Three 201As, three 222s	7/8
*Four 201As, three 222s	3/4
*One 201A, one 199	3 1/4
*Two 201As, one 199	1 4/5
*Three 201As, one 199	1 1/4

(For purposes of calculating *current* drawn, two 222s equal one 201A, approximately, and two 199s equal one 222. A ½-ampere tube, 112 or 171, counts as two 201As.)

*As this resistor reduces the "A" voltage only to 5, additional resistors will be necessary in series with the low-voltage tubes.

5-volt "A" Supply (Behind Resistor)	
One 222 (at 3.3 volts)	13
One 199 (at 3.3 volts)	27
One 222 (at 3 volts)	15
One 199 (at 3 volts)	30
4½-volt "A" Supply	
One 222 (at 3.3 volts)	10
One 199 (at 3.3 volts)	19
One 222 (at 3 volts)	12½
One 199 (at 3 volts)	25
4-volt "A" Supply	
One 222 (3.3 volts)	6
One 199 (3.3 volts)	12
One 222 (3 volts)	8
One 199 (3 volts)	17

The figures above given are *minimum* resistances and, though fixed filament voltages need not be critical, a lesser value should not be employed—remembering always that resistors may be slightly below their rating and that power units, in particular, may deliver slightly over their rating. The application of too much voltage across a tube filament, within reason, will not burn it out; but it tends to shorten greatly the effective life of the tube.

Radio Wrinkles

(*Continued from page* 842)

simple mounting which can be assembled in little time and with little effort by the constructor.

A piece of round bus bar, ⅛-inch shorter than the diameter of the secondary coil form, is placed through two holes in the tickler form drilled diametrically opposite each other. After drilling and shaping two wooden blocks, 1 x ½ x ⅜-inch, for the ends of the bus-bar shaft, mount a spring on each bus-bar projection and insert it into one of the blocks; the entire assembly is then slipped into the secondary form where it can be rotated, or moved up and down, with the assurance that the tickler will be held in any desired position.—*Contributed by J. A. Donothan.*

On the Short Waves

(*Continued from page 845*)

that you will kindly publish a note announcing this.

G. E. Fuller,
Avellaneda 255, Buenos Aires, Argentine Republic.

(The newspaper account stated that it was suggested that the club be known as a "short-wave" organization; and while this motion was not adopted, the proposed transmissions will undoubtedly be attempted on short waves for foreign listeners. We have asked for details as to the programs which will be transmitted.)

LOCAL INTERFERENCE

Editor, Radio News:

The other night we tried, as usual, to tune in on Station WGY and could only hear the program very faint. By a mere accident one of us happened to lay his hands on the short-wave adapter and to our surprise the reception came in very clear. Thus we continued with "the laying on of hands" during the rest of the time that WGY was on the air and with very good results.

The next day the adapter was taken apart to see if there was anything wrong with it. Inside we found a spider had spun a very beautiful web which had caused the entire adapter to be grounded.

The tube on top of the adapter must have been removed long enough to allow the spider to enter through the holes on top.

We are very curious to know if you have heard from anyone else who has had a similar experience; if not this may be of some benefit to others who use the short-wave adapter in the tropics.

Albert M. Clair,
Chicle Development Co.,
C/o Alvaro Perez, Sucs.,
Alvaro Obregon, Tabasco, Mexico.

(A spider's web should not cause an electrical short-circuit, being akin to silk which is a good insulator; but this, and other material a large tropical spider might drag in, could alter the condenser's capacity; which is evidently what happened.)

AN AERIAL-CONDENSER LEVER

Editor, Radio News:

Thanks for the "Wonder Box," which is my new name for the "Junk-Box." Here is a pointer: when the small aerial condenser C3 is well insulated from the baseboard it smoothes out lots of troubles. I mounted mine on two Polymet resistor bases. My panel is attached to the sub-panel with my son's erector parts; there is a 3½-inch space between the panel and the sub-panel. I used more erector parts to make a simple lever, attached to the sub-panel brace; and I can adjust the aerial condenser *with the set in operation.* When the tickler coils are just right, this little condenser can be very critical; but, after I ran a lead from the soft-iron erector parts to the ground post of set, body capacity disappeared. I added a stage of audio; last transformer, choke and grid condenser are under the sub-panel.

The hams around 80 meters roll, in on this little set on the speaker, strong and clear, from all parts of the United States and Canada, while the hams themselves are howling "I can't get U, OM, QRM here to-night." This is my first letter after several years of reading the only *real* radio paper ever printed.

Joseph Moore,
General Delivery, Flint, Michigan.

CORRESPONDENTS WANTED

Editor, Radio News:

I would appreciate it if some amateur or short-wave fan could help me in getting a license.

Paul B. Lovegren,
7846 Euclid Ave., Chicago, Illinois.

Some of the other readers of Radio News who express a desire to communicate with other short-wave fans are: James Fletcher, 173 Avoniel Road, Belfast, Ireland; Kendall B. Wood, 3 Harvard Place, Ann Arbor, Mich.; Melford C. Kupps, (wishes California correspondence) 537 North Meyler St., San Pedro, Calif.; Ben F. Locke, Marthaville, Louisiana (interested in the "Pilot Wasp"); Larry Lucas, 19928 Canalport Ave., Chicago, Ill. (wishes letters from hams); Earl Eugene Martin, 114 So. 34th St., East, Cedar Rapids, Iowa; George C. Brown, 96 Eighteenth Boulevard, Rockaway Beach, New York; John A. C. Bechtler, 114-11 One Hundred and Twenty-Sixth St., South Ozone Park, New York (broadcast receivers and accessories as well); William Henderson, Route 2, Thomaston, Georgia.

The Constructor's Page

(*Continued from page* 850)

houses of offer dealers' discounts to individuals should be discontinued; as it would soon ruin the parts business.

In my estimation, no such business exists outside of such houses. Since reading his letter, I have visited several radio stores (some in Springfield) trying to buy parts, and failed in buying even a binding post. They not only fail to carry parts in stock, but will not offer to obtain them on special order.

They also insist on giving a long monologue on how foolish it is for anyone to build a receiver; as much better manufactured sets may be obtained (those they sell, in particular).

I do not blame these dealers for not carrying parts, if there is not enough demand for them; but I do not believe a dealer who will not risk his money carrying parts and does not want to sell them, anyway, is entitled to the profit. Honest experimenters should not be forced to pay list prices when they have to take the trouble of doing the dealer's work in sending for parts themselves.

If anyone is ruining the parts business, it is the dealers who try to discourage amateur set builders and experimenters.

NAPOLEON A. YOUNG,
15 *High Street, Monson, Mass.*

(*There were in* 1923, *in the United States, not less than* 24,000 *stores retailing radio parts; it is to be doubted that, at the present time, there are more than* 300 *making a serious endeavor to do so. The dealers complain that mail-order competition is killing their business; yet most of them had long discontinued their line of parts, even before the mail-order houses began to offer goods at practically wholesale prices. The reason is, of course, that a dealer has to have a complete stock in order to carry parts at all; and most dealers frankly admit that this is too much work and bother for them, and that is why they have taken to the set business entirely.*

Our correspondent, in his letter, has stated the case accurately.—EDITOR.)

