RADIO NEWS

REG. U.S. PAT. OFF.

DECEMBER

25 CENTS

IN THIS ISSUE:

Radio Technique in the Talking Movies

Amateur Radio at the Cleveland Air Races

The Band-Pass Filter in Theory and Practice

Another of Wenstrom's Short-Wave Articles

6 features that make TRIAD the world's most profitable tube line

1 TRIAD QUALITY

Above all, Triad tubes are famous for quality. The severest tests known, plus close inspection limits, assure their absolute uniformity. They are manufactured to a standard which only Triad perfection can consistently meet. Dealers have learned that Triad Quality cuts costly service calls to a minimum!

2 TRIAD INSURANCE

Every Triad tube carries with it a printed certificate insuring a minimum of six months' perfect service. Any suggestion of sales resistance is quickly eliminated by this guarantee. It is a silent and powerful salesman that protects the customer's investment—and the dealer's profits. Only Triad has tube insurance!

3 TRIAD BOX

This unique Triad box possesses tremendous merchandising value and sales appeal. Its unusual shape and design lend themselves easily to spectacular and attractive displays. The tube trade of the country is fast learning to "Ask for the tube in the black and yellow triangular box."

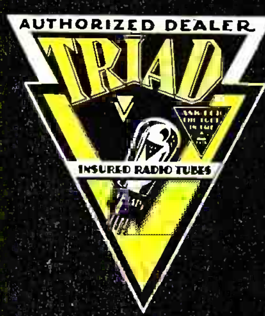
4 TRIAD ADVERTISING

Large-sized newspaper advertisements, color pages in national magazines—these and other periodicals are carrying the Triad message in one of the most extensive advertising campaigns known to radio tube history. This national advertising is winning for every Triad dealer the maximum tube sales in his community.

5 TRIAD BROADCASTING

The TRIADORS broadcast every Friday evening at eight o'clock (Eastern Standard time), over WJZ and associated NBC stations—and over WNAC and WEAN Sunday evenings, 7:30 to 8 p.m. The popularity of these programs are well proven by the greatly increased tube business now enjoyed by every Triad dealer.

6 TRIAD DEALER HELPS



Entire window displays, flyers, counter stands, flashers—every conceivable help is given to the Triad dealer to tie up his store with Triad national advertising and broadcasting. Thousands of dealers throughout the country are benefiting by this cooperation and are winning greater tube sales than they have ever before enjoyed!

TRIAD *insured* RADIO TUBES

Dealers—call your jobber or write direct for complete Triad information.

TRIAD MANUFACTURING CO., INC.
PAWTUCKET, R. I.

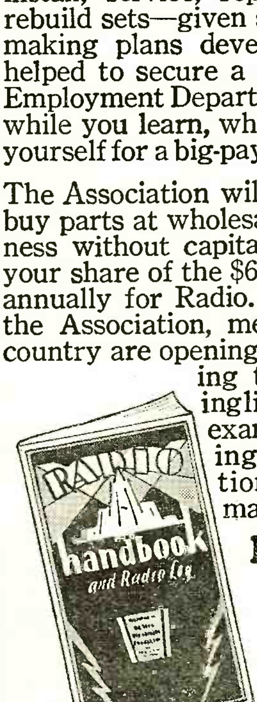
4 of the 40 Easy Ways to Make $3.00 an Hour In Your Spare Time *in* RADIO

THE four plans shown are but a sample of the many ways in which our members are making $3.00 an hour upwards, spare time and full time, *from the day they join the Association.* If you want to get into Radio, have a business of your own, make $50 to $75 weekly in your spare time, investigate the opportunities offered the inexperienced, ambitious man by the Association.

Our Members Earning Thousands of Dollars Every Week

The Association assists men to cash in on Radio. It makes past experience unnecessary. As a member of the Association you are trained in a quick, easy, practical way to install, service, repair, build and rebuild sets—given sure-fire money-making plans developed by us—helped to secure a position by our Employment Department. You earn while you learn, while you prepare yourself for a big-pay Radio position.

The Association will enable you to buy parts at wholesale, start in business without capital, help you get your share of the $600,000,000 spent annually for Radio. As a result of the Association, men all over the country are opening stores, increasing their pay, passing licensed operator examinations, landing big-pay positions with Radio makers.



Mail Coupon Today for the FREE HANDBOOK

It is not only chock-full of absorbing information about Radio, but it shows you how easily you can increase your income in your spare time. Mailing the coupon can mean $50 to $75 a week more for you.

Radio Training Association of America
4513 Ravenswood Avenue Dept. RN-12, Chicago, Illinois

Below are a few of the reports from those now cashing in on the "40 Easy Ways"

Clears $3,000.00 Frank J. Deutch, Pa.—"Since joining the Association I have cleared nearly $3,000.00. It is almost impossible for a young fellow to fail, no matter how little education he has, if he will follow your easy ways of making money."

$1,100.00 in 6 Weeks J. R. Allen, Calif. — "Have done over $1,100.00 worth of business in the last 6 weeks. Next month I am going to open up a store of my own. I never knew that money could come so fast and easy."

$25.00 a Week Spare Time N. J. Friedrich, N. Y.—"I have averaged $25.00 a week for the last 7 months even though I am not a graduate but just learning."

Training Lands Him Job R. C. Kirk, N. C.—"Your training has been very valuable to me. I landed a job with the big department store out here a few weeks ago because I had my membership card with me. There were a large bunch of applications ahead of me."

ACT NOW If You Wish NO-COST Membership

For a limited time we will give to the ambitious man a No-Cost Membership which need not—should not—cost you a cent. For the sake of making more money now, and having a better position in the future, mail coupon below *now.* You'll always be glad you did.

Radio Training Association of America
Dept. RN-12, 4513 Ravenswood Ave., Chicago, Ill.

Gentlemen: Please send me by return mail full details of your Special No-Cost Membership Plan, and also a copy of your Radio Handbook.

Name ____________________

Address ____________________

City ____________ State ____________

Radio News

Vol. XI — CONTENTS FOR DECEMBER, 1929 — No. 6

In Radio News Next Month

Herbert Hoover, Jr., communications engineer for Western Air Express, tells what radio has done—and what it will do—for the development of commercial aviation.

Dr. Lee DeForest, inventor of the audion, describes the manifold non-radio applications of this marvelous electrical valve.

Norman Wunderlich and *W. F. Diehl*, respectively chief engineer and assistant chief engineer of Radio Victor Corporation, show how laboratory control is maintained over mass production of radio parts.

Edward H. Loftin and *S. Young White*, who have recently sold a large group of their patents to the Radio Corporation of America, describe a recent invention of theirs which is an important contribution to the radio art.

Besides these, January RADIO NEWS will contain a wealth of constructional material on Broadcast Receivers, on Short-Wave Receivers and Transmitters, and up-to-date "dope" for the Experimenter and Serviceman; with such authors as John Rider, S. Gordon Taylor, James Millen, Milton B. Sleeper, Glenn Browning, and others, each a leader in his respective field.

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Member: Audit Bureau of Circulations

B. A. MACKINNON, President — H. K. FLY, Vice-President and Treasurer

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EDWARD LANGER PRINTING CO., INC., JAMAICA, N. Y.

Are You Caught Behind the Bars of a "Small-Time" Job?

Why be satisfied with a "small-time" job at low pay? Why grind along at tiresome, uninteresting work with long hours and no future? Why take orders all your life from every Tom, Dick and Harry who happens to be your boss?

Right now—this very minute—you hold the key to REAL SUCCESS in your hand. Hundreds of other men before you have read of COYNE just as you are doing now—and are making \$50—\$75—\$150 a week as a result. This is your BIG CHANCE to get friendly help and practical training that will enable you to climb out of the rut, and EARN REAL MONEY! Don't miss it! Today may be the big turning-point in your whole life!

LEARN ELECTRICITY
Without Books or Correspondence
IN 12 WEEKS

By Actual Work—in the Great Shops of Coyne

SOME kinds of jobs ought to be labeled with a big sign that says "Man-killer." They are either so heavy, dirty and hard that they sap a man's strength and keep him dog-tired all the time—or else they are so disagreeable, uninteresting and poorly paid that they kill his ambition in almost no time. And AMBITION is the most valuable thing a man can have!

Fascinating Work—Real Pay!

That's why so many men are turning to ELECTRICITY, which offers unlimited rewards and opportunities—with ordinary salaries of \$50—\$75 and up a week! Right now big electrical jobs are actually going begging! Electrical experts are in demand—and the need is growing every day! The situation is one that spells O-P-P-O-R-T-U-N-I-T-Y in letters a foot high for the man who is wide-awake enough to see it!

Learn Quickly

Let me make you a master electrician — the Coyne way. I've done it for thousands of others—farmers, laborers, factory men, and hundreds who haven't had more than 8th grade education! I can do it for you—and start you off on the road to independence and big earnings in just 90 days!

Not by Books

The secret of Coyne-training is that it is ALL PRACTICAL work. No books—no dry lessons—no useless theory. In the great shops of COYNE you learn the "ins and outs" of Electricity by actual work on *real* electrical equipment—the finest outlay in the country! And best of all—experts work right with you every step of the way, showing you all the electrical secrets that are essential to your success!

Big Pay Jobs

are common in electricity. Our free employment bureau puts you in touch with openings to choose from. The following are only a few of the kind of positions you fit yourself for in the Great Shops of Coyne:

Farm Lighting Experts \$60 to \$100 a Week
Armature Expert \$50 to \$100 a Week
Power House Operator \$50 to \$75 a Week
Auto Electrician \$60 a Week and up
Inventor - Unlimited Income
Maintenance Engineer \$60 a Week and up
Service Station Owner up to \$200 a Week
Radio Expert, \$60 a Week and up
Contractor, \$3,500 to \$15,000 a Year

Special Reduced Tuition Offer

NOW—For a short time I am making a Special 30th Anniversary Offer. You can now get a real money-making training at the lowest price.

No Advanced Education or Experience Needed

With a personal, *practical* method like this, is it any wonder I say I can make any man into a master electrician in 12 happy weeks? You don't need a bit of previous experience or advanced education. Many of our most successful graduates are fellows who never went to high school and hated "book learning." The Coyne method is *different!*

Special Offer Now

Make up your mind today to get into one of these real-pay electrical jobs. If you act *now*—I'll pay your railroad fare to Chicago and give you these courses free! AVIATION ELECTRICITY, RADIO and AUTOMOTIVE ELECTRICITY! And besides that, I help you to a part-time job while learning! FREE employment service for life after graduation, too. We place dozens of men in wonderful jobs every week.

Mail This FREE BOOK Coupon To-day

Send for FREE Book

Just give me a chance to tell you about the unlimited opportunity that awaits you. Let me send you this big book free, containing over 150 photographs and listing and telling you how you can qualify for the kind of jobs that lead to \$75 to \$200 a week. If you really want more money and a wonderful future, send for this book now! No obligation. Simply mail the coupon.

COYNE ELECTRICAL SCHOOL
H. C. LEWIS, Dept. 99-27
500 South Paulina Street, Chicago, Ill.

Dear Mr. Lewis:—I want the facts, so without obligation, send me your free illustrated catalog and details of your R. R. fare.

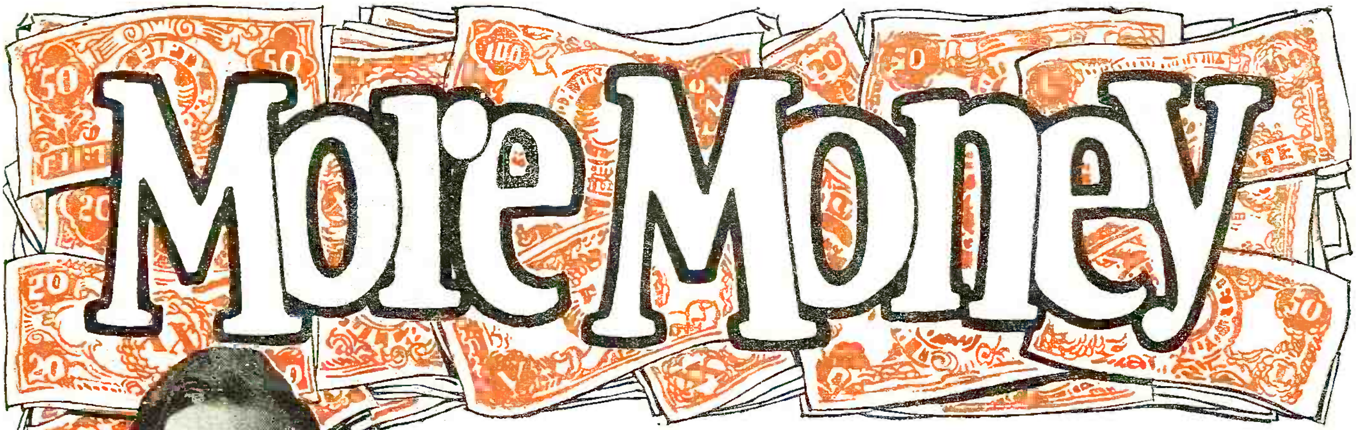
Name..

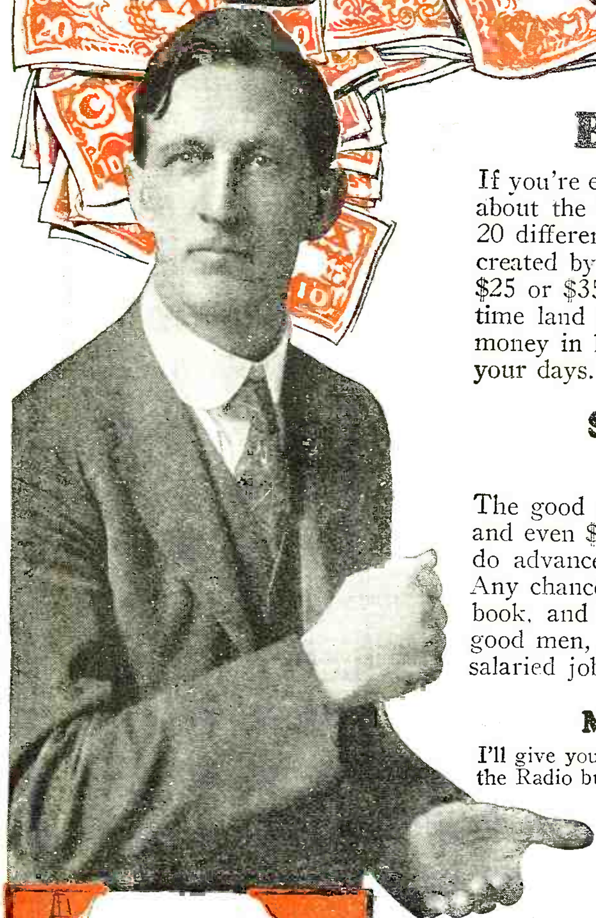
Address..

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

COYNE ELECTRICAL SCHOOL

500 S. Paulina St., Dept. 99-27 H. C. Lewis, Pres., Chicago





Be a Trained Radio Expert

If you're earning a penny less than $50 a week, get my free book of information about the Radio business. Trained Radio Experts are needed in more than 20 different lines of this new and growing profession (300,000 new openings created by the swift growth of Radio in past few years). Why go along at $25 or $35 or $45 a week all your life? Study radio, and after only a short time land yourself a REAL job with a REAL future! Be a man who has money in his pocket and in the bank—don't scrimp and scrape for the rest of your days.

Salaries of $50 Up to $250 a Week Not Unusual in Radio

The good positions in Radio pay all the way from $50 on up to $150, $200, and even $250 a week. Suppose you don't climb to the very top, but that you do advance to a position that pays you $125 a week, year in and year out. Any chance to make that much where you are now? Then send for my free book, and learn about a field where there's some *real opportunity.* Where good men, *if they have the right training,* can work their way into really big salaried jobs!

Money Back If You Aren't Fully Satisfied

I'll give you all the training you need to get into any line of the Radio business. And I back up this training by a signed agreement to refund every penny you pay me if upon completion of my course you are not satisfied with the lessons and instruction service I give you.

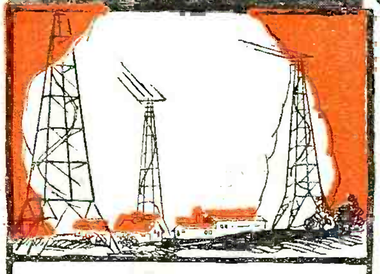
Six Big Practical Outfits Given You to Help You Learn

I teach you both the "why" and the "how" of Radio. You learn to DO a thing, and you learn WHY it's done. I send you, WITHOUT EXTRA COST with your course, six big practical outfits of material to experiment and work with. These outfits are the real thing—not toys. The parts they contain will build approximately 100 different Radio circuits. With all this material you do practical work from start to finish of your training. You get your hand in, and you get confidence in yourself. Then when you run into a Radio problem later on, on the job, you KNOW you can do it because you've already done it—with these six outfits of practical material. With me you don't learn to be a "paper Radio Expert"—you learn to be the kind of expert that shows his worth on the *payroll.* Full details in my big book—sent free.

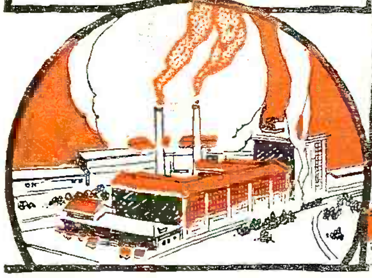
Send for Free Book of Information

GET BOOK!

Find out for yourself about the bigger pay waiting for you in Radio! From $2,000,000 in 1920 to $1,000,000,000 in 1929 —that's the record of the Radio Industry! Plenty of big Radio jobs are waiting for the man who KNOWS! John Fetzer sent for my free book—now he's Chief Engineer at WEMC and designs and builds broadcast stations. T. M. Wilcox sent for the book—now he's in his own Radio business and reports profits as high as $70 in one day! All information will be sent to you free, without any obligation—just mail coupon on opposite page.

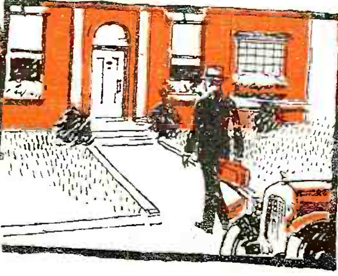


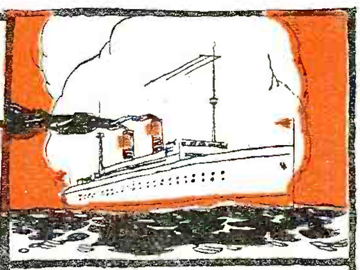
Broadcasting and commercial Radio land station work appeal to a lot of men—it's a big, growing field and fascinating work. My course prepares you thoroughly to get into this field and make good.



Radio manufacturing has grown faster in the last 6 years than any other big business ever did. It's 250 times as big as it was. That means lots of good chances for the trained Radio Expert.

Ten million Radio receiving sets in use in the United States means millions of dollars are going to Radio Service and Repair men everywhere. For this work you must be trained.





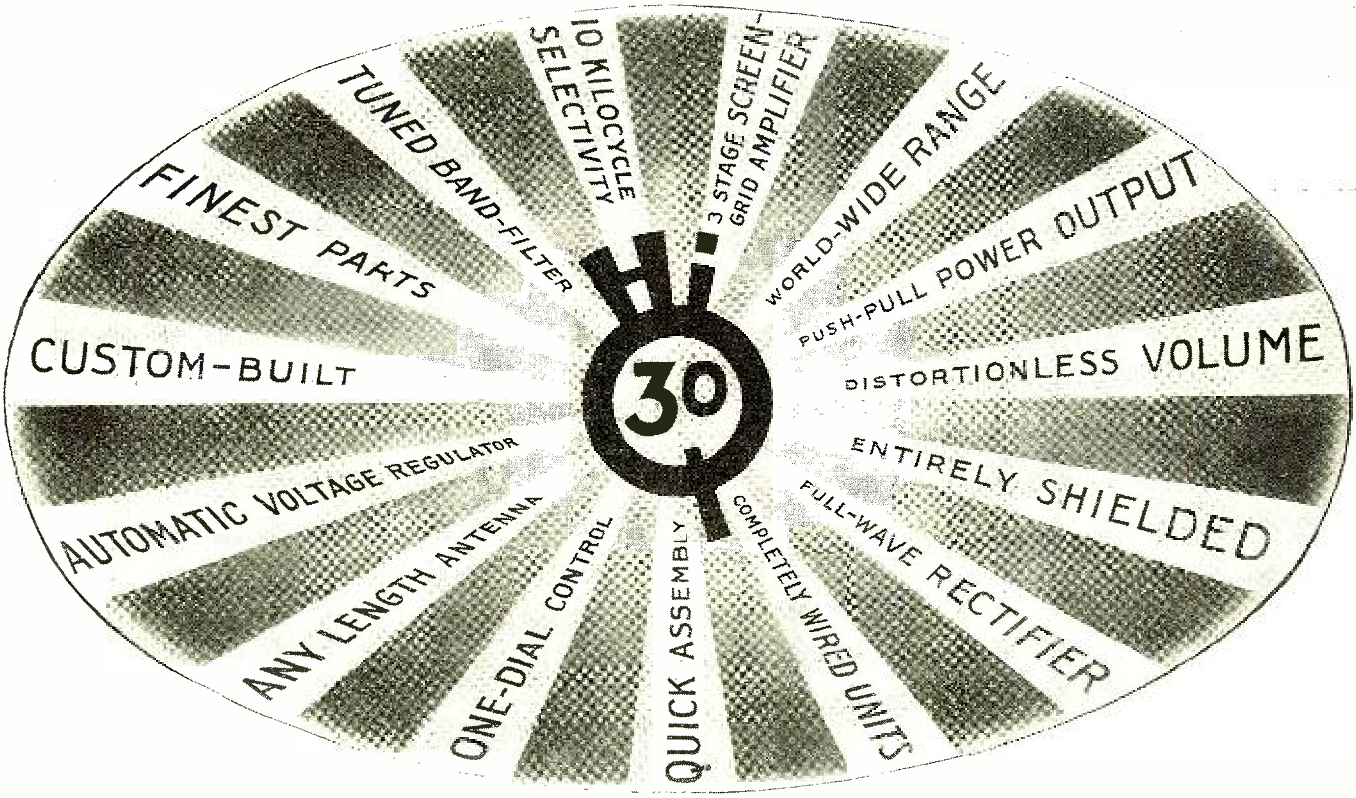
Radio operators on board ship go everywhere—see everything. You sail the world over, all your expenses paid, and draw a good salary besides. It's the life of Reilly.

see coupon next page

LIEUTENANT JAMES H. DOOLITTLE, who recently flew an airplane with enclosed cockpit, at Mitchel Field, Long Island, N. Y. His take-off, flight, and landing were accomplished without his being able to see anything outside the cockpit.

In addition to the usual altimeter and artificial horizon, the plane was equipped with a visual indicating radio beacon receiver which made possible this first demonstration of blind flying; an augury of what radio will do to conquer fog, the aviator's worst enemy.

Name Your Radio Ideals—



The New HAMMARLUND HAS THEM ALL!

YOU don't have to be an acoustical expert to recognize superlative tone—nor a radio engineer to know when you're listening to a program from the other side of the world—sweet, clear, free from noise or interference.

But the more you know about the fine points of radio design, the greater your appreciation of what Hammarlund engineers have accomplished in the new Custom-Built "HiQ-30" Band-Filter, Screen-Grid Radio.

The World's Premier Custom-Built Radio

For five years, Hammarlund Custom-Built Receivers have given spectacular performance — each season's model scoring greater and greater success.

And now, a glorious climax, the "HiQ-30"—premier radio of all time, with every detail a *feature*.

Here's amazing power, sensitivity, selectivity, tone, beauty; with unlimited choice of cabinets and speakers. For the first time a *unit-built* chassis with the chief units ready-wired and factory-tested, which you or your local custom-radio builder can completely assemble in two hours. A. C. and Battery models, $139.50 to $1175, complete, less tubes.

Ask your local custom-radio builder to demonstrate the "HiQ-30" and to build one for you. Or assemble it yourself. It is easy and perfect results are assured.

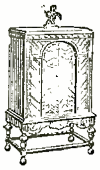
Mail coupon for the "HiQ-30" Manual —a mint of new radio data for only 25 cents.

Hammarlund-Roberts, Inc.
424-438 W. 33rd St., New York, N. Y.

Mail This Coupon
and 25c (*stamps or coin*)
For 48-page
"HiQ-30" MANUAL
(RN12)

Name..
Address...
....


MILAN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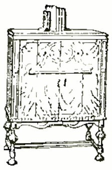
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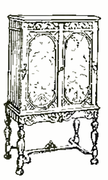
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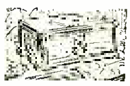
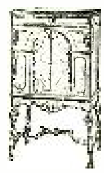

OXFORD

The "HiQ-30" chassis fits standard stock cabinets. These nine beautiful, specially selected models are supplied by Hammarlund. Fully described in "HiQ-30" manual.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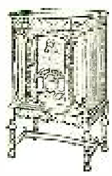
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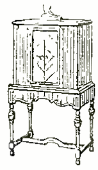
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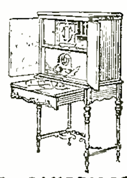

CAMBRIDGE

for Those Who Care What Goes I*nside* the Console

The Radio Owner who *knows,* looks for a manufacturer experienced in Radio.

The maker of the NATIONAL MB-29 fills that bill. NATIONAL CO., INC., first made the names of Browning and Drake known in Radio.

The Discerning Buyer looks for design and performance *in advance* of the general run.

He finds it in the MB-29 with its FOUR Screen Grid R. F. tubes giving enormous distance even without antenna—its new-design Linear Power Detection (for getting the best out of the latest high-percentage broadcast modulation)—its Band-Selector Tuning for selectivity without loss of quality, and its magnificent precision-built shielded aluminum chassis.

The Really Discriminating Purchaser looks for an audio-system capable of reproducing for his ears the timbre and power of each separate instrument or voice, alone or in combination, from the merest whisper to the huge volume of a symphonic or operatic finale.

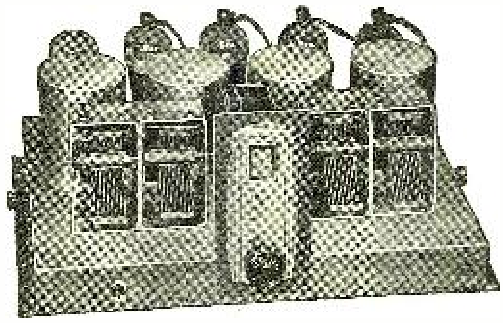
The Velvetone Amplifier of the NATIONAL MB-29 has such an audio system. Built with two of the new UX-245's in push-pull, with liberal margin of power supply and generous factors of safety, this R. C. A.-licensed instrument delivers to the loud-speaker everything that goes into the broadcast.

Add a high-grade speaker (and a phonograph pick-up if you wish) and you have every element of an ideal radio or radio-phonograph.

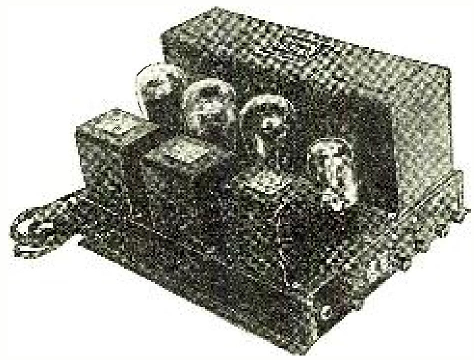
CONSOLES AND TABLES FOR THE MB-29

A number of the better-known makers of cabinets are prepared to furnish a selection of beautifully finished and specially priced consoles and tables designed especially for housing the MB-29 in various popular combinations.

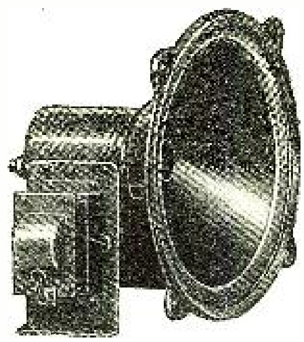
The MB-29 is full of new and ingenious features for your convenience and pleasure. Write us today for full information.



The National MB-29 Screen-Grid Tuner. Note clean-cut shielded construction with wiring concealed in base and National Projector Dial.



The National Velvetone Power Amplifier uses two 245 tubes in push-pull. Has Field supply for dynamic speaker.



A high-grade Dynamic Speaker with flat response curve gives the best results with the NATIONAL SCREEN-GRID MB-29.

NATIONAL
« SCREEN-GRID » -- MB 29

NATIONAL COMPANY INC.
ENGINEERS AND MANUFACTURERS
61 SHERMAN ST., MALDEN, MASS.
Est. 1914 W. A. Ready, Pres.


Longer life
High Vacuum
23 Years of engineering leadership
minimizes service costs
No hum
No buzz
No crackle
de Forest AUDION 424
1906 1929
de Forest
AUDIONS

Where We Are Heading

EVERY once in a while someone asks us what we are contemplating doing with RADIO NEWS. Some fellows remark that all of the other monthly magazines in the radio field devoted to the interests of the experimenter, have found that they could not survive, and have either ceased publication altogether or have attempted to switch to a so-called "trade" policy.

Some folks have asked us to state for them the policy of RADIO NEWS, and our answer is that our policy could not be more definitely outlined than it already is, in the title of our magazine. Perhaps, however, even the title requires a word or two of explanation.

We do not contemplate publishing news of a trade nature unless that particular bit of news has to do with the development of new circuits, or patents or kinks, which would affect the radio business generally. For instance, although it would be a matter of real interest to certain manufacturers and certain jobbers to know that a jobber located in Pittsburgh, Pa., was going to throw out one brand of receiver and confine his sales efforts to another, we feel that this would not be of interest to the majority of RADIO NEWS readers. If, however, the same jobber were to develop some new circuit which would improve receiving conditions, we believe that that would very definitely be the kind of news that you, our readers, would want.

Shortly after we took over the Experimenter Publications, we made an experiment with RADIO NEWS, to find out just how much interest there was among our readers in aviation and in radio as applied to aviation. We went so far as to include a special sixteen-page section in RADIO NEWS, devoted entirely to aviation, without any thought of radio. As a result of this experiment we found that a great many of our readers were very keenly interested in aviation, but that they would rather have us confine RADIO NEWS to the radio field, and many suggested the publication of more complete information regarding aviation in a separate magazine. This has been done, and we are very proud of the new member of the Experimenter Group called *Aero Mechanics*.

Some of our readers, and even some of the members of our own organization have wondered and have asked why we are devoting so much attention to the development of a receiver suitable for use on a motor boat. They call attention to the fact that the number of people who own motor boats is relatively small, and the number of people who would want a radio receiver on the boat they may happen to own is perhaps even smaller.

There is no question of the accuracy of a statement of that character, but the same problems incorporated in the operation of a radio receiver on a boat are experienced when we attempt radio reception in an automobile or airplane. We are not confining our efforts to boat receivers; we are doing experimental work, also, with receivers in aircraft and automobiles. Some of these receivers have been described in RADIO NEWS, and others will be shortly.

This development work on our part is going to open up an entirely new field of interest in radio; it is only another evidence that we are living up to the title of the magazine. Not merely describing and telling about new developments, but actively helping to bring them about.

This, then, is the function and the policy of RADIO NEWS. In carrying it out, we have found the coöperation of our readers of very real help. We want you to feel that this is *your* magazine, as much as it is ours; and we welcome your criticisms and suggestions.

Arthur H. Lynch

EDITORIAL DIRECTOR

R. T. I. QUALIFIES YOU TO MAKE MONEY AND ITS SERVICE KEEPS YOU UP-TO-THE-MINUTE ON THE NEWEST DEVELOPMENTS IN RADIO, TELEVISION, AND TALKING PICTURES **R. T. I.**

R.T.I. Training Brings Big Jobs Like These!

GOOD JOBS *Right at Your Finger Tips*

WHEN YOU ARE R.T.I. TRAINED IN RADIO-TELEVISION-*Talking Pictures*

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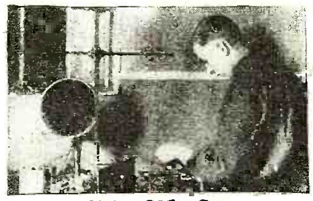
Your radio course has enabled me to earn over $500 in two months' spare time work. Understand that this is all spare time work, as I have a permanent position with my father in our store. I give you all the credit for the above and as I said before, I wish to finish the entire course as soon as I can.—Your student, J. NOFFSINGER, Greenville, Ky. R 1. Box 37.

Salary Raised 33 1-3% Since Enrolling

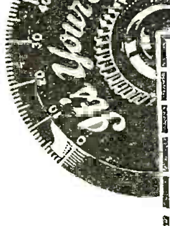
You may be interested to know that I am now Radio Service Manager for the H. N. Knight Supply Co. who are distributors for Eveready Radio Receivers in the State of Oklahoma, and Texas Panhandle, with an increase in salary of about 33 1-3%, since I enrolled with your school.

Thanking you for your interest you have shown in me, and your wonderful course, I am, EARL P. GORDON, 618 East 6th St., Oklahoma City, Okla.



Makes $25 a Day

Haven't forgotten you. How could I when I make as high as $25.00 per day and have made $600.00 in two months from Radio work. That's not so bad when I'm only 19 and in a small town. I just looked over the catalog you sent me before I enrolled, and you did about all you said you would and about as much more.—FLOYD KNISELY, R. F. D. 2, Box 91, St. Joe, Ind.



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Radio News

Vol. II DECEMBER, 1929 No. 6

Current Comment

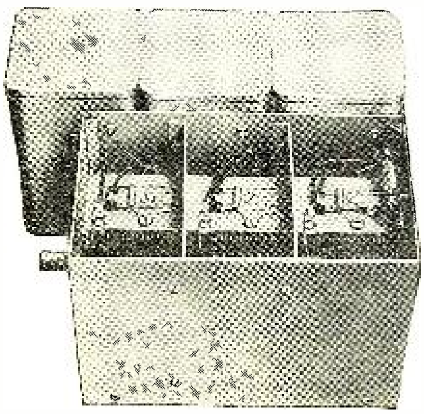
TO the average visitor, the 1929 Radio Show was probably "just another show." But to the thoroughly inoculated radio enthusiast, veteran of many shows, there is just a little more than period furniture and suave demonstrators. . . .

For your veteran radio show-goer does not stop to see the obvious features of the new models, nor to take up the beautifully printed booklets tendered by smiling young misses equally as beautiful. He is on an errand, and goes almost directly to his objective, and moves on. He is looking for things that the blind fan cannot see. He probes into chassis, goes behind the scenes of period cabinets and points his inquisitive gaze into the "innards" of all apparatus.

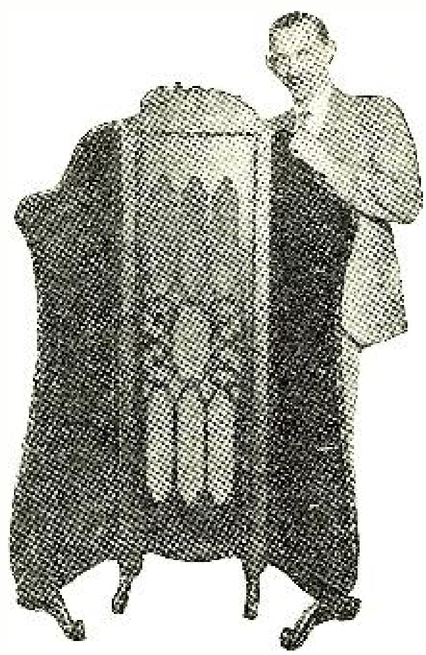
And what does he find?