NOISY A.C. DETECTORS

Editor, RADIO NEWS:

In the majority of cases, frying or humming noises in an A.C. elcetric set may be traced directly to the 227-type detector. One can easily tell by disconnecting the aerial and tapping the 227 tube, with the set turned on. Usually the tapping will cause the noise to cease temporarily.

Now here is the point: it is often impossible to obtain adjustment on these tubes, as they test perfect. What can we do with them? They represent $4.00 each; shops accumulate several dozen in a month.

Becoming disgusted, we decided to put some of them out of their misery, by placing the heater terminals directly across the output of a good, healthy storage battery. Result? No, the tube did not flash out; the heater did heat, though. Now, is it not a natural conclusion that these frying noises produced by the tube are caused by poorly-welded connections and that the excessive voltage produced a high temperature in the heater element which corrected these? We checked the tubes for emission in a tube tester and then tried them in sets. The noises were gone.

If you have a flock of noisy 227 tubes, try this: apply 5 or 6 volts for about 30 seconds. If they don't burn out, there is a pretty good chance the useful life of the tube is extended.

PAUL L. MCCOUN, *W9EHB,*
1218 *So. 17th St., St. Joseph, Mo.*

(*Desperate cases may require desperate remedies. One method of reducing hum—not contact noises—is to put a positive voltage, say* 45, *on the heater of the* 227 *tube, as compared with the cathode.* —EDITOR.)

TWO STATIONS ON ONE WAVE

Editor, RADIO NEWS:

The letter of Albert E. Gleason regarding the fading of signals from WBZ and WBZA causes me to write to say that the same thing is observable here; two years ago the editor of the *Rutland Herald* spoke of it in an editorial. I wrote to the radio editor of the *Boston Post* and suggested that it might be due to the signals part of the time, but he could not agree with me. However, I do know that reception from WBZ has not been as good since WBZA began using the same wavelength, as it was before.

R. L. HASTINGS,
Granville, Vermont.

Editor, RADIO NEWS:

If it will be of any help in solving synchronization problems, I will add the information that, while Worcester, Mass., is approximately half-way between WBZ at East Springfield and Boston, the power of WBZ is 15,00 WBZA at watts; while that of WBZA is only 500 watts. he problem, however, is complicated by the fact at some interfering condition exists at Wor ter or near it which blocks reception of WBZ from people very far east of Worcester; and b ks reception of WBZA from people living very ar west of the city.

A. R. AB r,
125 *Chestnut St., I yoke, Mass.*

WOMEN'S INTEREST IN ADIO

Editor, RADIO NEWS:

May I combat the opinion Mr. neker voices in the September issue? He is conv ced women's only interest in radio magazines is sentimental one; leading me to believe that knows only the type who prefers her newspape for the pictures rather than as food for though I am earnestly convinced that the majority women are carnestly endeavoring to grasp some f the essentials relative to good reception, u ep and an insight into the future of radio. While some might enjoy knowing more intima y the facts pertaining to the personalities in lio, if they had the slightest experience in t line, they realize that such interest is futile I quote R. W. Service:

"Dreams are best—
But ye must not seek too r."

For the shut-in, the isolated wom woman is her best friend, councillor, and insp tion. Music is the language of the soul and, e more she makes it an important part of her e, the more does her heart, mind and soul expand *Real* women desire more than the frosting on cake.

(MRS.) E. CORSON,
Manhasset, L. New York.

FROM A JUNIOR REA R

Editor, RADIO NEWS:

I am only twelve, but I am very ch interested in radio. I have been listing all the ations I can get, 33 in the last three months. T only station I got on the dial over 75 was GBS Rugby, England (*This was an American rebroad t—GBS is a short-wave station and cannot be hea on a broadcast receiver without an adapter.*) ave the January issue of RADIO NEWS and find i elpful to me. I have given two speeches on radio at hool and got 88 and 90 per cent. in oral Englis I will give another Thursday. I hope it will b successful. I know I would not have got over 83 cent. before if I had not read the October RADIO ws. If this letter will do any good, you can pub it, to show that boys as well as men can run take apart radios.

J. P. PAPEZ
101 *Elmwood Avenue, Ith , New York.*

(*Many of our youngest readers t an exceedingly intelligent interest in radio, an nake it their business to learn thoroughly, where any of their elders skim over the subject.*)

DON'T ASK FOR A LOCATION UEPRINT!

Editor, RADIO NEWS:

The real test, as Mr. O. R. Aikma calls it, of a set is to use a wet "A" battery and y "B"s, and disconnect both aerial and ground. I e in a stucco house, plastered-over metal lath ou de, and am able to tune in all local stations, d some outsiders as far as Denver on a four-tu T. R. F. set without aerial or ground. If Mr. kman doubts this, let him write to any friends h may have in Los Angeles and ask them to call me and be convinced. With the aerial and grou I have had reception, verified by letter, of 4QG, isbane, Australia. *It's not the set—it's the loc .*

R. WILLIS,
6332 So. Cottage St., Huntingo Park, Calif.

RECEPTION WITHOUT A ENNA

Editor, RADIO NEWS:

I note with interest the letter fr Mr. O. R. Aikman of Salem, Illinois, and yo comment in regard to readers being able to rec e on power-unit line alone as an aerial.

I have for some time been puzzled the peculiar action of a superheterodyne of my ov design, with a one-stage Robert's neutralized lio-frequency amplifier ahead of the first detec . This set receives all of the more powerful s lons without either ground or aerial connection f any sort. Ordinarily, I use an indoor aeria f about 25 feet with a waterpipe ground. To sconnect the aerial reduces volume about 25 pe ent, and to further disconnect the ground lea reduces the volume about the same. I thus ive stations with about 50 per cent volume thout either ground or aerial leads attached. W n aerial and ground are disconnected, the tuning the antenna

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circuit changes about one degree on the dial and requires very fine adjustment.

This set uses an inductively-coupled coil in the antenna circuit, wound on a two-inch tube; and neither positive nor negative filament leads are grounded. This set previously had the negative filament lead grounded; but, in order to use a short-wave converter, I found it necessary to disconnect this lead in the set.

Last night I had good reception from Kansas City, Mo., and Hot Springs, Ark., using neither aerial or ground, and atmospheric conditions were not good. When receiving in this manner, I find that to place the ground lead within two or three inches of the aerial coil produces a noticeable increase in volume.

I recommend for those superheterodyne fans who wish really clear, natural reception the use of the crystal as a second detector. I am using a carborundum unit with flashlight-battery bias and the tone of this set is as nearly perfect as any set I have ever heard, with almost complete absence of noise.

F. L. Worcester,
Mutual Bldg., Richmond, Virginia.

INTERNATIONAL HETERODYNING NEXT?

Editor, Radio News:

Japanese broadcasting has followed the American lead, and the BCJ chain (Broadcasting Corp. of Japan) was completed at the beginning of November, 1928. We are now able to hear everywhere programs of high degree, originating in Osaka or Tokio. American DX hunters around the Pacific coast should be able to hear the same, from 8 p. m. Japanese time (*3:00 a. m. the same day, Pacific standard time*) on some of the Japanese wavelengths.

On Nov. 10 at 3 p. m. all Japanese radio listeners heard over the BCJ chain the "Banzai" shouted by Premier Tanaka before the "Shishinden," where the enthronement of the Emperor and Empress was taking place; also the National Anthem played by the navy band and the voices of the people gathered at the ceremonies.