This year, he sniffed around the screen-grid radio receivers. He knew, of course, that screen-grid tubes were listed as one of the Show's "sensations." What he wanted to see, however, was the way in which these tubes were used in radio circuits. So he looked for genuine bandpass filter circuits, and to his astonishment, discovered that only three, possibly four, manufacturers had worked it into their new models. He saw that there were several varieties of the same idea, and that there can be bandpass filters, and tuned filter bandpassers. Probably the most ambitious application of the principle was in the Hammarlund Hi-Q 30.

The pre-selector unit of the new Hammarlund "Hi-Q-30," shown for the first time at the New York Show

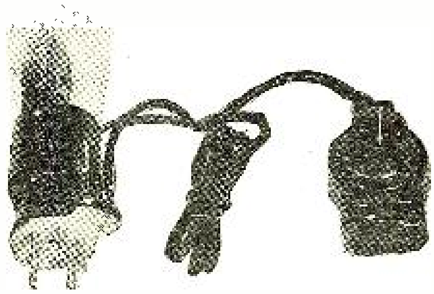


While looking for the new screen-grid bandpass circuits, he discovered a receiving set that only used a single stage of audio amplification in push-pull, immediately after the detector, preceded by four stages of screen-grid amplification. This, according to quick figuring, should give a mighty wallop in the speaker, with amplification into the millions! He saw for himself, power detection, automatic volume control, installed both in radio and audio circuits, but because of the complexity of wiring, and the general unwillingness of engineers to divulge their "secrets," he went away comparatively uninformed on the "how" of the method.



One of the models of the new Kyle condenser-type loud speaker

There were other things that engaged his attention, which as an old-timer in the matter of show inspection and radio history, he was equipped to thoroughly appreciate.



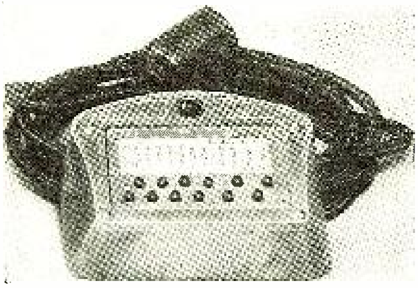
The new Pacent phonotrol adaptor which eliminates electric connection changes when playing records through the audio system

In a corner, for instance, and quite unobtrusively presented to the gaze of the onlookers that ignoringly glanced at it, he discovered the model of the original "neutrodyne" circuit receiver, as built by Professor Louis A. Hazeltine, the inventor. He recalled his own home-made neutrodyne set of many years ago, and observed that there were still many neutrodynes at the present show, though in modified or improved form.

Another sight which interested him as an old-timer was the early model receiver built by the amateur pioneer Alfred H. Grebe. In the "pile" of sets he saw also an amateur transmitter for short-wave work, one of the first commercial sets, and, he learned, the very one that an amateur used to speak directly with Europe for the first time. This was probably ten years ago! Compared to these relics, the crystal set that won the "radio relics" contest was a grown-up boy!

It seemed that there were several other "historical" displays that are really part of radio history. For instance, he lingered long enough before the cases showing Dr. DeForest's

Bunsen burner detector, which the good doctor himself says was the original step in the invention of the world-famous audion, which is shown in its original state alongside of the burner. A little farther along, the



The Butler push-button type of remote control

veteran show-goer saw replicas of Marconi's first trans-Atlantic receiving set, including one of the real kites used to support the antenna. Then, there was an "S.O.S." ("C.Q.D.") key, the same, indeed, which had sounded the S.S. *Republic's* call of distress. Here was a relic indeed!

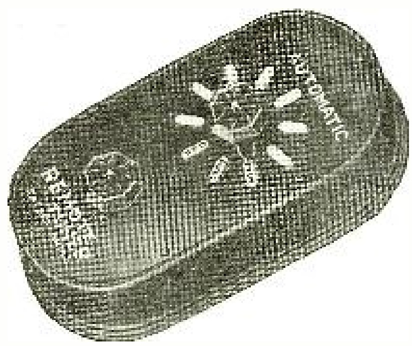
Next, after finding that the miniature models of radio installations on ships were working models, and that the small direction compass could actually turn and has a needle in its base, the show-goer turned his attention to the newer devices of radio science.

For a long time he had wanted to see the recording machinery used for making talking pictures. Here was one of the instruments, bare of any covers, and easy enough to look over in great detail, since hardly any one took notice of it!

Aside from an automatic voltage regulator, which the show-goer had heard of before, and which seemed to actually work, though built on a transformer principle and labeled as something "really different and new," there were other novelties that engaged his attention.

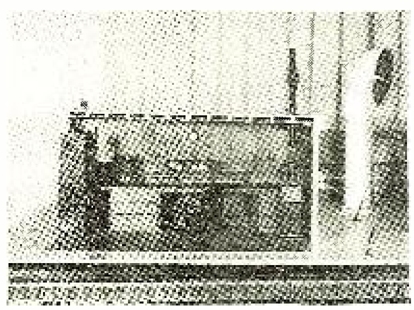
There were remote and automatic controls for tuning in radio receivers that could be called new. One of them was that developed by J. D. F. Freed. A semi-automatic arrangement was seen by our show-goer on the Lincoln set. The Motomatic remote control was worth a second look. Edison's device for visual tuning interested him a bit, as did the remote tuning arrangement that was shown by M. B. Sleeper, and which permitted the tuning, at any distant point, of a receiver located any distance away. The idea used was probably not "new," as it consisted of a remotely controlled motor. The method of control was, however, although it did look a bit complex right there at the booth. Other remote controls were shown by Richardson-Davis and by Carter. There was also an automatic printer for typewriting news on a machine, as picked up by a broadcast set. Zenith showed an improved type of remote control, by a small dial. It was fascinating for our show-goer to watch the precision with which these devices tuned in automatically the stations selected. Kolster, too, had an ingenious remote control by push-buttons.

Trick furniture, notably modernistic conceptions as applied to radio, relieved the monotony of too much woodwork, apparent everywhere. It wasn't until the show-goer could



The remote control tuning device featured by Zenith

squeeze his way through a group looking under the top of a beautiful table in the Atwater Kent booth that he discovered that it was a radio receiver built under it! An automobile



A small scale model of a modern ship's wireless installation, including the radio compass

receiver, for installation under the cowl, was another interesting development.

As becomes a blasé onlooker, our veteran show-goer only casually looked at the television demonstration, to notice that it had visibly improved over last year's transmissions. He heard the automatic wireless transmitter and receiver, set up to show how this was done, on a large scale, between countries.

With all the new electrically operated devices threatening to make hash of radio reception, manufacturers of filtering devices have not been asleep at the switch; so that there are few forms of interference that will not yield to one or another of these filters.

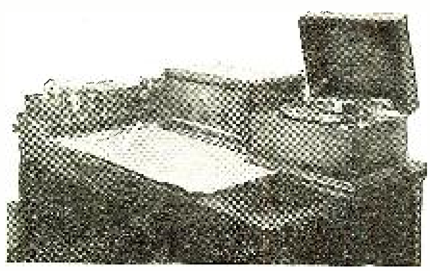
Of particular interest to dwellers in city districts where the lighting service is direct current, is a new product of Ward-Leonard; so new, in fact, that as we go to press neither details nor price can be obtained. A boon it will prove, however, as it is nothing less than a properly filtered and shielded miniature motor generator set; permitting the d.c. dweller to avail himself of the most modern of a.c. receivers.

Last, but not least—perhaps to show the versatility of radio—was the R. C. A. device known as the Theramin, a totally new musical instrument for the home. An offshoot of radio, the demonstrations of this instrument at the Show proved it to be capable of producing some really fine tone shadings, both volume and pitch being controlled entirely by proximity of the operator's hands.

Perhaps the most important thing of all at the Radio Show (speaking now particularly of the Radio World's Fair at Madison Square Garden, New York) escaped the casual visitor entirely.

Seven years ago when broadcasting took the public by storm, the first attempt at a public showing of radio apparatus on the Hotel Pennsylvania Roof in New York was swamped. Today, when so many calamity howlers have been talking of the complete lack of public interest in radio, as contrasted to the furor of several years ago, it might be well to consider the attendance figures at the various shows throughout the country. If these are any criterion, radio interest is far from being on the wane.

A speech amplifier system adapted for microphone pick-up, radio or phonograph reproduction



J. P. Turner, president of the Cleveland Wireless Association, Inc.

Hams Take WINGS

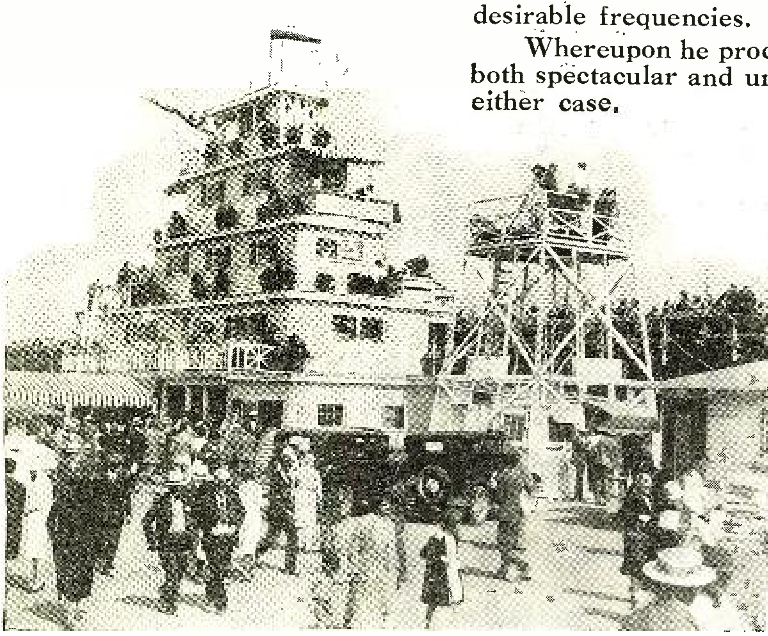
How the Cleveland Wireless Association Covered the National Air Races

By Ralph P. Worden
Radio Editor, The Cleveland News

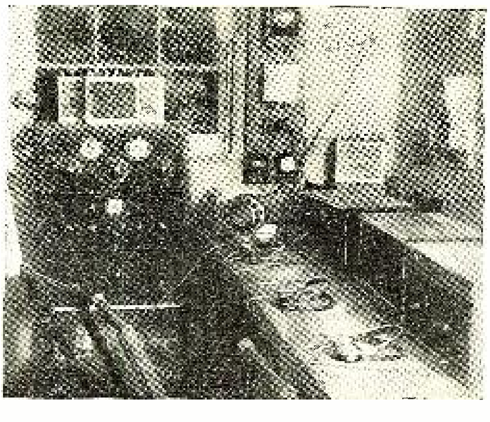
SCORE another triumph for the amateur radio operator, better known as the "ham."

Largely responsible for all the early developments in radio, the ham's reward was to be shoved down into the then commercially unimportant wavelengths. Each time his ingenuity proved the practical usefulness of the wave-bands assigned him, these have been taken over for commercial use, and the amateur operator relegated to less desirable frequencies.

Whereupon he proceeds to conquer the new job, rendering service both spectacular and unspectacular. And does a workmanlike job, in either case.

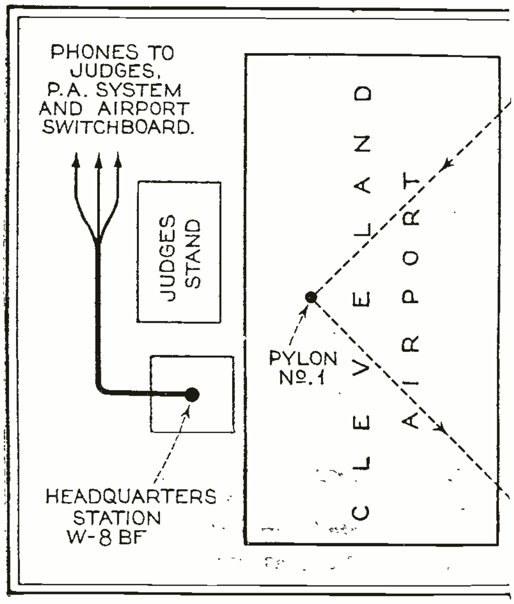


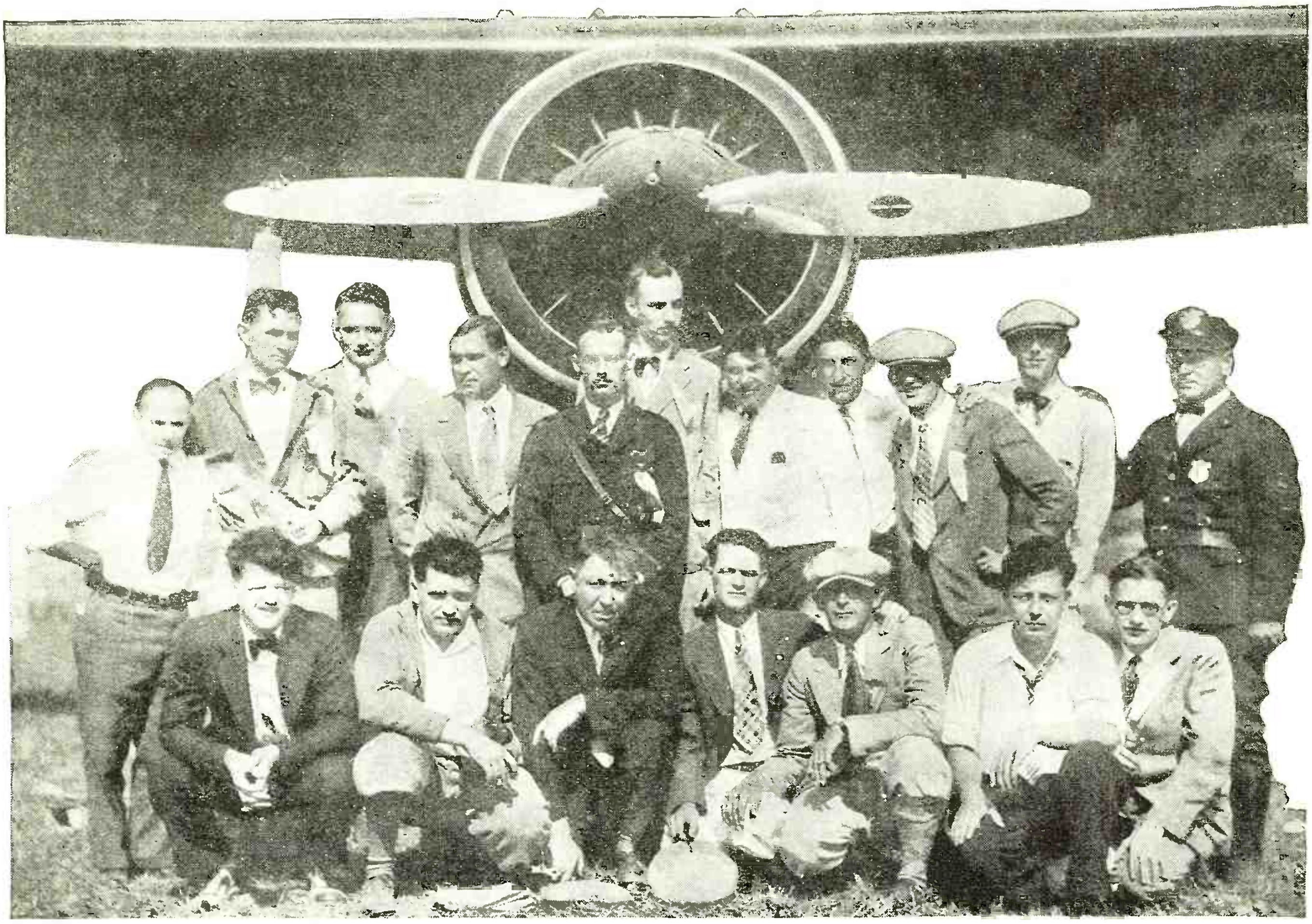
Above—The judges' stand at the left, and the official photographers' stand at the right. In the lower part of the latter structure is the headquarters station, W8BF, of the Cleveland Wireless Association



Interior of headquarters station, with transmitter at the left and three short-wave receivers (each permanently tuned to one control pylon's transmitter) at the right

ROARING around a closed ten-mile course, tilting on edge as they banked less than 100 feet above the ground and skimming around pylons at speeds of 140 miles an hour and more, airplanes entered in the daily events at the National Air Races in Cleveland, August 25 to September 2, gave spectators a steady succession of thrills, and gave amateur radio its opportunity to stage a splendid demonstration of what can be done in the way of speedy, highly accurate communication.

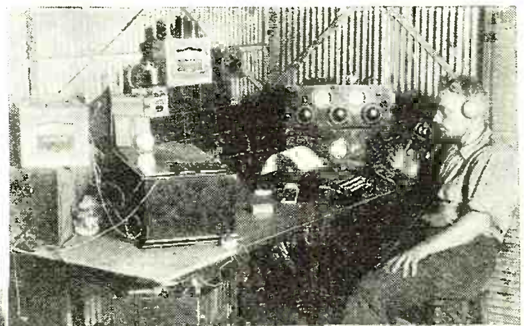


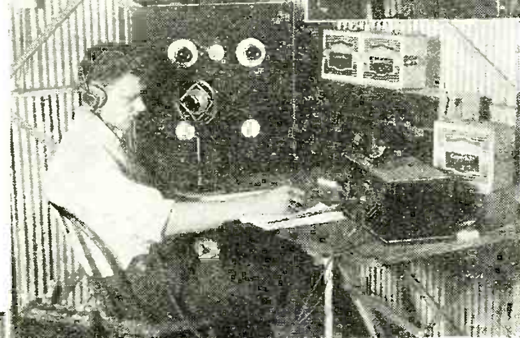


Away back in the winter, members of the Cleveland Wireless Association, Inc., convinced Clifford W. Henderson, managing director of the 1929 air races, that they could set up radiophone stations at each pylon and transmit satisfactorily the report of every plane's passage at each point, as well as reporting any irregularities.

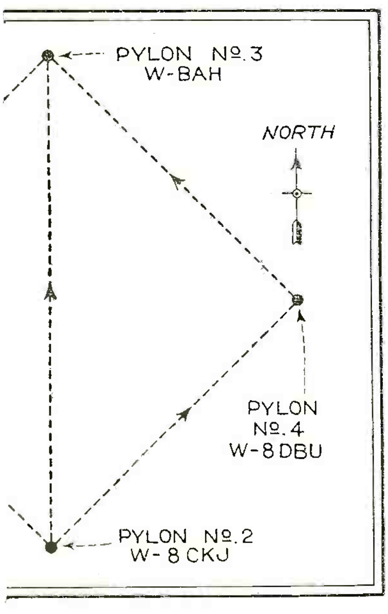
When a man is made managing director of an air meet, it is safe to assume that he is modern in his ways. So Mr. Henderson took the radio men at their word, told them they had acquired a job and proceeded to leave the working out of details to them.

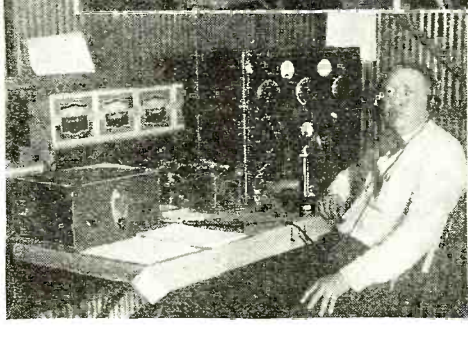
What took place during the racing meet really constitutes an epic in amateur radio achievement. Split-second reporting was handled without a slip. Racers might develop engine trouble during a race, or Jimmy Doolittle might tear the wings off a plane while driving, but





At the top of this page is a group picture of the members of the Cleveland Wireless Association and Cleveland Amateur Radio Association, in front of Captain Hawks' Lockheed plane





The three control pylon stations: Paul Forrest, W8BAH; Russell Karg, W8CMU; Glenn Rogers, W8BBE. These stations kept the judges in touch with every part of the course at all times. The diagram at the extreme left shows the layout of the course and the positions of the respective short-wave stations

E. T. Huddleson, vice-president, Cleveland Wireless Association

never a sign of mechanical or electrical trouble did those four radio stations develop.

How the Air Reporters Worked

First we shall describe the general layout and method of operating, and a little later the apparatus which stood up so well.

The race course was laid out after the fashion of a baseball diamond. The distance from the home pylon around all three bases was ten miles. By cutting from first to third base, a five-mile course was available.

The Cleveland Wireless Association, Inc., placed at each pylon a transmitter and receiver, and at the home station, under the judges' stand, a master transmitter and three receivers, one tuned to each pylon. Thus the start of a race was broadcast to all three stations, following which the home station closed down and its receiving operators checked each plane as reported by operators at the pylons when it passed.

The headquarters or home station was a real radio central. It had the transmitter and three receivers in use, a spare outfit ready for immediate duty and three telephone lines. One came from the judges' stand, one from the control point of the public address system and one from the airport switchboard.

Speed and accuracy, the two characteristics which many ill-advised people still believe separate the amateur from the professional, were prime essentials in this work. The word "work" is used advisedly. Picture, if you will, fifteen army planes racing at a speed which puts each plane around a given pylon every four minutes and you will readily see what degree of speed was required in reporting.

Frequently several planes banked around a pylon in what looked like a huddle. The observer called their numbers in the proper sequence, and the operator passed them on in that order. The receiving operator not only had to check them all by, but also was required to list them in exact order, lap by lap.

In one important and hotly contested race three planes dove for the pylon in tight formation, each flyer intent on cutting it shorter than the others to avoid collision and at the same time to gain distance. They miscalculated just a few feet. The official observer ruled that all three had cut inside the pylon and were disqualified. The operator reported the fact, judges were apprised of it and the three were ruled off before they had time to complete the lap. Through the public address system some 40,000 people also knew about the foul within a fraction of a minute of the time it happened, several miles away.

Another time radio proved vital was when an Australian pursuit got under way over the short five-mile course. Rules for this type of race provide for a handicap in starting, supposed to give every plane a chance to finish at the same time, and also require that anyone who is overtaken by another must drop from the race. Hence, the order in which they pass each pylon is of prime importance.

Glancing at the score sheet of the man clocking the pylon ahead of him, the receiving operator for No. 3 noted the entries reading 61—60—7—43 and so on. He had checked 61 and 60 by. Then came a pause of some length and then a report on 43. Where was Number 7? Before he had time to voice the question he heard his operator say, "One plane swung out to the pylon for the long course and has not passed here." Two more planes were reported and then he added, "Here goes No. 7. Tell the judges he flew the ten-mile course."

The information was passed to officials and the plane flagged down. Ordinarily he could have remained and tried to make up the time he lost, since he passed all pylons, but in the pursuit race he was disqualified, since two others had technically overtaken him by passing No. 3 pylon before he reached it.

Thrills? Just a steady succession of them, day after day. Here are three which were a bit out of the ordinary, though.

One racer, either to save time or to give the ground crew a surprise, rounded pylon No. 2 and cut through between the antenna and counterpoise without touching either. The antenna is 70 feet above ground, the counterpoise about 15 feet. The plane had a 35-foot wing spread and was making close to 150 miles an hour.

The first day of the meet a parachute jumper miscalculated wind velocity and instead of landing in the circle on the field dropped behind the stands, missing the headquarters station's antenna by a matter of inches.

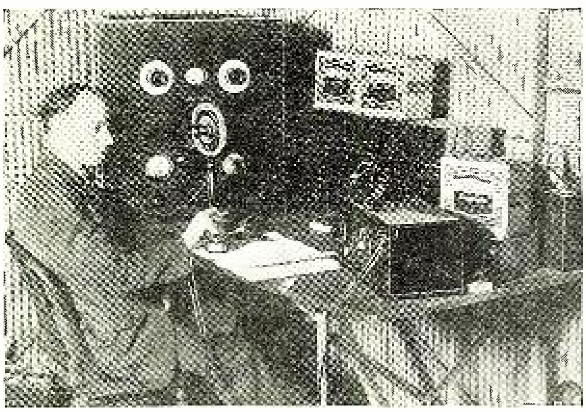
Between the second and third pylons, during an army race, one flyer descended abruptly and disappeared from view. Immediately the voice of a radio man announced, "That plane you saw come down had engine trouble. He landed safely." Whereupon the National Guardsman detailed to sentry duty at the next pylon remarked, "That's my brother; I'm glad to hear he made it without cracking up."

Equipment Used Was Specially Built for Job

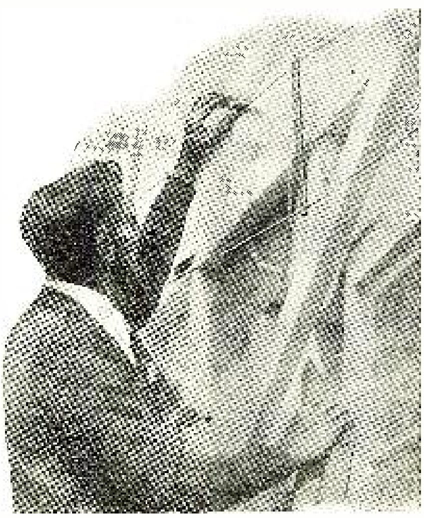
Now for the radio equipment itself. Every transmitter and every receiver was built especially for the race work. Just by way of proving that successful operation depends more on the man than on the circuit used, the club members installed different types of apparatus at various points. Thus three transmitters were of the tuned grid, tune plate variety and one was a Hartley. Three used counterpoises and one—a different one this time—used a "zep" antenna. One of the three employed loop modulation, the others were conventional Heising jobs.

Just to top it off, battery power was used for transmitting at the pylons, while headquarters not only had rectifiers but had three a.c.-operated receivers working smoothly.

The power used was 15 watts at headquarters and 7½ watts at each outlying station. Distances covered on official transmissions were all under ten miles,



Norman McConnell, operating at Pylon No. 2, is shown at the left. At the right, Al H. Gyssler (W8BXB) is using a neon tube to find the nodal point on the antenna system at the headquarters station



although the announcements were reported as clearly received by amateurs in Massachusetts, Michigan and Washington, D. C., as well as in numerous nearby cities.

Headquarters station, operating as W-8BF, employed a tuned grid, tuned plate transmitter, with Heising modulation and a "zep" antenna system. The reason for the latter, of course, was that it was close to the grandstands and it was feared that a counterpoise might be detuned by persons walking immediately under it. The transmitter was built and tuned by Al H. Gyssler, whose home call is W-8BXB.

Receiving equipment at headquarters included three screen-grid, a.c.-operated sets built of composite parts. All worked well, over the distances required. Some hum was observed, but not enough to mar the work for which they were built.

At pylon No. 2 was a 7½-watt Hartley oscillator, with Heising modulation, battery operated. During the races this was W-8CKJ. The set was built by Russell Karg (W-8CMU).

The No. 3 transmitter was of the tuned grid, tuned plate type, 7½ watts, but differed from the others in using an absorption loop for modulation. It was built and operated by Paul Forrest, of W-8BAH, and used that call for its official work.

Out at the end of the course was pylon No. 4, with a tuned grid, tuned plate circuit and Heising modulation. Officially, the station was W-8DBU. It was built by Orrie Baumgardner, who in private life is W-8BF. This station had for receiving a new National "Thrill Box," which the operators said lived up to its name.

Amateurs' Service Was Gratis

As has been intimated before, members of the Cleveland Wireless Association, Inc., took on this work without pay, either for their services or for the equipment required. In the latter case, three Cleveland firms co-operated. A supply of heavy duty "B" batteries which lacked just five pounds of weighing an even ton was donated by the National Carbon Company. Storage batteries for filament heating were furnished by the Willard Storage Battery Company, which also sent a car around every 48 hours to deliver freshly charged batteries and pick up the old ones. Tubes were supplied by the Kolster-Brandes Distributing Company of Cleveland and the city loaned voting booths which served as homes for the stations.

And did the boys take the work seriously? Well, most of them arranged their vacations to come during the air races, this including several who had to take vacations without pay. At least one member quit his "gainful occupation" flat, in order to devote full time to the race work.

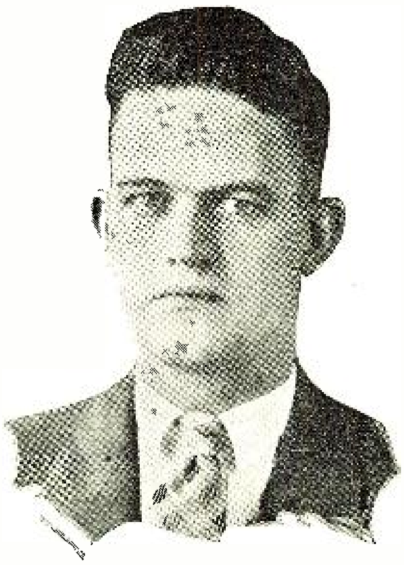
On Wednesday, the day's work over, operators gathered at the headquarters station to assist in keeping track of the *Graf Zeppelin,* then on the way to Cleveland and due late at night. Unable to establish direct communication with the German ship, they shaped up an amateur network in Ohio and Michigan, predicted the time of arrival, over the airport within two minutes, and finally, after checking with W-8RD at Utica, Mich., called W-8IQ at Toledo and had him break the news to his disappointed fellow townsmen that they would not see the *Graf Zeppelin.*

Practically all of the radio men who put this job over are known to the amateur fraternity here and on other continents by their call letters. Hence, calls as well as names will be given. Where the same call appears after more than one name it indicates joint operation of the station by the men named.

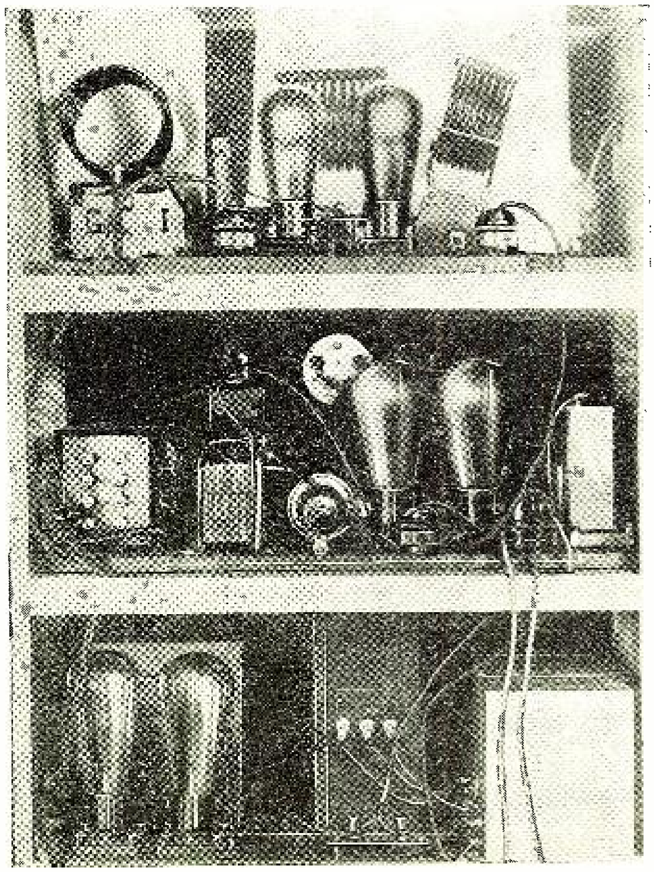
Harry A. Tummonds (W-8BAH) was chairman and Orrie Baumgardner (W-8BF) chief engineer of the air race radio committee.

Officers of the club are J. P. Turner (W-8BAH), president; E. T. Huddleston (W-8BDU), vice-president; E. F. Putzier (W-8CKJ), secretary, and Fred Sauer (W-8CRD), treasurer.

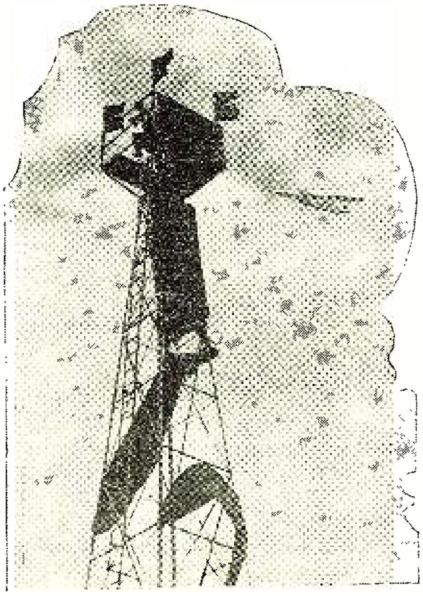
Other members participating were as follows: C. J. Dorazil (W-8CE), Al H. Gyssler (W-8BXB), Russell Karg (W-8CMU), A. R. Zeska (W-8BJW), H. F. Byrd (W-8DRD), N. C. Foster (W-8ACZ), Glenn A. Rogers (W8-BBE), Paul Forrest (W-8BAH), N. D. McConnell (W-8BS), Theodore S. Wenberg, Roy E. Watterson, Robert Kosin, C. N. Thrasher, John Miskavic, Frank Heisler, Al Wenigep, and Clifford Barnes.