I am experiencing trouble occasioned by a continual heterodyne whistle between 3LO, Melbourne, Australia, and JOCK, Nagoya, Japan; as well as between 3LO and an unidentified station which I am sure is 7CA, Calcutta, India, at times. There is one regularly between 2FC, Sydney and COHB, Harbin, Manchuria; and sometimes between 2BL, Sydney, Australia, and JOFK, Hiroshima, Japan. This is caused because stations occupy channels so close together as 370 and 371 meters. I am able to find two pairs of stations which might cause a heterodyne: KGO, Oakland, California, and JOGK, Kumamoto, Japan; also KPO, San Francisco, California, and 2FC, Sydney, Australia.

I hear that in the United States a careful clearing of wave channels has been carried out, and that all the stations are being picked up easily without heterodyne squeals. I am anxious to know if this is true, and if readers of Radio News at different points throughout the world would drop me a line to tell what heterodynes they find, I shall be much obliged.

Minoru Nakamura,
Yamate, Oiso, Kanagawaken, Japan.

(*The troubles of regulating radio in North America and in Europe alike have been many. In the former, with only four countries to consult, international problems have not been acute; but the commission has simply put small stations in the United States on the same waves and let them interfere with each other to their heart's dissatisfaction, while giving cleared channels to high-power stations. As a ten-kilocycle whistle is rather above ordinary ears and audio amplification, little trouble should be experienced by owners of fairly selective sets, except in locations so near to a transmitter that its wave seems unduly broad. In Europe, with many populous nations in a small area, greater trouble is experienced in making allocations; and the first of this year has ushered in wide and sweeping changes. However, heterodyning between continents is a new proposition; and if it must be taken into consideration, all the problems previously facing radio administrators will become insignificant. We have learned that reception across the Pacific is seemingly better than across the narrower Atlantic; but apparently high DX sensitivity must bring drawbacks. It would be a terrific surprise to the average DX listener if he found WJZ heterodyned by Hamburg, Germany; WGY by Stuttgart or WLW by Frankfurt. Have any of our readers with supersensitive sets been troubled like this?*)

WE ARE REBUKED

Editor, Radio News:

I have been an ardent radio enthusiast since the opening of the pioneer station KDKA, and remember well the opening of some of the other old-timers such as WWJ, WJZ and WSB and others. Beginning with a simple one tube set when it was impossible to secure pa and a complete receiver was unheard of (tl is, for broadcast reception) I have since bu for my own use and experimented with every cuit that I considered worth while.

Perhaps it would interest you to kn that my present receiver, which I consider to l the peer of them all, is none other than the N roheterodyne, first described in Radio News in my opinion this receiver has not received ie notice that it deserves. Instead of the circui published I am using a stage of tuned R.F. ah l of the first detector and three stages of interm ate R.F. at 850 meters, instead of two at 650 ers, and I also use the grid-bias method inst of the condenser-leak method on second dete r. The A.F. amplification and power pack ar separate, using three stages of audio; impedance-, sistance- and transformer-coupled, respectively; e trans- former feeds into two 71 tubes connecte in paral- lel. The output transformer is home- structed, feeding into a home-constructed dyn uic cone speaker made from an old Magnavox un

I do not believe the Neutroheterody has re- ceived the attention that is due it and, encour- age its use, I shall be glad to assist one to the extent of my ability in constructing nd oper- ating this receiver. The only thing isk is a stamped envelope for reply.

One of the worthless articles appearin n Radio News recently is the Loveless antenn I have no patience with articles such as this. It would be perfectly all right if it were just nored by your readers, although even then it uld take up space in your magazine that could b rofitably used for something worth while; but it not ig- nored by a great number of your reade judging from the number that write you both p sing and condemning it. Now I am not an ex t nor a "designing engineer" (as some of my nds call themselves) but the aerial question was ettled as far as I am concerned several years go. Up until that time I followed every fad d fancy regarding aerials, loop, underground, de, out- side, vertical, horizontal, bare and insu ed wire.

For everyday satisfactory reception s as the majority of us want, the best place and est kind of aerial is the most convenient one; t means just string it up in any convenient pl , fifteen feet or more above the ground and for or more feet long. If the receiver is what it ould be, such an aerial will bring in just as mar stations, with just as much volume and select ty, with the same amount of static both natural nd man- made in proportion to signal as any er trick aerial ever conceived. The least of wor is your aerial. Needless to say I have not tried ne Love- less aerial nor do I intend trying it; f I would not use such a cumbersome outfit even it per- formed as the author claimed. You s uld drop this rot.

V. F. Holland,
528 *Pinckney Court, Spartanb , S. C.*

(*We must bespeak the kind patien of our readers for articles which may seem ecessary to them; but we may point out that the ost con- venient type of aerial differs for residen of New York and residents of Nevada, perhaps One of our readers in Canada writes that the of dis- tilling water for battery purposes is culous— it is necessary only to melt new-falle snow to obtain an ample supply. And, probably reader in Panama would have no more patience with this suggestion than Mr. Holland has with ple who reside on the twelfth floor of a twenty- story building, and who have the same opp unity to put up a good outdoor aerial that he s to be elected president of the United States. may be further remarked—as it is elsewhere in is issue —that the importance of the antenna s em can- not be overrated, so far as distance ption is concerned.*—Editor.)

THE EAST PASSES JUDGME

Editor, Radio News:

I have been a constant reader of your agazine for several years, as well as of several er pub- lications, both British and American, derive much pleasure and information from the

Radio broadcasting over here has not en very popular in the past, the fundamental re n being the lack of broadcast stations. Howe , there are some very keen amateurs here who succeed in bringing in far-away stations, especia on the short waves. However, we are assur by the government of a local broadcast static in the near future.

Radio dealers here are very few; but at they have for sale are good quality parts of both British and American origin, widely vertised in your own and other radio journals; s we have a fairly good chance of comparing B ish and American parts and ideas. The writer is opinion that, providing parts of well-known kes are

selected, there is very little to choose in general between both countries. You Americans excel in superheterodyne construction, "A" and "B" power units and socket-powered sets, as well as in R.F. amplification.

But there is one point in which the writer is dissatisfied with American apparatus, and that is in the matter of vacuum tubes. It is his unbiased opinion that the British tubes are very much superior, and I think that the American public does not realize it. Take, for instance, the 201A type of tube; the impedance is approximately 10,000 ohms, amplification factor 8, filament current 0.25-ampere, volts 5; the conductance being roughly 0.7 milliamps per volt. The 199-type has an impedance of 16,000 ohms, amplification factor 6, filament volts 3, filament current .06-ampere; the mutual conductance being roughly 0.3. These are representative examples of your general-purpose tubes, as used for both radio- and audio-frequency amplification.

Against these may be compared the British "valves" for general purposes, such as the new Marconi and Osram DEL610, whose characteristics are: filament volts 6; current 0.1-ampere, impedance 8,000 ohms, and an amplification factor of 15. The DEL410, with a filament voltage of 4, current of 0.1-ampere, has an amplification factor of 15. And compare the 240-type with the DEH610; the former has an amplification factor of 30 for an approximate impedance of 150,000 ohms; while the latter has an amplification factor of 40 for an impedance of only 60,000 ohms. And look also at the British screen-grid tubes, especially Ediswan; the SG610 with a filament voltage of 6 and current of 0.1-ampere has an amplification factor of 140 for an impedance of 100,000 ohms; while the 222 has an amplification factor of 180 for an impedance of approximately 800,000 ohms. You will see that British tubes are enormously superior.

A simple test can easily be made by the substitution of a British tube in an American circuit designed for say, the 201A-type, for which a DEL610 is very suitable. The amplification obtained will be increased very noticeably. In the Browning-Drake circuit, such a test in the radio-frequency amplifier increased amplification enormously; so you will see that there is a good deal to be done in the matter of improvements in American radio tubes. The introduction of the Ceco "Type K" is a step in the right direction; but results as yet do not compare with the British tubes.

The writer does not wish to disparage the American product; but in the craze for sensitivity and volume would it not be more sensible and logical for the manufacturers to look into the matter of vacuum tubes? American research laboratories have done extremely well in the performance of amplifier coupling devices, both radio- and audio-frequency, such as the Loftin-White, the Jewell, the Hiler, the Clough and others; let us see some improvements in tubes.

There will be a huge market for the sale of radio in China in the near future, if only the government becomes a little more settled and officials do not consider radio sets as contraband of war. But literature and catalogs relating to American products are rare here. The writer, as a dealer and constructor, would welcome any which your manufacturers may send him.

EDWARD CHAN,
P. O. Box 262, Hongkong.

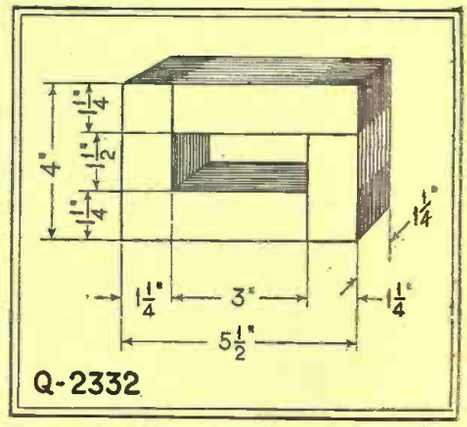
(The late Col. Mulberry Sellers, with all his optimism, never visualized the market which a modernized Orient offers for radio. The criticism which our correspondent offers impartially may be of interest to our readers; although American tubes, developed for the American trade primarily, are of the highest quality, they may not be so satisfactory as the European tubes for consumers bent on strict economy. The design of the American tubes has reached a high degree of standardization; the short list of tube-types which we are now publishing is hardly a tenth as long as the European roll of "valves." The American receiver of commercial manufacture furnishes the principal demand for tubes; and no such economy is sought in their use as in Europe, where it is important to squeeze the last bit of energy out of each tube. The British radio press chronicles with awestruck surprise that the average set exhibited at the World's Fair in New York last fall had seven tubes; and wonders what in the name of Croesus the maximum could have been. If the American manufacturer finds that a couple of extra tubes which add no amplification will make it easier for the lady of the house to operate the receiver by the snap of a switch alone, he incorporates them in the design, and they are charged to the paying teller of the family. Nor, since there are light-sockets everywhere (almost), does an extra hundred, or two hundred, volts of "B" present an obstacle. In Europe, as in Asia, such Sybaritic luxury does not appeal to the average home constructor.— EDITOR.)

I Want to Know

(Continued from page 852)

and, in this case, No. 12 D.C.C. wire should be used to carry sufficient current for a number of 226-type tubes. Center-tapping of the windings which require it should be done as the winding progresses, and the ends of the wires should be brought out through holes in the end of the spool.

One section of the core should be assembled with the long laminations, (offsetting every other one, 1¼ inches, so that the core will fit together correctly; see Fig. Q2332) using enough to make a pile 1¼ inches high; the pieces are then bound firmly together with friction tape. The spool containing the windings is next slipped over the core and fastened tightly by forcing several wooden wedges between the coil and the core. Finally, the rest of the core is assembled around the coil and the complete core is firmly bound with friction tape to prevent the laminations from vibrating.



Four laminations are used for each layer of the core; they are "staggered" to make it firm. It should be bound firmly together.

It might be well also to clamp the laminations tightly between wooden blocks, although this is not essential. Such blocks are 5 inches long, with holes cut in the ends to carry bolts. Four are required, and placed at the opposite ends of the core; one at each side with a bolt at each corner. To design a transformer for 25-cycle current, the cross-sectional area of the core should be twice the given value, or 1¾ inches square; the same number of windings will be used in each case.

HIGH-FREQUENCY FILAMENT SUPPLY

(2333) Mr. A. H. Murray, Rochester, N. Y. writes:

(Q.) "Can you give me some data as to how I may step up a 6-volt 60-cycle current of four or five amperes to radio frequency? I believe that the Fansteel Company uses such an arrangement in their new radio receiver. If details cannot be given, I will be satisfied with an idea of how to proceed, so that I will be able to do some experimenting along this line?"

(A.) Most A.C. receivers produce a small amount of hum, even though care is taken to prevent this. The 226-type tubes cause a considerable amount of hum unless they are carefully balanced, and even the 227's with isolated heater-filaments are not absolutely free from hum. The "A" power units used to electrify battery-type sets are practically hum-free, if properly constructed, but they are affected by changes in the supply voltage. Series-filament arrangements have been used with some success, but radical changes must be made in the wiring of the set for such a method of supply. Other complications, such as audio feedbacks, are also encountered and are often hard to eliminate in sets of this type.

One method of overcoming these difficulties has been utilized by a radio manufacturer, to change the rate of alternations in the supply voltage from 25 cycles or 60 cycles to a *frequency above the audible range.* In this way, ordinary battery-type tubes can be operated from an alternating-current supply without noticeable hum. A frequency is chosen above the audible band but not high enough to cause interference in the radio frequencies. Such high-frequency currents are produced by a 250-type tube, which is supplied with current from an ordinary high-voltage "B" power unit, using 281-type rectifiers.

The 250 tube is connected as an oscillator with a suitable coil arrangement, using either very thin laminated iron, iron filings or air only, even, in the cores. An ordinary oscillator circuit, such

as the Hartley, is used and suitable coils are coupled to the oscillator inductor to light the filaments of the tubes in the set. The tubes are connected in the usual parallel manner.

Offhand, one would not suppose that a 250 tube can supply sufficient current to light the filaments of the tubes used in a radio set; but it must be remembered that the plate current of this tube is almost 25 watts at maximum value and the current required for the filaments of an average 5- or 6-tube set, rarely exceeds 12 watts. The frequency of the current does not affect its ability to light the filaments as long as there is sufficient current, and a suitable oscillator arrangement can be made to supply this current.

The power tube or tubes in the receiver can be operated from the usual 110-volt-primary, step-down transformer; since very little hum is noticed when these tubes are operated on the 60-cycle supply, and this lightens the load on the oscillator even more. The transformer must be specially constructed, as mentioned above, and no information is available as to the construction of a filament transformer of this type. If the system is to be tried out, the experimenter will have to try different core arrangements, etc. No one except an amateur familiar with transmitting work and R.F. currents of some magnitude should attempt it.

Another point which must be considered is the control of the filament supply. This may be accomplished by controlling either the filament voltage or the plate voltage in the oscillator tube; it might be varied also by adjusting the value of the grid leak on the oscillator. The filament current for the 250 oscillator tube in manufactured power units is supplied from a special filament winding on the power transformer; which supplies also the plate current for this tube and the other tubes in the receiver.