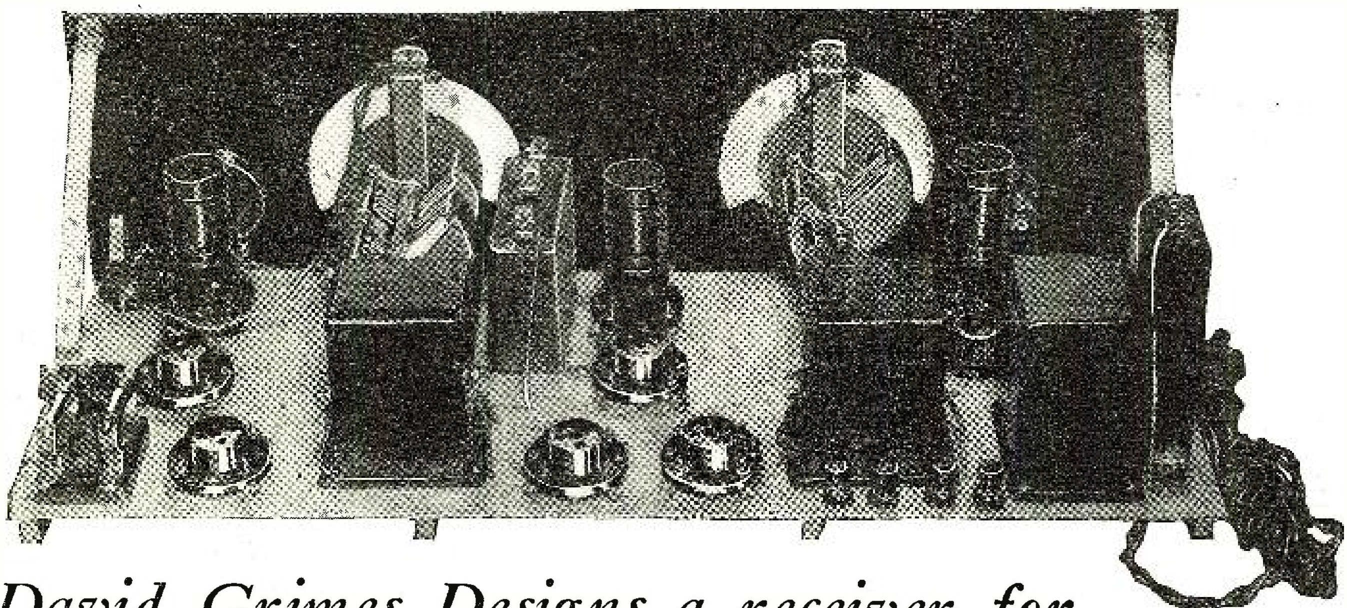
Harry A. Tummonds (W8BAH), chairman of the air race committee of the Cleveland Wireless Association



At the right is shown the transmitter at headquarters station W8BF, built by Al H. Gyssler, whose home call is W8BXB. It employs tuned grid, tuned plate circuit, with two 210 tubes, having a power rating of 15 watts Oscillator tubes are at the top, modulators in the center, rectifiers and power equipment at the bottom; this station being a.c. operated



One of the pylons, 70 feet high, marking the course is shown at the left. In the base of each was located the "ham" station which reported to headquarters the progress of each plane



David Grimes Designs a receiver for D. C. Line Operation

A 110-Volt D. C. Line-Operated Low-Cost Six-Tube Radio Receiver

By Norman Matthews

ALMOST from the first days of broadcasting there have been sporadic attempts to operate various radio circuits direct from the d.c. power mains. These efforts, except by experimenters, have been few and far between, perhaps due to the relatively few people interested in or affected by the direct current situation. The circuit and kit designer has apparently assumed that the employment of power tubes, with their recommended high voltages, precludes the use of the direct current mains, where only a mere 110 volts are available with no easy means of stepping it up.

Even so there are any number of radio fans residing in the d.c. districts of our large cities who have been operating their own d.c. sets for many months. And nearly every one of these sets is materially different in construction and circuit arrangement from any of its neighbors.

This article is not presented as the only cure for a malignant condition, but rather is it offered as a most unique method for obtaining maximum results with a minimum initial outlay and operating cost, for David Grimes, the originator and designer of the circuit described here, has once more considered economy and efficiency as matters of prime importance.

Two Major Problems

There are two major problems to be taken into consideration in the design of a d.c. receiver for power line operation. First, there is the question of noise. The brushes on the commutator of the d.c. generator at the power house create quite a powerful tone, around 500 cycles. This goes out on the line as an audio tone super-imposed on the direct current. Then again d.c. motors and other d.c. apparatus connected to the lines operate by means of commutators and other breaking contacts. These create tones and disturbances of their own which travel back on the line to other locations. These noises, while not as strong as the 60-cycle hum on alternating circuits, are nevertheless more numerous and must be taken into account before satisfactory operation of the receiver is possible.

Second, the relatively low voltage available makes it extremely difficult to obtain real volume with any sort of bass note resonance. One of the most apparent deficiencies in the average d.c. power line receiver is the harsh reproduction, with the low notes conspicuous by their absence! The engineering methods of the past, employed for meeting these two factors, have largely consisted of brute force tactics. The d.c. set has been surrounded by large and expensive filters for ironing out the "ripples" in both filament and "B" supply circuits. These have been very costly because of the large currents required in the filament branch. Supersensitive loud speakers have been attached only to render rather raspy rackets or magnificent whispers.

All of which brings us to the subject at hand. No, the real d.c. set must be designed from start to finish for the purpose intended, in spite of the handicaps. Fig. 1 shows the complete filament circuit. The only accessory apparatus of any kind is the 10-ohm rheostat and the 60-watt lamp. There are no filters, voltage dividers, by-passing condensers or

PROMINENT among the events of the past and present season has been the ascendency of the a.c. tube and subsequently its application to radio receivers, both of the home-built and factory-made kind. In fact, so much attention has been paid this new activity that those to whom we look for new receiver designs have more or less centered their attention solely on this feature alone.

It has remained for an old-timer, David Grimes by name, he of the Inverse Duplex fame, to come forward with a receiver design which will be received with open arms by those radio enthusiasts who, because of residence in a d.c. supplied vicinity, have of necessity been forced to depend solely on battery operation of their radio installation.

The receiver described here employs the simplest of filter systems. Its cost is at a veritable minimum. Moreover, it performs. Tone quality, volume and tuning response are all that can be desired.

what-not in the filament path. Certainly nothing could be more simple than this.

"Push-Pull" Filaments

One departure is obvious from a superficial glance at Fig. 1. The filaments of the six tubes in the set have been arranged in a series-parallel circuit. There are two reasons why they cannot be connected in a straight series so familiar to d.c. experimenters. First, each tube naturally subtracts five volts from the total line voltage available to the tubes at the positive or right-hand end of the circuit. If a straight series filament circuit were utilized, only about 85 volts could be placed on the last tube, and this, as will be evident later on, must of necessity be the power tube—the least capable of standing such a reduction. Second, it is absolutely imperative to employ push-pull amplification in the power audio stage. Tubes operated in push-pull combinations must be fairly well balanced, and it is a foregone conclusion that each must have the same plate and grid voltages. This would be impossible if the filaments of the two tubes were not of the same potential in the circuit. By running them in parallel, this requirement is fulfilled. So, at least, two of the tubes must be connected in parallel.

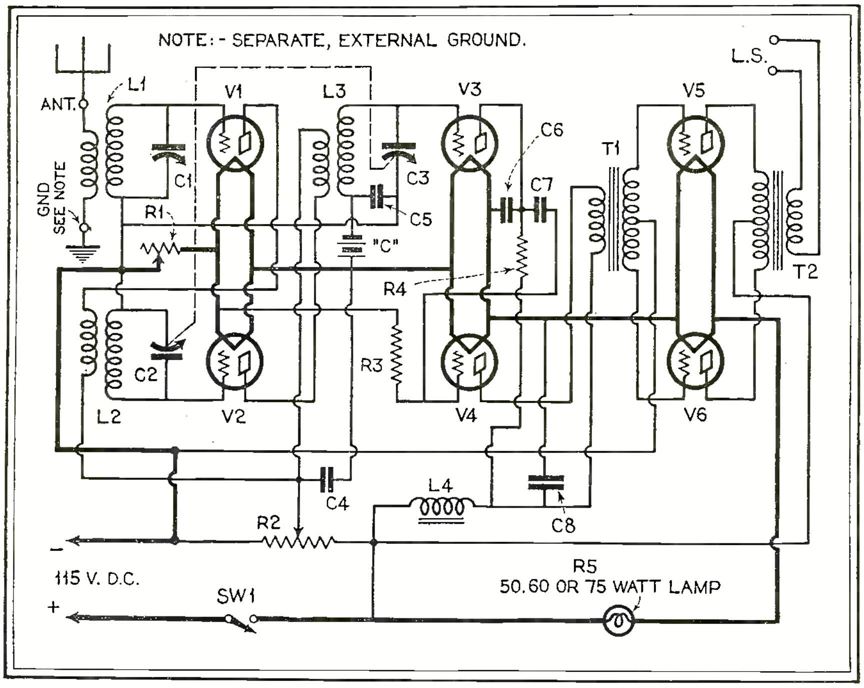


Fig. 2—This is the complete circuit diagram of the Grimes d.c. receiver. Compare it with the evolutionary circuits below

This prerequisite determines the amount of total filament current. Each path draws one-quarter ampere or a total of one-half ampere. This current must flow through the entire filament circuit so the other tubes must be connected to handle this flow without any one tube drawing more than its share. Accordingly, the rest of the tubes are connected in series-parallel. The 60-watt lamp is placed in the line to limit the current to the proper value and it is placed in the positive lead so that the filaments will be negative to the plate voltage taps which are taken off the extreme positive end of the incoming circuit. These taps are shown in Figs. 1D and 1E and will be subsequently discussed in greater detail.

The Grid Biases

Fig. 2 illustrates the grid circuits of the radio-frequency stages and the detector. The radio amplifiers require the same negative grid bias on each tube and the same plate voltage. The best grid bias is about 1½ volts, and this is supplied by the variable 10-ohm resistance, which is placed in the negative filament lead in much the same manner with which we are familiar in the storage-battery set.

The answer to the detector stage is not nearly so simple. If a grid leak detector could be employed, no bias would be needed, as the grid return could be connected directly back to the positive end of the detector filament. But a grid leak

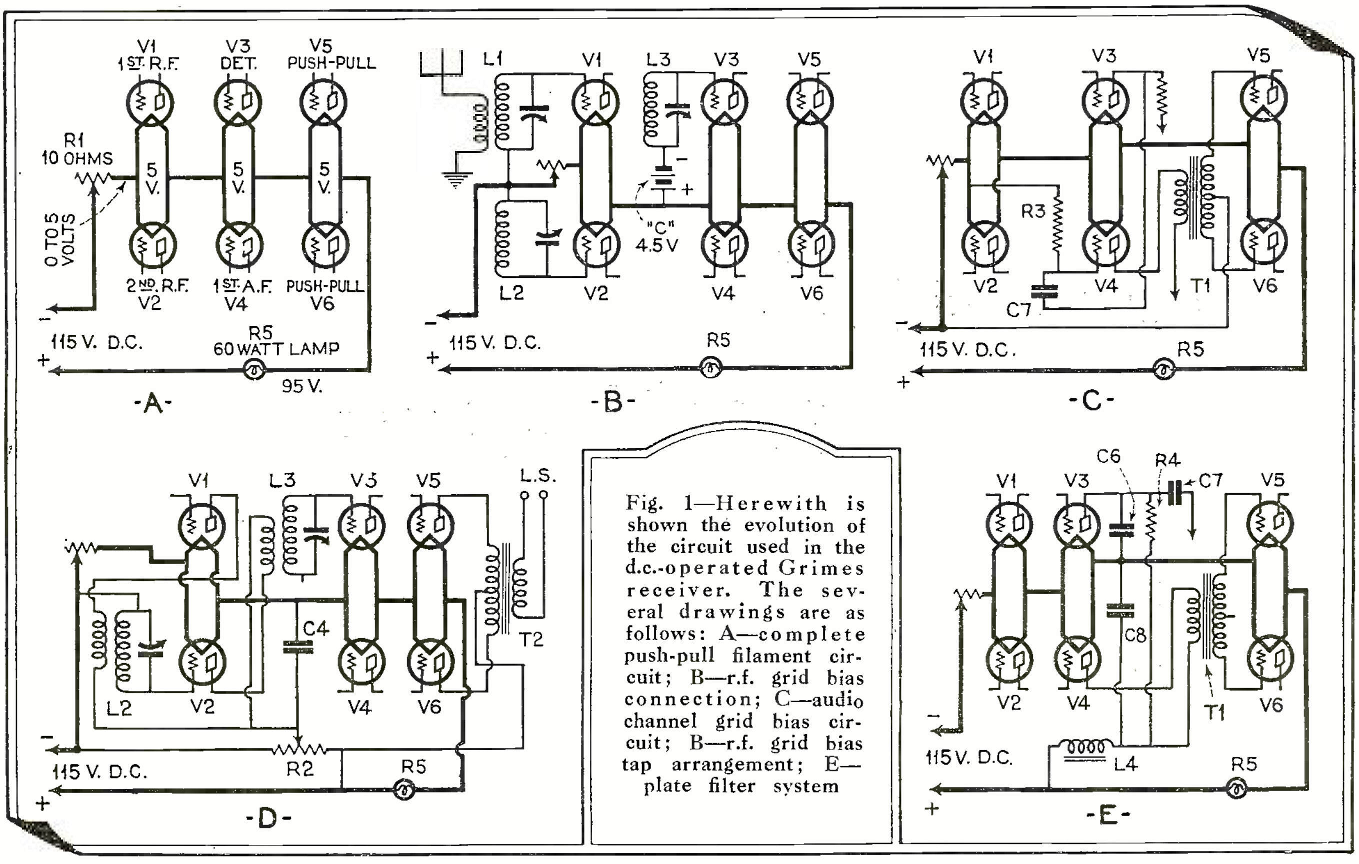


Fig. 1—Herewith is shown the evolution of the circuit used in the d.c.-operated Grimes receiver. The several drawings are as follows: A—complete push-pull filament circuit; B—r.f. grid bias connection; C—audio channel grid bias circuit; B—r.f. grid bias tap arrangement; E—plate filter system

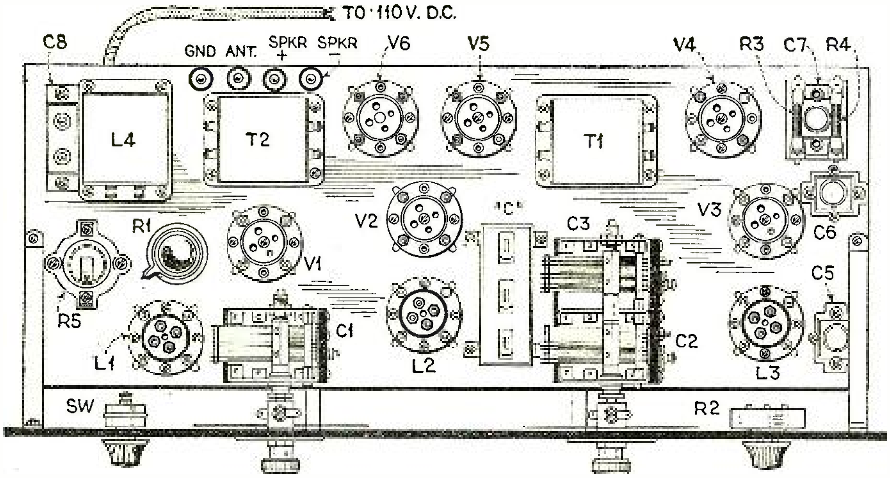
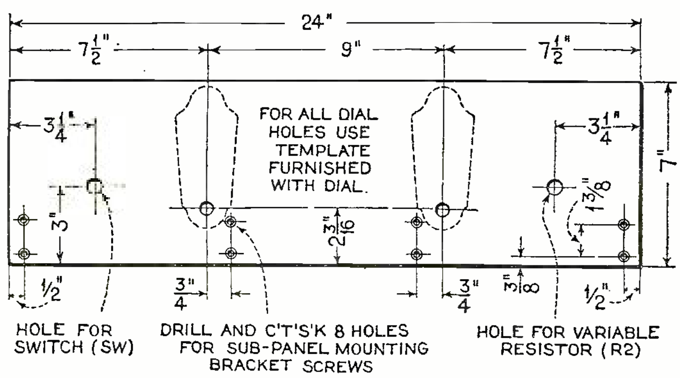


Fig. 3—The various parts employed in the construction of the receiver are laid out on a subpanel, as shown here. The several accompanying photos will also prove helpful in this respect

system is not recommended for the d.c. receiver. Such a system easily chokes up when any real volume is required of the detector, and good signal strength must be obtained from the detector so that less audio amplification will be required. You see, if we rely on excessive audio amplification for our volume, we will be deliberately amplifying any residual noise still present in the filament "B" and "C" circuits. The audio amplification must be kept low and the signal strength obtained by forcing a detector that will stand considerable overload. The "C" bias shown in Fig. 1B is our alternative. Now, ordinarily, this bias could be obtained by returning the grid wire back to the negative end of the radio-frequency tubes. But the noisy currents in these filaments are too much for the sensitive gride of the detector. The least voltage fluctuation at this point receives the full benefit of the entire audio amplifier. A small 4½-volt "C" battery installed as shown is the best answer at this stage of the development.

The "C" bias requirements for the first audio and push-pull stages are very simple. These are given in Fig. 1C. As will be gathered from the sketch, the first audio stage employs resistance coupling and the second stage consists of the push-pull combinations. The total amplification here is quite low, so that any noises

Fig. 4—The panel dimension and drilling template for the main panel



introduced by the grid bias circuits are not noticeable in the speaker. Thus the biases may be obtained from voltage drops along the filament circuit. The proper grid voltage for the first audio stage is obtained by connecting the grid return back to the negative side of the filament of the r.f. stages. This gives about 5 volts negative potential on this tube. The bias for the push-pull tubes is

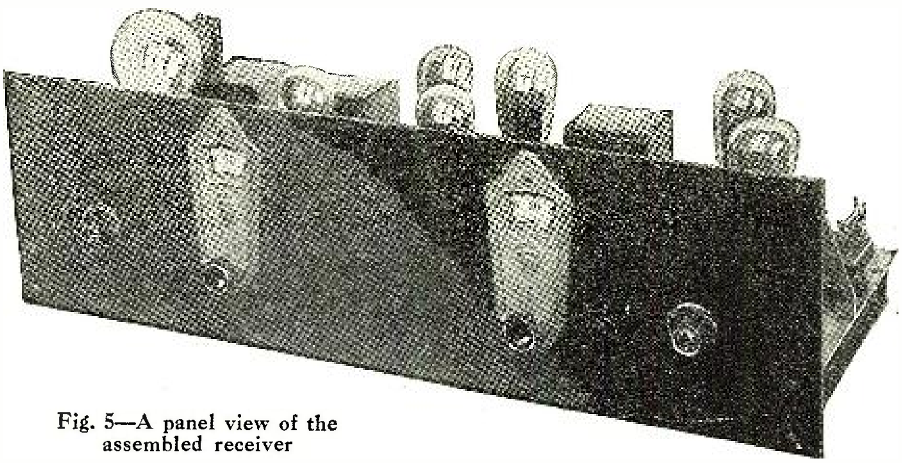


Fig. 5—A panel view of the assembled receiver

secured by running the return clear back to the most negative end of the filament circuit. This makes available the entire voltage drop across all of the other stages and the variable resistance in addition. A total of between twelve to fifteen volts is thus obtained, depending on the adjustment of the rheostat. This is approximately the proper value required for the 171A tube when it is operated on about 95 volts plate potential.