THEM AIN'T WOLVES, THEY'RE MOSQUITOES!

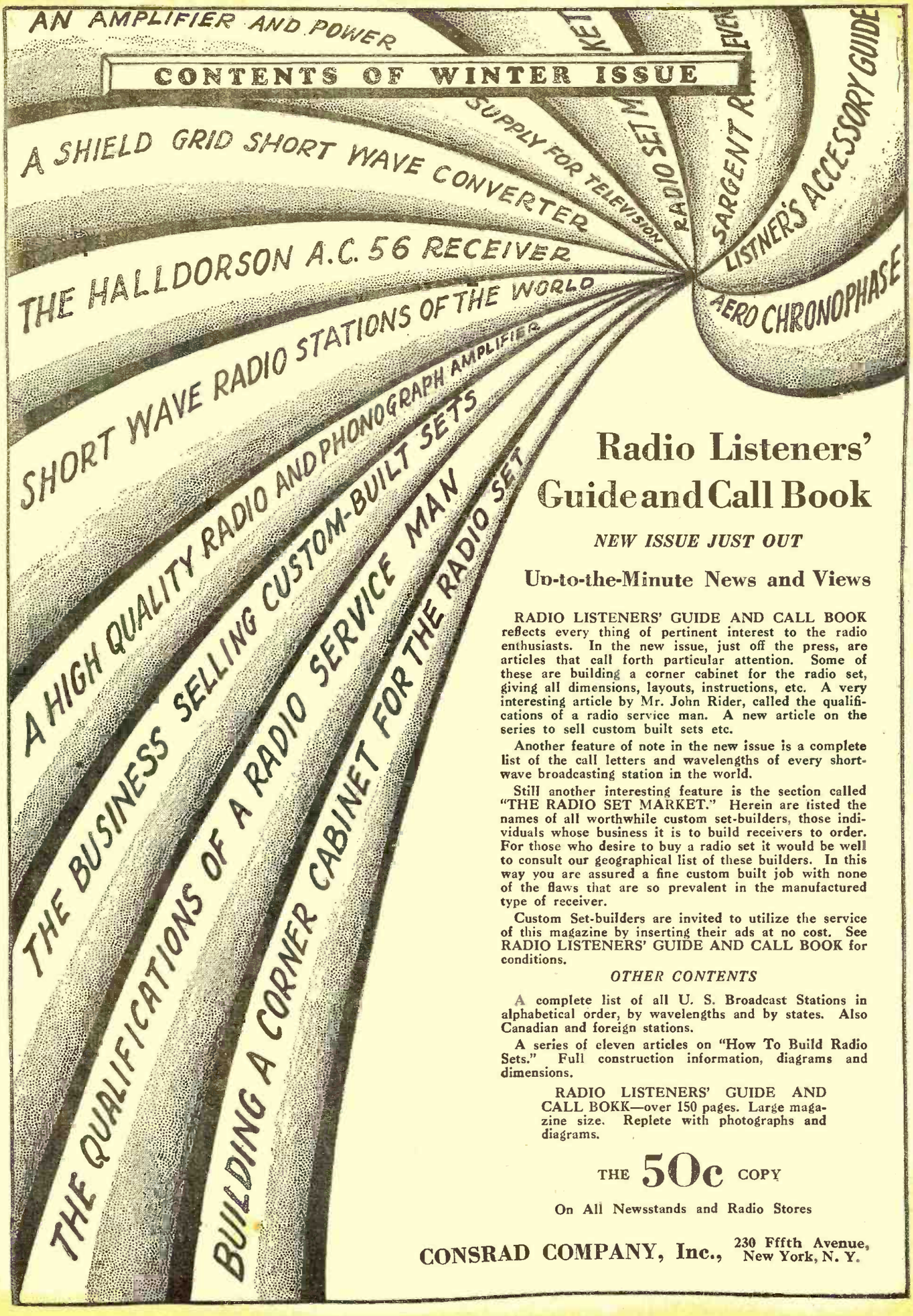
Aspersion on New Jersey's suburban residence belt and on the RADIO NEWS station is, we fear, contained by innuendo in this listing from the latest *Citizen's Radio Call Book*: "W2XAL-WRNY, COYOTESVILLE, N. J." Our worthy chief engineer,

Mr. Maresca, climbed the aerial masts with his trusty Springfield, and reported not a coyote in sight.—*Joseph Riley.*

NO USE—WE TRIED IT

Volume-control tip from the *Providence Journal* calls for resistor of about 100,000 ohms which "should be inserted so as to control the LATE voltage on the radio-frequency tubes—all three or four of them." Our "B" batteries have run down until we can speak of their voltage as the late lamented; but we don't believe any resistor will get another amp. out of them. We'll just have to buy more.

—*Chester H. Page.*



Radio Listeners' Guide and Call Book

NEW ISSUE JUST OUT

Up-to-the-Minute News and Views

RADIO LISTENERS' GUIDE AND CALL BOOK reflects every thing of pertinent interest to the radio enthusiasts. In the new issue, just off the press, are articles that call forth particular attention. Some of these are building a corner cabinet for the radio set, giving all dimensions, layouts, instructions, etc. A very interesting article by Mr. John Rider, called the qualifications of a radio service man. A new article on the series to sell custom built sets etc.

Another feature of note in the new issue is a complete list of the call letters and wavelengths of every short-wave broadcasting station in the world.

Still another interesting feature is the section called "THE RADIO SET MARKET." Herein are listed the names of all worthwhile custom set-builders, those individuals whose business it is to build receivers to order. For those who desire to buy a radio set it would be well to consult our geographical list of these builders. In this way you are assured a fine custom built job with none of the flaws that are so prevalent in the manufactured type of receiver.

Custom Set-builders are invited to utilize the service of this magazine by inserting their ads at no cost. See RADIO LISTENERS' GUIDE AND CALL BOOK for conditions.

OTHER CONTENTS

A complete list of all U. S. Broadcast Stations in alphabetical order, by wavelengths and by states. Also Canadian and foreign stations.

A series of eleven articles on "How To Build Radio Sets." Full construction information, diagrams and dimensions.

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Radio Literature

(*Continued from page* 847)

POWER AMPLIFIER MANUAL, published by Thordarson Electric Manufacturing Company, Chicago, Ill. Pamphlet, 7½x10 inches, 64 pages, circuit and schematic diagrams, half-tones. Price 25c.

Here is a little booklet which should please the radio constructor who finds himself dabbling with power units and power amplifiers. The publishers, well-known manufacturers of radio apparatus since the days of 200-meter "spark" amateurs, have presented to the radio fan every type of "B" power unit and power amplifier worth bothering with. And have done so in commendable manner—plenty of schematic diagrams, circuit diagrams and pictures for the fan who feels their need. While it is only natural to assume that the publishers have specified and illustrated their own products throughout—and they have—it should be borne in mind that the diagrams they offer apply to standard apparatus produced by any manufacturer of power-unit components; schematically, a power transformer is just a power transformer, and the same may be said of a filter condenser or a resistor. In other words, should the constructor desire to build from this pamphlet with suitable apparatus he has on hand, he will have no trouble in doing so.

A RESUME OF THE TUNED-DOUBLE-IMPEDANCE SYSTEM OF AUDIO-FREQUENCY AMPLIFICATION, by John F. Rider. Published by Hiler Audio Corporation, Irvington, New Jersey. 11½x8¾ inches; 16 pages; pamphlet; diagrams and curves. Free distribution.

Mr. John F. Rider, though he be ever so slightly bald and wears glasses, is a research engineer who has done more to make the "characteristic curve" popular with the experimenter than has any other pioneer in this difficult and worthy endeavor. Furthermore, the gentleman in question possesses an uncanny knack of emerging from his laboratory (famous for its thorough instrumental equipage) and presenting to all who are interested in technical radio a compilation, a table or a curve. Whatever it may be, the reader may rest assured that it is accurate and worthy of reading—otherwise Mr. Rider would not have bothered with it. The pamphlet reviewed herewith is somewhat of a compilation or, better yet, a thesis accompanied by a group of enlightening curves which deals with relative audio-amplification systems and just why they are or are not that way. Though the handling of the subject is somewhat above the beginner's ken, it should be read by all who are interested in this subject; for Mr. Rider promises in the foreword of his excellent pamphlet to emerge from his laboratory every so often with a new pamphlet on the same subject until he has completed a series which will cover the subject in his usual thorough style.

While it is not the reviewer's position to question or affirm the contents of the pamphlet, it must be admitted that the cause of the tuned-double-impedance audio amplifier is championed in a most convincing manner. In fact, the mathematically precise proofs offered by the author and the manner in which the entire matter is presented should be enough to sway any experimenter interested in audio-amplification systems.

A.C. TUBES—HOW TO USE THEM, by John F. Rider. Published by Radio Treatise Company, New York City. 11¼x9 inches; line drawings and curves, 75 pages. Price $1.00.

There should be a law compelling every radio constructor to read and study the contents of this book. It is the best dollar's worth of vacuum-tube literature ever presented to the experimenter.

We are very anxious to have every "expert" who doubts the efficacy of the A.C. tube read this book; for we are quite sure that, even though it is nothing more than a simple treatise, he will stagger through the very comprehensive and intelligent writings of Mr. Rider. Then we are positive that we will be rid of another pest of the know-all type.

In his introduction the author says, "A.C. tubes are satisfactory—providing that the tube used is of good design and that it is correctly employed." In our estimation that is not strong enough, though we admit it was written by a mind a bit more conservative than ours. It should have been worded as follows: "A.C. tubes are the equal of any other type—providing the user has a mental age of more than 10 years. Every high-priced commercial receiver built today—offering tonal quality, ease of operation and cleanliness of maintenance such as was never dreamt of five years ago—employs A.C. tubes throughout. In the vernacular— Laugh that off!"

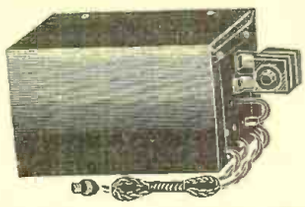
However, all this does not describe the book, which contains about everything worth-while knowing about A.C. tubes and their operation. It is chock full of circuit diagrams, curves and suggested circuits, and presents its subject matter in customary Rider style. More than that cannot be said of any book.

Radio News Laboratories

(*Continued from page* 847)

"A" POWER UNIT

The "No. 600" "A" power unit submitted for test by the R. B. Specialty Company of 318 Sycamore Street, Cincinnati, Ohio, is designed to operate directly from a 110-volt 60-cycle house-lighting circuit. Under actual use, two amperes of current at six volts were obtained without hum or undue heating. The rectifier element is of the dry-disc type and rated at 2.5 amperes. The entire apparatus, comprising a step-down transformer, choke and filter condenser, is enclosed within a black enameled sheet



metal case, 6 inches by 8 inches by 5 inches. A bakelite panel serves as a mounting support for the rectifier element and also for tip jacks which are used for the adjustment of the device. A ten-foot extension cord leads to the light receptacle, and two three-foot colored leads are supplied for the output.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2532.

CAGE-TYPE ANTENNA KIT

The cage-type antenna kit submitted by the Thorola Radio Products Co. of 110 E. 21st Street, Chicago, Illinois, is composed of five strands of No. 16 enameled wire, separated by four discs which taper from a diameter of ¼ inches at each end. The length of the cage is approximately 30 feet without the lead-in; it is supplied with two porcelain insulators and a lightning arrester. The construction is very rigid and will withstand hard usage.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2534.

SHIELD CANS

The "Type AS-1" shield can, submitted by the Hammarlund Mfg. Company, 424 W. 33rd St., New York City, N. Y., has been designed to enclose R.F. stages of radio receivers where a shielded compartment 6x7x6 inches is required. The can is constructed of sheet aluminum 1/32-inch in thickness; its sides are held together by aluminum corner pieces which slide into place, making a rigid and positive contact joint. When completely assembled, the can was found a very effective electrostatic shield, due to the lap joints of the various sections. The "Type AS-29" shield can is of the same general characteristics but with dimensions of 6 inches by 8 inches by 5⅛ inches, and designed for use in the Hammarlund-Roberts "HiQ-29 Master" radio receiver.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATES OF MERIT NOS. 2535 AND 2536.

No. 2536

No. 2537

The "Type HQS" shield can, submitted by the same concern, has been designed for use where a double-compartment can is desired. It is con-

(*Continued on page* 895)

OPPORTUNITY AD-LETS

Follow these advertisements every month. Reliable advisers from all over the country offer their most attractive specials in these columns.

Classified advertising rate twenty-six cents a word for each insertion. Names and addresses must be included in the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisements for less than 10 words accepted.

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Inventors—Should write for our Free guide Book, "How To Obtain A Patent" and Record of Invention Blank. Send Model or sketch and description of inventions for inspection and Advice Free. Radio, Electrical, Chemical, Mechanical and Trademark Experts. Terms Reasonable. Victor J. Evans & Co., 922 Ninth, Washington, D. C.

Patents

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Print Your Own Cards, Stationery, Circulars, Advertising, etc. Complete outfits, $8.85; Job Presses, $11, $29; Rotary, $149. Print for others; big profit. Easy rules furnished. Write for Catalog Presses, Type, Paper, etc. Kelsey Company, J-13, Meriden, Conn.

Radio

Dealers and Set Builders—Write for lowest prices on A and B power devices. D. L. G. Mfg. Co., 2937 West Lake, Chicago.

Wanted: Men to work with National Radio Service organization. No selling scheme. Radio Doctors, Inc., Dept. N. Essex St., Salem, Mass.

Radio (Cont.)

Build Your Dynamic Speaker with our castings and instructions Send M. O. for $8.50 to A. C. Klein Co., 1058 N. 10th Street, Reading, Pa.

Bargains, used radios. Guaranteed perfect working order. Blue Ribbon 5 tube, 2 dial, Console $19.95. Freshman $14.95. Atwater Kent $19.50. Tubes included. Many famous makes. Send money order with order. Bargain list on request. Surplus Radio Co., Dept. 2-C, 172 W. Harrison St., Chicago.

For Sale—New type short-wave coils and receivers. A. R. Dempster, Uhrichsville, Ohio.

Powerful, shieldless, loop, antennae circuit, $1. Archer, 617 Decatur St., Brooklyn, N. Y.