And right now is the proper time to say a few words on the subject of power tubes. There is a widespread belief that power tubes require high voltages for proper performance. This illusion is undoubtedly fostered by the instruction slips which accompany each tube. There is always specified some particular voltage for plate and filament. Power tubes will function on much higher voltages than ordinary tubes, but the value listed on the label is the maximum and not the absolutely essential value. The 171A will operate on almost any plate value less than the specified maximum and, volt for volt, will give much better results in the last stage than the standard 112A tube. Thus, with but 95 volts available for the last stage, better quality and truer volume can be obtained with the 171A than with the 112A. This is because the power tubes permit the use of larger "C" biases and thus are capable of handling more powerful signals without overloading.

The very fact that the push-pull 171A tubes require a larger "C" bias necessitates the placing of these tubes on the extreme plus end of the chain of filaments. In this location the voltage drop across all of the other tubes may be applied as the negative bias on the grids of this stage. While it would seem preferable to locate these tubes at the extreme negative end of the series in order to get the full advantage of the maximum plate voltage, it would be impossible at this location to obtain sufficient grid bias, and the latter is more essential than a few volts more or less on the plates.

The Plate Supply

We are now ready to proceed with a study of the various plate connections. Here again the question of noise consideration enters into the problem. Brute force methods of the past have placed all of the "B" supply through filters. This is a considerable drain and calls for rather elaborate filters. And it is so unnecessary! All of the plate supply leads do not cause objectionable trouble. There is absolutely no need to filter the plate supply lead for the push-pull audio and no real improvement is noted in filtering the plate supply for the two r.f. stages. Accordingly the connections presented in Fig. 1D are recommended. The "B" lead for the last audio is run directly to the high plus "B" side of the power line. The r.f. tubes are supplied through a potentiometer purely for the sake of controlling any tendency toward oscillation. This unit is connected directly across the power line with a small radio-frequency by-pass condenser from the mid-tap to filament for removing the "loss" effect of the resistance from the r.f. circuits.

The plate supply for the detector and

(*Continued on page 560*)

By CARL DREHER
Illustrated by James P. Ronan

OUT of radio and telephone needs grew modern speech amplifier pickup apparatus. What more natural and obvious, then, than to utilize this apparatus to give the movies a voice? And immediately all Hollywood studied elocution.

It isn't as simple as all that, however. Stage technique is one thing; camera angles and camera technique another; the pickup and amplification and recording of sound has a technique of its own, as Mr. Dreher explains.

In the nature of things, camera men and the sound people get in each other's way

When CAMERA Meets "MIKE"

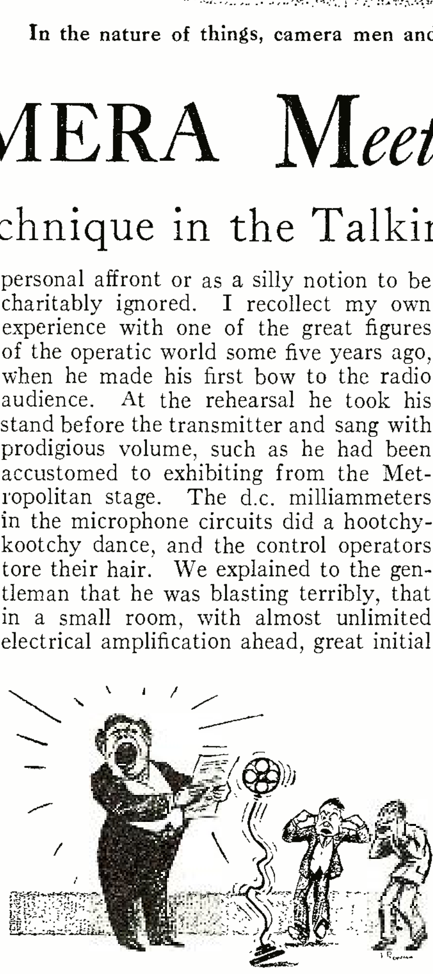
Radio Technique in the Talking Movies

It is one thing to be able to place the mike where one pleases

WHEN one compares microphone technique on a sound moving-picture stage with the corresponding manœuvres in broadcasting, one notes many close parallels and also some salient differences. A microphone is a microphone, but it is one thing to be able to place it where one pleases, in relation to the performers, as in the broadcast studio, and something else again when the business of the play, camera angles, camera noise, and all sorts of dramatic considerations must be taken into account. Movie microphone technique, as a result, is more intricate and requires greater adaptability on the part of the specialists.

Broadcast Experience Invaluable

It should be acknowledged, however, that without the preceding experience of the broadcast rooms, the job of the sound movie technicians would be insuperable. Not only did they learn their craft in broadcasting, but broadcasting taught the artists the amenities without which natural sound reproduction is impossible. It was in broadcasting that the co-operation between the performer and the technician, which is indispensable in this field, was first developed. The artists who first appeared in the radio studios took the idea that they should modify their execution for the sake of the microphone either as a personal affront or as a silly notion to be charitably ignored. I recollect my own experience with one of the great figures of the operatic world some five years ago, when he made his first bow to the radio audience. At the rehearsal he took his stand before the transmitter and sang with prodigious volume, such as he had been accustomed to exhibiting from the Metropolitan stage. The d.c. milliammeters in the microphone circuits did a hootchy-kootchy dance, and the control operators tore their hair. We explained to the gentleman that he was blasting terribly, that in a small room, with almost unlimited electrical amplification ahead, great initial

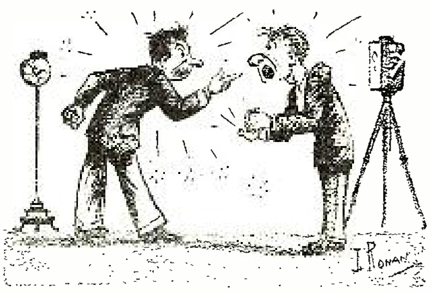


Trying to reach Rome, on 750 watts

volume was superfluous and injurious, and that better results would be secured if he would tone down his performance. After some snorting and argument in Italian with his manager, the artist graciously consented to make an effort to hold himself down. In the evening, however, he could not be restrained and the undeniable beauty of his voice was largely lost in transmission. Later on we found that an imbecilic scheme of the artist's press-agent, probably abetted by similar mentalities on the station staff, was partly responsible for the colossal fortissimos which the great tenor flung against the quaking walls of the studio. It seems that a group of the artist's friends were assembled in Rome to hear him broadcasting in New York (the power was about 750 watts). Little as he knew about radio, he realized that the attempt was a desperate one, and he reasoned that the only chance of getting across was to sing as loud as possible. He therefore dismissed the counsel of the engineers and did his damnedest.

Lowly Microphone Now Commands Artists' Respect

As broadcasting developed and stood on its own feet, a new generation of artists took the place of those of the older luminaries who had not shown themselves adaptable to the new order. These people developed a microphone technique which experience showed gave the best reproduction in the homes of the listeners. They realized that their reputations and future incomes were in the hands of the engineers, and, instead of waiting for the technical people to correct them, they asked them how to do it right in the first place. Some of these artists made, and are making, an imposing lot of money. This intelligence being spread abroad through the musical and dramatic trade papers, a new attitude toward the microphone and its mentors was created in the entertainment profession generally. The happy result is that in the talking movie



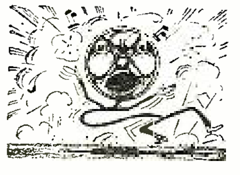
While two groups are trying to teach each other, a good many tempers are lost studios most of the actors are as eager to play to the microphone as to the camera, and the engineers get from them all the co-operation imaginable.

If some of the movie directors are less pliable, it is because they have not yet assimilated the broadcast viewpoint, which is based on the simple fact that the acoustic characteristics of the present-day microphone and its surroundings must be conformed to in the action, if the final product is to be successful. But this goes the other way also—many of the engineers have been slow in adapting themselves to the movie technique which preceded their entrance into the business and will in major degree survive it. Both parties must gain an understanding of technical limitations in photography and sound pick-up, not merely in one of these fields. The situation which exists in many studios is that the sound engineers know the limitations of the microphones (even under the best acoustic surroundings which can be provided), while the cameramen and the directors who have been working with the cameramen for years know the photographic limitations. The engineers ask for microphone placements which result in impossible camera angles; the directors want to photograph as in the past and demand miracles in microphone work from the engineers. While the two groups are educating each other, a good many tempers—and much money—are being lost.

In such situations the engineer, if he is to perform his task effectively, must be a practical psychologist as well as a sound technician. There are times when he must be firm and even severe. Experience shows that if he quietly accepts an impossible microphone placement, with merely a polite statement to the effect that the sound will not be good, he will be blamed later for the result. The director and the other functionaries will conveniently forget their part in the compromise and intimate that the engineer just doesn't know his business. In the nature of studio activities, loss of confidence in any technician proceeds rapidly, once the process is started. The sound man must not let it start if he can help it.

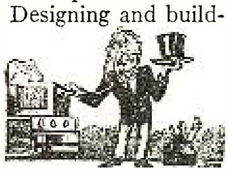
Sound Engineers Incur Wrath for Time Loss

Another peculiarity of studio psychology which he must be prepared to meet is that the law of identities does not hold between sound and picture. The law of identities, for the benefit of those who have forgotten their college courses in logic, is the simple proposition that a thing is equal to itself. Twenty minutes, for example, is twenty minutes—but not in a sound-picture studio. There twenty minutes of delay caused by sound equals forty minutes of picture delay. If the sound engineer, with his hundred millionfold energy amplification following the microphone, is stopped for a few minutes by a noise which he cannot locate, a far more serious crime against the studio has been committed than when a cameraman interrupts the shooting to have the lights changed. This is unfair, but perfectly understandable. In the first place the sound man is an alien in the studio, during the present period of adjustment, and judgments of him are likely to be more



A mike occasionally becomes noisy

severe. But more than that, when he causes a break in production it is looked on as one more source of delay in a business which was already appalled by its losses resulting from delays. The great bogey in the picture business is holdups in production. The actual "takes" occupy a lamentably small portion of the time of the studio. Designing and building of sets, rehearsals, placing and shifting of lights, changes in the action of the play, and now, microphone placing and amplifier adjustment, take up most of the time, and the actual photographing and recording which bring in the money are in the proportion, almost, of minutes to hours. And those hours, especially when the cast is ready and waiting, and all the grips and electricians and property men and directors and supervisors and the thirty-seven varieties of assistants with them, cost a dreadful lot of money. Nobody sees a few thousand dollars an hour going down the chute calmly, and the hysteria is at its worst when the sound apparatus is the cause of the loss.

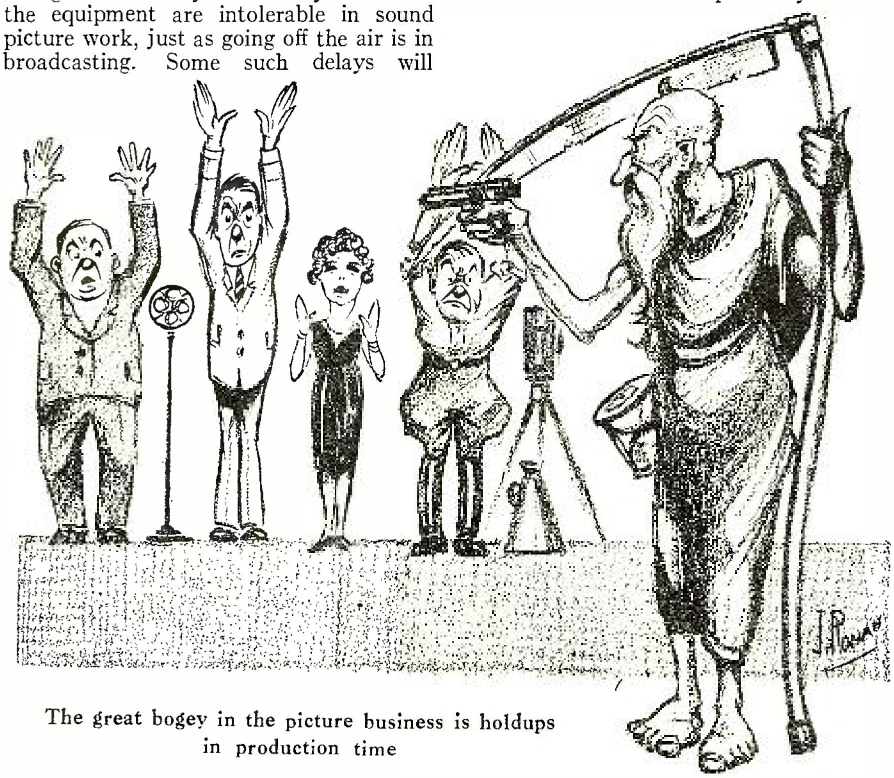


The engineer must be a skillful diagnostician

"Mike" Placement Still Matter of Cut and Try

Some delays the sound engineer cannot avoid; if, for example, he finds that with a given microphone placing he is not getting the best results, the action must usually be held up until the transmitters can be shifted. With even the shrewdest technical personnel on the job, microphone placing is a matter of cut and try, and sometimes the first try is not good enough. But delays caused by failure of the equipment are intolerable in sound picture work, just as going off the air is in broadcasting. Some such delays will nevertheless occur, just as breaks on the air have not been entirely eliminated by even the best broadcast stations. A microphone becomes noisy, or some electrical disturbance is picked up, or a circuit opens somewhere. The remedy, as far as there is one, is careful testing. The equipment must be gone over each day before production is scheduled to start, from microphones to film, and its performance tested at all the essential frequencies. Voltages and currents must be checked and any anomalies rectified before the damage is caused rather than afterwards. A good audio oscillator and a complete stock of meters has saved many a sound engineer's professional neck. If trouble nevertheless occurs, he must rely on his skill as a diagnostician. Most irregularities have their characteristic sounds, which can be recognized. During spare time they should, in fact, be deliberately produced, and such objects as a leaky condenser microphone, or a lead which meggers below the safety line, or a microphonic tube have considerable instructional value in this connection.

The subordinate sound technicians should be encouraged to keep accurate logs, and when sound equipment causes a delay the precise loss of time and the cause should be entered. Such a record is often of value later, although naturally it is not the matter of primary importance, which is to produce high quality sound negative as fast as possible. The notation comes in handy after studio incidents like one I witnessed, where it was necessary to shift microphone positions at the cost of about ten minutes. During this interval the director decided that the camera angles were wrong, whereupon the cameras were shifted and the lights changed. This manœuvre was completed thirty minutes after the sound men had finished their job. Later sound was charged with the loss of forty minutes. The sound engineer protested to the producer and was able to prove by his rec-



The great bogey in the picture business is holdups in production time

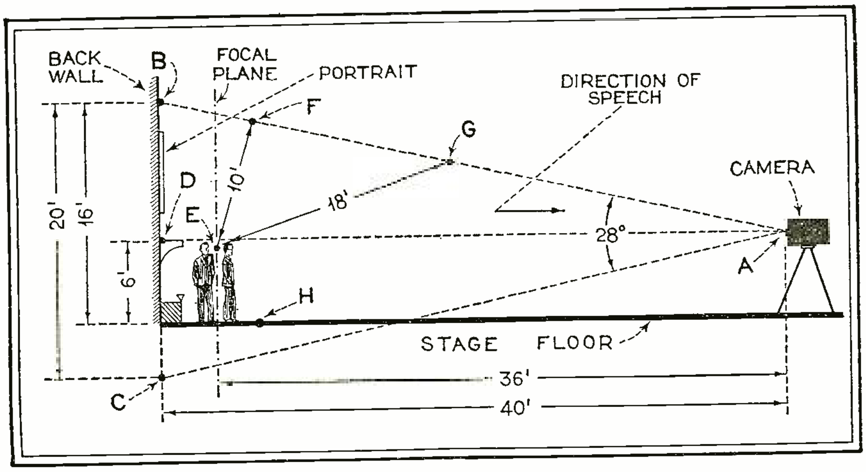


Fig. 1—A typical problem for the sound engineer, discussed in detail in the text

ords and other testimony that he was responsible for only ten minutes out of the forty.

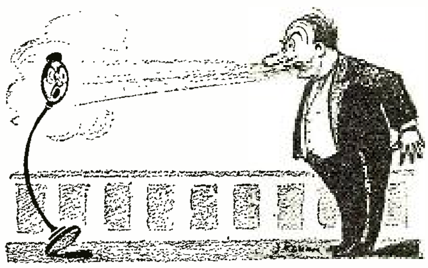
In contrast to this sort of thing one may turn to an article on "Sound Men and Cinematographers Discuss Their Mutual Problems" in the August, 1929, issue of the *American Cinematographer,* the excellent journal published monthly by the American Society of Cinematographers in Hollywood. In the nature of things, the cameramen and the sound people get in each other's way. Before sound invaded the picture studios the cinematographers could do about what they pleased, and the sound men, in their laboratories and broadcast studies, had their own way likewise. With the merging of the two techniques plenty of difficulties arose, and in some studios the less enlightened men in each group began to get on the nerves of similar temperaments in the other group. There was no good in that for anybody, so the cinematographers, as the senior body, started a movement for better understanding and recognition of the ultimate mutuality of interests. Before long the public will pay to see and hear only those pictures in which the story is good to begin with and the photography and sound are good after that. Such technical discussions as the one cited above benefit the whole industry enormously by promoting the proper feeling among the men responsible for reproducing scene and sound.

Having considered these general aspects of moving-picture sound recording at some length, we may proceed to a more technical description of the methods employed.

Movie Studios Borrow Page from Broadcast Studio Book of Tricks

The studio itself is first treated internally to reduce the period of reverberation to a value suitable for dialogue recording. So much has been written on this subject, starting with the classical work of Prof. Wallace Clement Sabine down to the present extensive literature, that it is merely necessary to state here that for good speech recording the room should have a period of not over 0.5-0.75 second, and if the volume is too great to permit the period to be brought down to this value it becomes necessary to box in the set with absorbents, making a studio within a studio. The absorbents used must be effective at low frequencies as well as high, which generally involves thick layers (2-4 inches) of such materials as felt, mineral wool, and other compounds. In recording of music higher periods are allowable.

The next problem is to bring the microphones close to the actors, say between two and five feet. Within this range the best intelligibility is secured. Beyond it a loss of the high frequencies of speech, which are so essential to intelligibility, is inevitable. Furthermore, since these tones



Tones issue from the mouth in the form of a beam

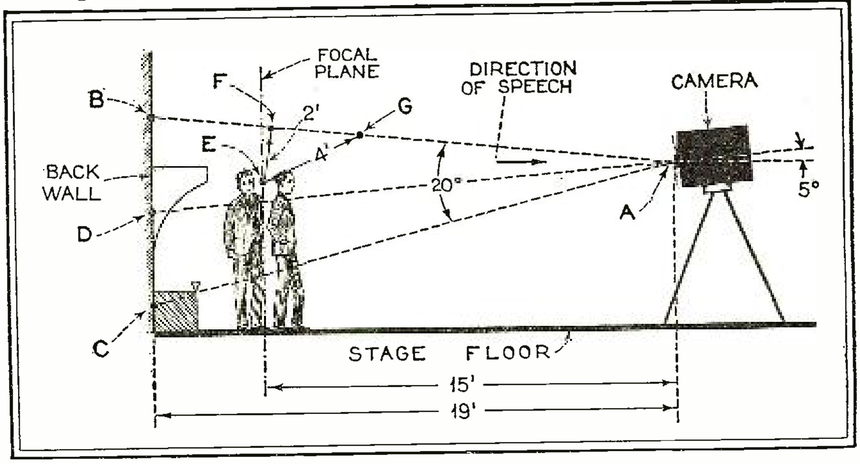
issue from the mouth in the form of a beam, like the radiation from a searchlight, the microphones should face the actors quite consistently throughout the action. This may entail placing a number of microphones, if the business of the play is such that it cannot be confined to a small area. And now complications arise because of the necessity of keeping the microphones out of sight of the camera.

A Complete Example Worked Out

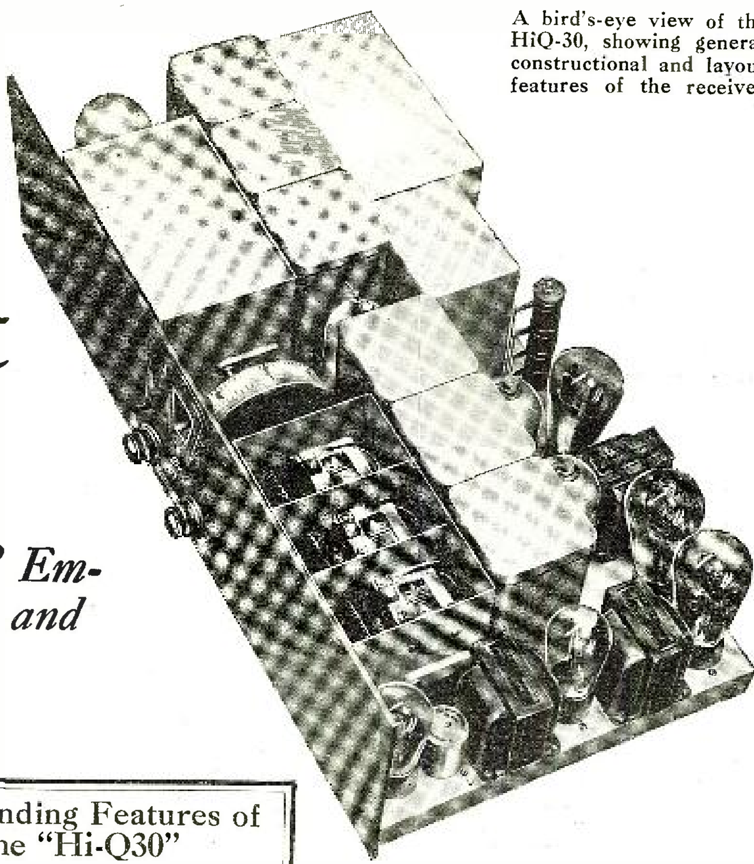
Fig. 1, drawn to scale, shows a typical problem. The scene takes place in a drawing room, which is shown in side elevation, the background being the wall at the left. There is the inevitable fireplace, with the ancestral portrait above it, and two people talking in the direction shown. The camera is set for a long shot, about 40 feet from the back wall of the set, so that the focal plane is about 36 feet from the camera lens, the two actors being four feet out from the wall. The director wants the camera to take in the ancestral portrait on the back wall. In photographic section we have, then, an isosceles triangle, ABC, with a 20-foot vertical base, BC, and a 40-foot altitude, DA. The microphones must either be outside of this triangle, or, if they are to be placed within it, they must be masked from the camera. The usual location for the microphone in speech pick-up is above the heads of the characters, just out of the camera field, and in front of them. Referring again to Fig. 1, it is clear that a pick-up of this type is not feasible in this case. Measuring from the sound source E between the mouths of the two actors, the nearest point on the border of the photographic field is F, the intersection of the perpendicular dropped from E to the side BA of the triangle. This is about 10 feet, considerably too far for high quality speech pick-up. Furthermore, the microphones would be practically over the heads of the characters and out of the high frequency beam. If the microphones are moved forward along BA to a point in the line of the beam, about the best that can be done is point G, which is 18 feet from the speakers, a hopeless distance under most acoustic conditions for sustained dialogue. Hence in this case, barring a lateral pick-up, about the only recourse is the placing of a small table, a chair, or other piece of furniture at H on the stage floor, in which a microphone can be concealed about waist-high four to five feet from the heads of the actors. This method may run into other complications, of which more will be said later, but one does not have to be much of a geometrician to conclude from Fig. 1 that it is the only system offering any hope of natural reproduction at all in the situation shown.

(*Continued on page* 558)

Fig. 2—The "close-up" offers advantages for sound pickup



The Band Pass Selector in a New Unit-Built Receiver



A bird's-eye view of the HiQ-30, showing general constructional and layout features of the receiver

The Hammarlund "Hi-Q30" Embodies Progressive Electrical and Mechanical Features

By LEWIS WINNER

PICTURE, if you will, a receiver employing nine tubes and embracing such outstanding features of design as a three-stage tuned pre-selector or band pass filter, a two-stage high-gain screen-grid radio-frequency amplifier, a super-sensitive tuned detector, a low-ratio high-quality first-stage audio amplifier, a push-pull output audio stage employing a pair of 245 tubes, a high-quality hum-free voltage-regulated plate and filament power supply—such is the Hi-Q30 receiver produced by the engineering laboratory of Hammarlund, a logical successor to the already popularly famous line of Hammarlund Hi-Q receivers.

To do full justice in describing the outstanding features of this veritable masterpiece of advanced engineering requires more space than can be allotted to the subject at this time. Therefore, this article will endeavor to explain as simply and as briefly as possible the circuit and construction features and will leave to a subsequent article the description of the technical and engineering features involved in its design and development.

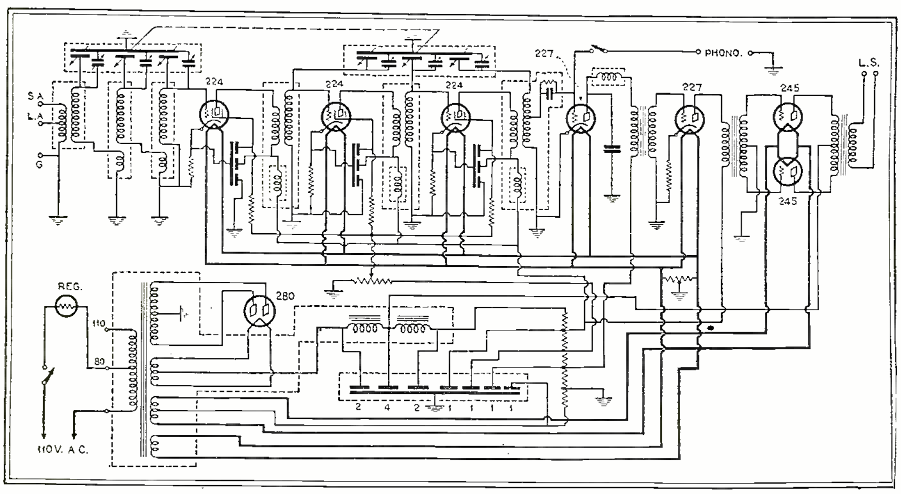
Outstanding Features of the "Hi-Q30"

- Three-section band-pass filter or "pre-selector."
- Three-stage high-gain screen-grid r.f. amplifier.
- Non-regenerative detector.
- One-dial tuning.
- Two-stage audio channel employing low-ratio transformers and a pair of 45 tubes in final stage.
- Sturdy units in a power device using 280 full-wave rectifier.
- Equipped with line voltage regulator to equalize a.c. line voltage variations.
- Entirely unit-built, making for easy, rapid assembly.

The Circuit

Backed by sound engineering principles, the findings of laboratory experiments and research, and the accumulation of much practical information concerning former Hi-Q receivers, the engineers of Hammarlund have evolved a circuit which not only contains all of the more worth-while circuit features which have been found by test and experience to be worthy of inclusion but have gone a step farther in the receiver's completeness by the development and application to it of the band pass filter, or pre-selector, as it is sometimes called.

Analyzing the receiver circuit from antenna post to the point where the loud speaker is connected, we find that in the order named we come upon first a three-section tuned filter system which comprises the pre-selector band or band pass filter unit; this is followed by a three-stage high-gain radio-frequency amplifier employing two a.c. screen-grid tubes; following this is a super-sensitive grid leak-and-condenser type of detector employing the 227 a.c. tube. The audio channel, consisting of two transformer-coupled stages follows. The first stage makes use of a low-ratio (1½ to 1) high-quality audio-frequency transformer inputting to an a.c. tube of the 227 variety; it is followed by a low-ratio (2 to 1 either side of center-tap, 4 to 1 overall) push-pull input transformer which in turn connects the plates of these tubes to the voice coil or magnetic winding of a loud speaker. Two things are worthy of note here. First, well-nigh flawless tone quality is assured by the husky low ratio transformers employed. Secondly, because of the relatively low step-up or amplification property of the

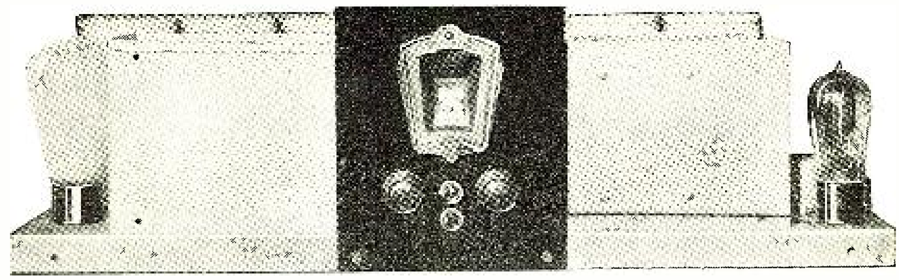


In the upper part of this circuit diagram is shown the pre-selector, r.f. amplifier and audio channel circuits, while below is the power supply circuit details audio channel as a whole, it is not difficult to realize the extreme amplification ability of the r.f. end of the receiver and the proportions of the signal which is delivered to the detector.

In the power supply unit there is a line transformer operating at 80 volts through a line regulator from a 110-volt a.c. source. Fluctuations of the line voltage are thus controlled automatically, thus insuring against erratic transformer actions and subsequently burned-out tubes. The center-tapped transformer secondary applies a potential of 750 volts to the plates of a 280 full-wave rectifier providing a 100 milliampere d.c. output.

Two filter chokes, one of 30 henries and rated at 100 milliamperes, the other of 30 henries and rated at 40 milliamperes, together with a high-quality condenser "B" block smoothes out the rippled output of the rectifier and passes on to the voltage divider a humless source of plate potential. In the condenser block only separate condensers of rather generous voltage ratings are employed. The total capacity of 12 microfarads is divided as follows: 2 mfds. at 600 volts, 4 mfds. at 500 volts, 2 mfds. at 400 volts, 1 mfd. at 400 volts, 1 mfd. at 300 volts, 1 mfd. at 200 volts and another 1 mfd. at 200 volts. The high d.c. voltage ratings of these units of the block provide ample range in case of accidental overload and thus insure against breakdown.

A wire-wound voltage divider in the power output circuit provides voltages of the correct value to the plates of the various tubes employed in the receiver proper.

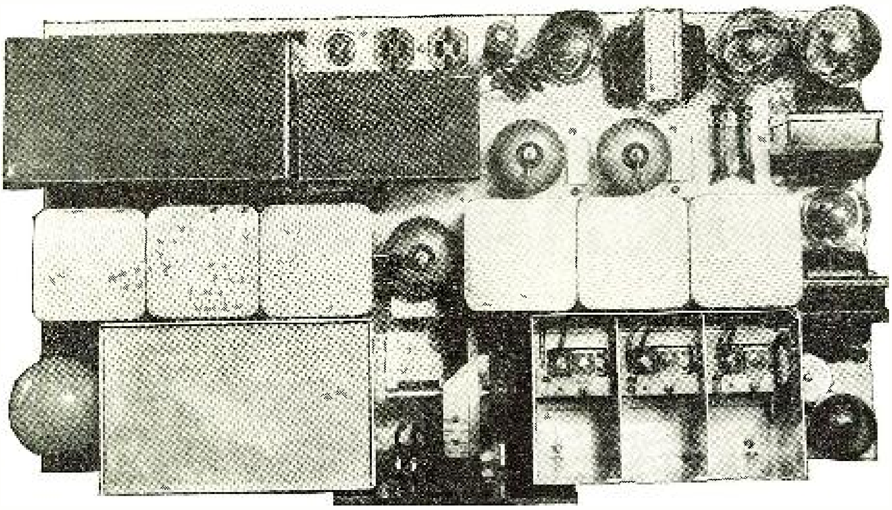


Looking at the front of the set shows the panel layout, the voltage regulator tube at the left and the audio tubes at the right

Some Constructional Features

Tuning of the receiver is accomplished by one knob actuating a drum dial which in turn controls the rotor sections of all the tuning condensers, both pre-selector and r.f. screen-grid amplifier. Volume control of the audio output is accomplished by the regulating of a potentiometer type of variable resistance which controls the amount of positive biasing voltage applied to the first two of the three screen-grid tubes in the high-gain r.f. amplifier. A phono-radio switch allows the connection of a phonograph pick-up to the input of the detector tube, thus enabling the audio amplifier to be employed as a sound amplifier for the reproduction of phonograph records.

Binding posts, conveniently located on the chassis, allow the connection of either a short or long antenna, or, if it is desired, the connection of a copper screen which will act as the signal collector for the pre-selector. The pre-selector or band pass filter unit consisting of the three tuned circuits previously mentioned is housed in individual shielded compartments. Each of the coils, as may be seen from the accompanying photographs, is mounted in a separate shield can. The three-section condenser is mounted in a single can container. The several sections of this gang condenser are not shielded, one from the other, since it was found that, to obtain the required band pass characteristics a certain amount of capacity coupling was desirable. In the r.f. amplifier, where absolute shielding of the several stages is a necessity, each of the condenser sections is totally shielded from the other.



This photograph illustrates quite completely the disposition of the units which comprise the receiver. Note the completeness of shielding and the absence of wiring "above the baseboard"

As an indication of the accuracy of design and construction which characterizes the finished units, the coils employed in the band-pass filter match within one twentieth of one per cent. of each other, while the condensers, having their individual trimmers adjusted at the factory, are correct with each other to within one-half of one per cent.

In the screen-grid r.f. amplifier the mode of construction is somewhat similar, especially as concerns the coil assembly and shielding; but, as has been previously pointed out, the condenser unit, unlike that of the pre-selector, has each of its sections totally shielded.

Complete filtering and by-passing of the radio-frequency currents in the plate and screen-grid leads to the tubes in the screen-grid r.f. amplifier unit is a subject which has claimed the attention of the designers. Shielded, polarized choke coils prevent the return of the r.f. currents in these leads to the voltage supply source. Three-section by-pass condensers afford an easy direct path for return to the filament circuits.

Meeting Aviation's Radio Needs

The Federal Radio Commission has taken a forward step in the interests of aviation progress, by adopting a comprehensive plan for the radio requirements of aviation, based on the establishment of chains of stations along the principal airways of the country.

The new set-up, which the commission said had the approval of the aviation companies and other Government agencies concerned, creates immediately four chains, each designated by a color.

Heretofore all licenses granted to airplane companies for plane-to-ground or plane-to-plane communication have been temporary, but under the new ruling all licenses will be granted for a year.

In the chain designated as "Brown," the following companies will operate: Universal Air Lines, Aviation Corporation, Braniff Air Lines, Central Air Lines, Continental Air Lines, Northern Air Lines, Southern Air Transport, Texas Air Transport, Gulf Air Lines, Interstate Air Lines, Clifford Ball and Colonial Air Transport.