Salesmen Wanted

Screw-holding screw driver! Amazing brand new patented invention! Retails $1.50. Factories, garages, electricians, auto, radio owners buy on sight! Exclusive state territory. Genuine opportunity earn big money. Free trial offer. Jiffy, 1058 Winthrop Bldg., Boston.

Song Writers

Song-poem writers, Address, Monarch, 236 West 55th Dept. 322, New York.

Song-Writers:—Communicate with Kendis, Gusman & Samuels, Inc., Music Publishers, 145 W. 45th St., New York. Enclose return postage.

Song Poems Wanted: Write at once. Valuable instruction book given free! Bell Music Co. D-11, St. Louis, Mo.

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Illustrated U. S. Price List 50c; Large U. S. and Canadian List Free. Stanley Gibbons, Inc., 38Z Park Row, N. Y. C.

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Telegraphy—Both Morse and Wireless taught thoroughly. Big salaries. Wonderful opportunities. Expenses low, chance to earn part. School established fifty years. Catalog free. Dodge's Institute, Cour St., Valparaiso, Ind.

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"THE FUTURE" is one of the most remarkable books of the age. Professor Low, the author, is a scientist of international reputation, also an experimenter and inventor in the many branches of science. This book written by him has aroused wide-spread interest. It deals with the world of the future, certainly an unusually absorbing subject. Written in the popular, non-technical fashion, "The Future" reveals the many advances and changes that are in store for humanity in a new life to come.

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Radio News Laboratories

(*Continued from page* 893)

structed of 3/32-inch sheet aluminum, which allows greater mass conductivity than is obtainable in the cans above described. The sides and ends slide into grooved aluminum posts which are held to the bottom of the shield by screws. After the apparatus is mounted and wired, the top is screwed down. Each compartment is 3¾ inches wide by 8¼ inches long by 5¼ inches high. The "Type HQS-1" shield can, submitted by the same manufacturer, is identical in construction to the "HQS" except that it has only a single compartment. It is 3¾ inches wide, 8½ inches long and 5¼ inches high, inside measurement.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATES OF MERIT NOS. 2537 AND 2538.

DYNAMIC REPRODUCER

The "Type No. 107-B" speaker, submitted by Wright-DeCoster, Inc., St. Paul, Minn., is of the electrodynamic moving-coil type. The field winding is of low voltage and uses heavy-gauge wire; the necessary current is obtained from a step-down A.C. transformer, and converted by a dry metallic rectifier. The cone is 8 inches in diameter and anchored to a cast-iron speaker frame by thin kid-skin strips, which are cemented around the edge of the paper diaphragm. The speaker's chassis is enclosed in a walnut cabinet, the front and back of which are grilled and screened to allow passage of sound waves; this serves as a baffle for the lower frequencies. The cabinet is 18¼ inches long, 14 inches high and 11 inches wide. Cords for connection to the lighting circuit and the radio receiver are provided. The speaker handles tremendous power with fidelity of reproduction from 20 to 5,000 cycles.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2539.

FUSE AND MOUNTING

The ¼-ampere fuse and mounting shown, submitted by the Oak Park Mfg. Company, Box 524, Oak Park, Illinois, has been designed for use to protect one or more ¼-ampere radio tubes, coils, transformers, "B" batteries, "B" power units or other devices that could be damaged by electrical surges. The fuse is in the shape of a fine wire, placed in a glass tube over the ends of which are metal caps. The fuse wire is soldered to the caps, the latter also serving as contact points. A special mounting block is provided to render the replacement of fuses more easy. The fuse tube is 3¼ inches long and ¼-inch in diameter; the mounting block, 2 inches long, ⅜-inch wide and ⅝-inch high, to top of clips, and provided with screw terminals and a single hole for fastening to the panel or baseboard.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2540.

BINDING POST

The "grid-type" binding post, submitted by J. L. Poke, 41 Belle Avenue, Troy, New York, is of molded black bakelite, and supplied with any markings desired; its mounting screw of No. 6 size passes through the panel and is fastened by a nut and lock-washer. The head of this screw, which passes through the body of the binding post, has a toothed under-portion which grips the wire when the pressure of the spring contained within the hollow body is released. In operation, the body is pushed downward, the wire inserted and the body then released, making firm contact. The maximum diameter of the binding post is ½-inch and its length overall 1⅝ inches.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2541.

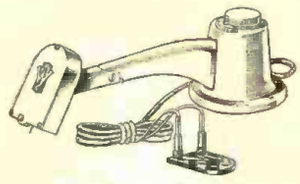
CONDENSER COUPLING

The "Type 12A" insulated condenser coupling, submitted by the Pilot Elec. Mfg. Co., 323 Berry Street, Brooklyn, N. Y., is designed for use in coupling gang condensers where the various rotors of the condensers are to be kept at different potentials. It consists of a bakelite disc, 1½ inches in diameter and 3/16-inch thick, to which are riveted the spring levers of two ¼-inch collars with set screws; the latter are placed on opposite sides in such a position to give a universal-joint action. The use of these coupling devices permits a slight misalignment of the condenser shafts and, at the same time, a positive rotating action without lag.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2542.

PHONOGRAPH PICK-UPS

The "Type 1A" phonograph pick-up submitted by the Webster Electric Company of Racine, Wisconsin, is of the electromagnetic type and makes it possible to reproduce music and speech from ordinary phonograph records when used in connection with any A.F. amplifier. The pick-up is attached to a channeled arm which swings freely from the bell-shaped base, in which is contained a volume control actuated by a knob in its top. The arm is in two pieces, hinged two inches from the pick-up unit to allow the insertion of a needle or change of records; provision is made for fastening the base of the support to the motor board of the phonograph. The pick-up unit consists of a permanent horseshoe magnet with a single winding placed in the magnetic field. The armature is of the balanced type and is held in position by soft cushion rubber. The pick-up proper is 2¾ inches long, 1½ inches wide and 1 inch thick; the support arm is 6½ inches long, ½-inch wide; while the base of the support is 3½ inches in diameter and 3½ inches high. A special adapter is provided, for either battery- or A.C.-receiver adaptation.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2543.

The "Type 1B" phonograph pick-up, submitted by the same manufacturer, comprises a pick-up head which is identical in construction to that of the Type 1A; except that it is provided with a flange designed to fasten over the tone arm of the phonograph. A separate volume control of the "Centralab" make is provided, in addition to the adapter for either a battery or an A.C. receiver.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2544.

DRUM DIAL

The dial submitted by the Ormond Eng. Co. ,Ltd., 199 Pentonville Rd., London, N. 1, England, has been designed for use on receivers where a drum scale is desired, and can be used only with tuning condensers that do not require a mounting space greater than 1½ inches from center of shaft to the panel. The drum which carries the celluloid scale is 3 inches in diameter. A special bushing for a 7/32-inch shaft is fastened within the drum; it is set into a special molded-bakelite strip which supports the milled-edge thumb-control which protrudes through the panel. The shaft of the thumb-control carries a special friction wheel which engages a flat disc inside the drum and serves as a drive. A special die-stamped aluminum bracket, fastened to the panel, serves as an anchor of the drum's position with a special split pin. The escutcheon plate is of black molded bakelite 3 inches long, 1⅝ inches wide and 3¾ inches thick; the window opening measures 1 inch by ⅝-inch.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2545.

BAKELITE BINDING POST

The lettered bakelite binding post shown here, manufactured by the Pilot Electric Mfg. Company, Inc., 323 Berry Street, Brooklyn, New York, is supplied with any markings desired. The knob is of the non-removable type and screws down upon the broad-faced nut; the threaded portion of the binding post proper (which is No. 10 size with 32 threads to the inch) is pierced with a 1/16-inch hole for the insertion of a phone tip or connecting wire. The portion of the screw which passes through the panel is No. 8 size, with 32 threads to the inch and ½-inch long.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2548.

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The very newest in design and construction. A most faithful reproducer with a full rich tone quality.

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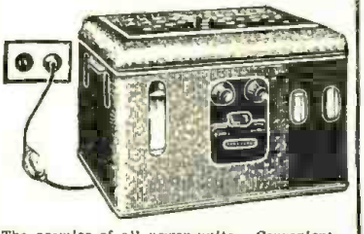
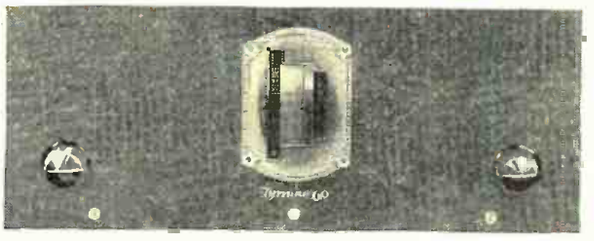
Willard "A" and "B" Combination Power Unit



The premier of all power units. Convenient, simple, and efficient. It is controlled automatically by the switch of your radio set. Just plug in your light socket. Regular list price $77.50. Shipping weight 82 lbs. **$29.95**

Tyrman 60

Custom-Bilt Shielded Grid



An Amazing Receiver At An Amazing Price

For battery or eliminator operation. Especially designed for Shield Grid tubes. The Tyrman "60" sets a new standard of comparison in performance and value in six-tube receivers. Panel is only 7x18 inches equipped with the Tyrman Single Vernier Drum Dial. Complete parts, factory packed, ready to assemble. Shipping weight 16 lbs.

Regular List Price $69.50

Our Special Reduced Price **$29.95**

Now Ready

Send For It!

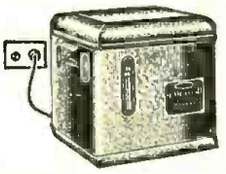
Set Builders and Dealers Save Money on Everything in Radio

HEADQUARTERS

Catalog also lists parts and kits for Tyrman, Carter, Tobe, Utah, Dresner, Hammerlund, Aero, Frost, Amertran, Thordarson and hundreds of others at rock bottom wholesale prices.

SM

WILLARD Standard "A" Power Unit



Charging current is supplied through a trickle charge of .7 amp. ouput. A relay switch is included as part of the unit where this feature is desired.

With Relay. List Price $35.00. **$10.00**

Shipping weight 45 lbs.

Without Relay. List price $32.50. Our Net Price **$9.50**

WILLARD STANDARD "B" POWER UNIT

It develops with ease 150 volts at 30 milliamperes entirely free from hum. As a "B" supply for sets of average current it has no superior.

List Price $35.00.

Our Net Price **$14.60**

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Big Reduction

List Price $17.50

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Trickle or Heavy Duty Use

Noiseless charger for 4 or 6 volt "A" batteries.

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Enclosed in rich two-tone mahogany cabinet. Pure reproduction, marvelous tone, full and resonant. Sensitive to the faintest impulses. Has a full 12-inch diaphragm actuated by the Orchestrion cone unit. Designed to stand the heavy volume of power tubes and power amplifiers.

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SPECIAL ELECTRIC SOLDERING IRONS

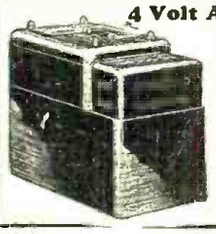
(List Price $2.50) Net Price **85c**

Shipping weight 2 lbs.

RADIOLA 28 Loops **95c**

Don't confuse them with the assembled cage type.

List $7.50. Shipping weight 4 lbs.



4 Volt A. C. Abox Converter

It provides a steady 4-volt direct current for your set and with a "B" eliminator it transforms the set to A. C. electric operation. Works only when the set is in operation and does not store up current.

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BAKELITE 3 Circuit TUNER

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Place it between the loud speaker plug and the speaker itself will produce much better clarity of tone. Protects the speaker from burning out. List $2.50. Shipping weight 2 lbs. NET.... **$1.50**

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Enjoy a powerful new Miraco set or complete outfit AC Electric or Battery 30 DAYS FREE

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Built like, Looks like, Performs like a $200 set

Marvelous new 3-year guaranteed, lighted 1-dial control, All metal Super Shielded Miraco set, removed from cabinet. Front switch, phonograph pick-up connection and all latest features. Built in power section on AC models.

The Latest, Finest and Costliest Construction

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CATHEDRAL TONED, SUPER SELECTIVE, POWERFUL DISTANCE GETTERS

Celebrating its 9th successful year, America's big, old, reliable Radio Corporation springs a genuine sensation in high-grade sets. With its latest, Super-powered, 1-dial Miracos—the All Electric wholly self-contained, hum-free, AC-8 and AC-9, using AC tubes or the new 8-tube models for batteries or Eliminators—you are guaranteed values and savings unsurpassed in the fine set field.

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Only exceptionally fine radios, of the very latest approved type, at rock-bottom prices, could possibly back up so liberally unconditional a guarantee. Send coupon now for *Amazing Special Factory Offer!*

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With its rich, clear Cathedral tone, hum-free operation, tremendous "kick" on distant stations and razor-edge selectivity—with its costly sturdy construction, latest features, including phonograph pick-up connection, ease of tuning, beauty, and economy—a Miraco will make you the envy of many whose radios cost 2 to 3 times as much!

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Exclusive Territory to User-Agents on BATTERY OR AC ELECTRIC OUTFITS

Many thousands of Miracos—bought after 30 day home comparisons—are cutting through locals and getting coast to coast with the tone and power of costly sets, their delighted users report. Miracos are laboratory-built with finest parts, and embody 9 years' actual experience in constructing fine sets. Approved by Radio's highest authorities.

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Everything reaches you splendidly packed and rigidly tested to insure your instant enthusiasm. Enjoy the outfit 30 days—then decide. Liberal 3-year guarantee on each set. Play safe, save lots of money, and insure satisfaction by dealing direct with Radio's old, reliable builders of fine sets—9th successful year.

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Unbeatable value in a 3-year guaranteed Super Shielded Metal Chassis.

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The newest and latest in battery operated sets, designed with same advanced features used in electric sets! Same wide choice of cabinets. Highest quality, amazingly low priced!

Miraco Outperforms 'em All In Chicago

On the Miraco Unitune, to start with, will say: I got to date 61 stations outside of Chicago, from the Pacific Ocean to the Atlantic Ocean, and from Anchorage, Alaska, to the Gulf of Mexico, and I tried the set with 3 different antennas. That is an outside aerial 152 feet, an inside aerial 20 feet, and light socket. I want to say that your set does outperform the other sets I have. I put it up against a World Record Super 9 and beat that one. Then I put it up against a (names expensive make), and beat that one. Next I put it up against a Neutrodyne and beat that one. HARRY KOPP, 6555 South Peoria Street, Chicago, Illinois.

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