The "blue" chain will include Western Air Express, Standard Air Lines, Mid-Continent and West Coast Air Transport.

In the "green" chain the Transcontinental Air Transport, National Air Transport, Northwest Airways, the Pitcairn Aviation and the Maddux Lines will operate.

The Boeing Air Transport, Pacific Air Transport, Stout Air Services, Varney Air Lines and National Park Airways will occupy the "red" chain.

The Pan-American Grace Airways and the Pan-American Airways have been granted sufficient frequencies to communicate along the Atlantic Coast and along the route of their Central and South American lines.

Wendall Hall, the "Red-Headed Music Maker"; first traveling troubadour of radio

Program

The Eveready Hour

AS the calendar tells time, it was not so long ago—December 4, 1923—that the name Eveready was spoken first into a microphone. But, as the whole radio industry counts time, it was ages ago—almost the Neanderthal period of radio.

In the first Eveready announcement outlining National Carbon Company's reason for sponsoring a radio program, it was stated that radio would grow as an integral part of national daily life only as the quality of program and educational material improved. Today, such a statement may appear arrogant. In 1923, however, conditions were greatly different than they are today. The total number of sets and listeners in the whole country was almost negligible compared with the millions of today. Sets were courageously effective for their day but pitifully poor in contrast to today's reproducing marvels. Listeners themselves were satisfied largely by the transmission of sound over air without wires, scarcely

An early Eveready Group photograph, and some of its outstanding artists. (1) Graham McNamee; (2) Thomas Griselle; (3) Edgar White Burrill; (4) Charles Harrison; (5) Wilfred Glenn; (6) Paul Stacy; (7) Betsy Ayres; (8) Arnold Morgan; (9) Theodore Webb; (10) Rose Bryant; (11) Max Jacobs; (12) Douglas Coulter; (13) Harry Gilbert; (14) Alfred Friese

Pioneers and Its History

By George C. Furness

IF any one broadcast program can be credited with having done the most to improve the standards of our radio programs in general, we believe that credit should go to Eveready.

And, for the courage and the vision to strike out along untried pathways, to learn by trying, and to risk mistakes, the group responsible for Eveready's programs owes its success to George C. Furness.

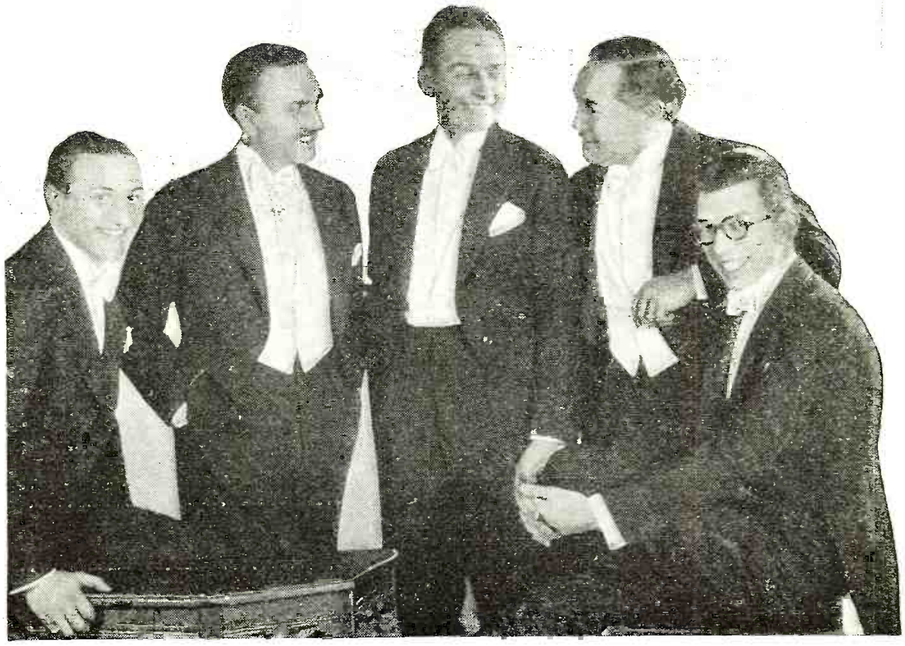
That is why we are particularly glad to present this intimate biographical sketch of one of radio's most popular features, written by the man primarily responsible for its growth.

THE EDTORS

Otis Skinner, one of Eveready's early guest artists

Rosalind Green, who came to the Eveready Group after previous experience with the WGY Players

At the right—The Revellers: Franklin Bauer, Lewis James, Wilfred Glenn and Frank Black



giving much of a hoot as to the nature or quality of the sound.

With George McClelland, we canvassed the nature of programs that were then available regularly to listeners, with the thought of providing something different. There were no regular minstrel shows. There were no regular one-act plays. There were any number of popular orchestras, but very few instrumental ensembles playing the more familiar classics.

It was intended to recommend that National Carbon Company select some one of these types for its series of programs. We shall never forget McClelland's expression when it was announced to him that the Eveready folks had decided to utilize all four types, alternating in presentation, one each week of each month, for a year. It was WEAF's first long-time commercial contract. The station went to it. We all went to it. And, that night in early December, 1923, the programs that have been uninterrupted weekly ever since, had their beginning.

Lawrence Grattan and Eva Taylor, well known to vaudeville patrons, retain the honor of having been the first Eveready artists. The list has been long and illustrious. And, from that first innocent little one-act play, "The Bungalow," the record runs up through—well, more of that later.

Eveready Hour had its guest artists early, too. Its fourth program presented Edwin Markham reading his own poems prior to Christmas. And Emma Dunn, "Cissie" Loftus and May Irwin all appeared in the period covered by the first ten programs. Edgar White Burrill read Ida Tarbell's immortal "He Knew Lincoln" for the first time, just prior to Lincoln's birthday in February, 1924. He has read it each year since.

Before telling how we began to get dissatisfied with our own programs and managed to evolve a type that made Eveready Hour more distinctive, mention should be made of two other conditions that marked the early days of Eveready Hour as well as the early days of all radio broadcasting.

When Eveready began, there was no network. For months, National Carbon Company fretted because their radio contribution reached only a local New York audience, that covered by WEAF. We all fretted with and for National Carbon Company. American Telephone & Telegraph broadcasting officials fretted. It is probable that this mutual fretting—this steady insistence that audiences, and also Eveready dealers, should be given the advantage of their programs in territories outside the radius of WEAF—had a great deal to do with hastening the actual materialization of the great chain that now covers the country from coast to coast and from Canada to Mexico.

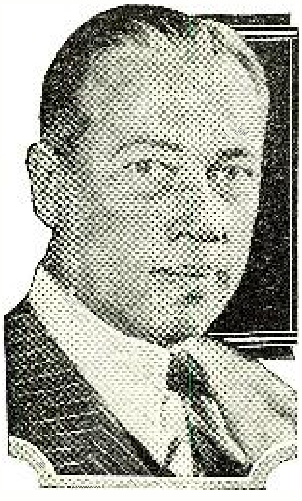
When Washington and Providence stations transmitted programs that originated in New Yorks WEAF for the first time, they were Eveready programs. These three stations, in New York, Washington, and Providence, were the nucleus—the beginnings of an engineering feat that is too little appreciated by the millions who today are in touch with the pulse and heart of a nation and of a world when events of nation-wide or world-wide importance unite them in common interest.

But growth of the chains was too slow for National Carbon Company. So, when it was realized that large sections of the country still could not be reached by the regular Eveready Hour for months and months, steps were taken to cover those areas without hooked-up stations. Wendell Hall, already famous for his radio croonings in Chicago, became the Eveready Red-Head in January, 1924. His "Ain't Gonna Rain No Mo'" had delighted KYW audiences and, soon, due to his bookings all over the country, in every state, in Canada, in Hawaii, Cuba and eventually in England and France, not only a nation but a good part of the world was singing and whistling it and other of the captivating jingles that he evolved during his long and successful career as an Eveready artist, the first traveling troubadour of radio. Vaughn de Leath and Carson Robison also were sent as Eveready artists to other territories untouched by the slowly growing chain of hooked-up stations. All three of these names are found among the active current entertainers and directors of radio today.

In the meantime, Harkness, Holman, McClelland and Hansen, pioneers technically, commercially and artistically, were working overtime not only to expand the network but to help make radio pay the advertiser. It was a period of working in red, then and for years to come, but they had the vision to foresee the day when the force of radio, properly administered, could be widely utilized as a necessary factor in many national advertising campaigns.

Marcella Shields, who played Dixie Dugan in the Eveready presentation of "Show Girl"

The famous Flonzaley Quartet, whose farewell program was given as the feature of one of the Eveready Hour programs



Reinald Werrenrath became a convert to the microphone as a means of reaching large audiences

Mme. Elly Ney, who delighted Eveready listeners over a nation-wide hookup

Along around the early part of the summer of 1924 we realized that our programs were not particularly outstanding; they differed very little from this, that or the other commercial or sustaining program.

"The number you have just heard was So-and-So. The next number will be Such-and-Such."

Interminably, announcers from all stations followed this formula. So did Eveready. There was no other method of presentation. Hour after hour, night after night, from every station: "The number you have just heard was," etc. It was not only boring in its monotony; it was stupid. We grew tired and sick of such uninspired dronings. We knew that eventually the growing radio audience also would sicken of it.

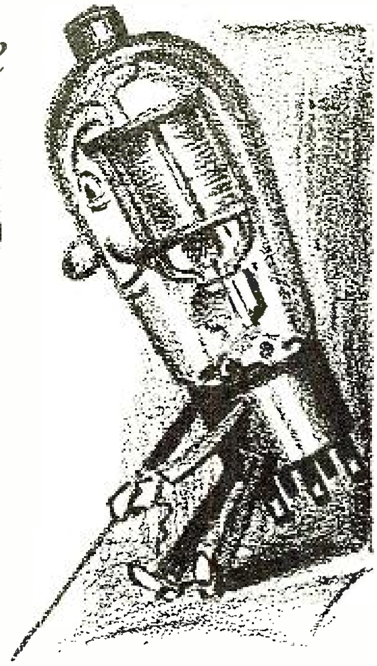
In July, 1924, we sat down and looked radio programs in the face. What were they? Sounds — sounds — transmitted sounds. Sound was the only medium in which program directors had to work. What classifications of sound were there? Music—vocal and instrumental. Programs to date had been nearly 100 per cent musical. Were there not other forms of sound? What of the spoken word—of the richness of literature—its beauties, its thrills, its humor, its adventure, its dreams? Could not one make selection from the rich stores of musical and literary libraries in such way that both forms would contribute one to the other, each illuminating and interpreting the other—both so combined as to present more vividly and interestingly a single, central theme that would dominate an hour's radio presentation?

We all were groping, groping rather blindly in the dark. There were no precedents for guidance. Radio had come upon us so miraculously fast that there was little time to catch hold of it and put it under a microscope.

With the fall season of 1924, National Carbon Company's programs appeared first under the name of Eveready Hour. J. R. Marsh of that company coined the title. It developed in the course of an

(Continued on page 581)

The SCREEN GRID Tube REVIVES Resistance-Coupled Audio



By James Millen *and* Gradon Smith

THE screen-grid tube was designed primarily for radio-frequency amplification; in which function it has proved a much needed boon. Like many other radically improved devices, however, this tube has other uses than the one for which it was designed.

Resistance-coupled audio amplification, which had fallen into the discard, is coming back. The new tube, with its high impedance and high amplification, changes the picture entirely, as between transformer and resistance coupling.

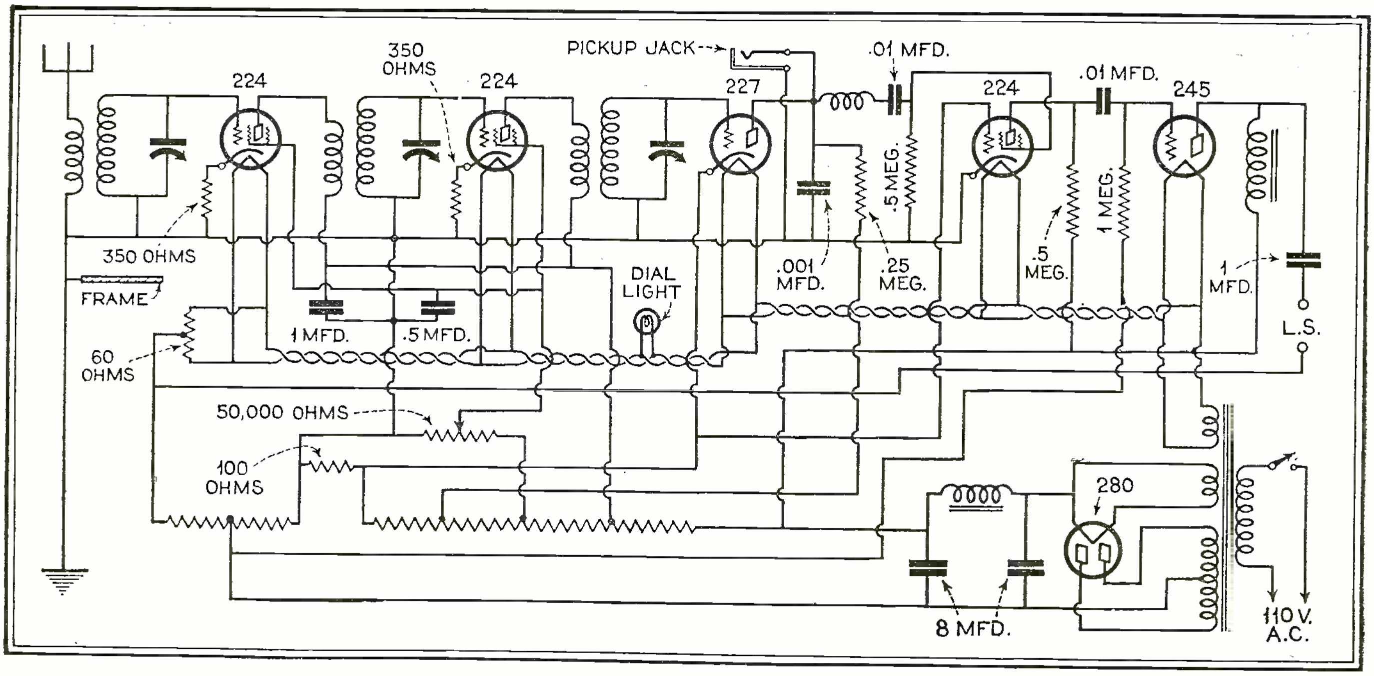
IN the old days, when radio was more of a hobby than a science for most of us, we built our amplifiers with d.c. tubes and sometimes with resistance coupling. Always d.c. tubes, three stages of them, and what grief the batteries gave! Life for the ham was one charge after another. It would not have been bad if one or two stages had been enough, but resistance coupling did not give much gain and there was no choice, and the resistors themselves were a nuisance. They were noisy, they were unreliable and they could not carry much current. To be sure, they gave much better tone than those makeshift transformers we used to use, but the audio amplifier was only one link of a long chain, and even with resistance coupling, the less said about the tone the better.

Then a.c. tubes came along, but they hummed. No matter how much we monkeyed with the circuit, they still hummed. Cheap audio transformers solved that difficulty for a time, because having low primary impedance, they refused to amplify the low notes. It was about this time that vaudeville actors began to give imitations of the radio on the stage.

If the actor's voice sounded funny enough, the skit was a sure hit. However, in spite of ridicule, the new system stayed with us. It had two big advantages. It was cheap, since it required only two stages, and it operated from the light socket.

Discriminating Public Wanted Quality Reproduction

But the broadcast-listening public demanded better tone. Heater type tubes eliminated most of the hum, so better audio transformers were designed. The public had to be served and nickel-steel cores and high-inductance windings gave them the tone they wanted. But the public never likes to pay and with one voice they cry for better tone and lower price. This, then, was the problem confronting the industry, and some manufacturers turned to resistance coupling as a solution. To be sure, it had the disadvantage of low gain per stage, but the tone quality was good. Furthermore, the resistors themselves, thanks to the chemist, were much better electrically and much less expensive than the cheapest of audio transformers. Then again, the many merits of power detection and its consequent adoption by the majority of set and chassis manufacturers provided another powerful argument for resistance coupling. Such a system of detection makes essential the use of an extremely high impedance input circuit to the audio-frequency amplifier if the tone quality of the receiver is to be at all good. To secure such a characteristic with a transformer-coupled amplifier requires the use of an input transformer with such a high primary impedance as to be quite out of the question from an economic point of view, unless the set is a very high-priced one. On the other hand, if a resistance-coupled input circuit is used, there is no such difficulty, for resistances of any value are readily obtainable at low cost. No doubt this is the reason



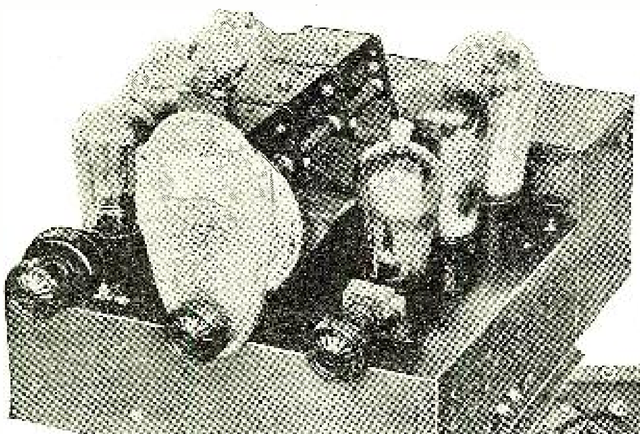
Complete circuit diagram of a low-cost a.c.-operated receiver incorporating two stages of resistance-coupled audio amplification

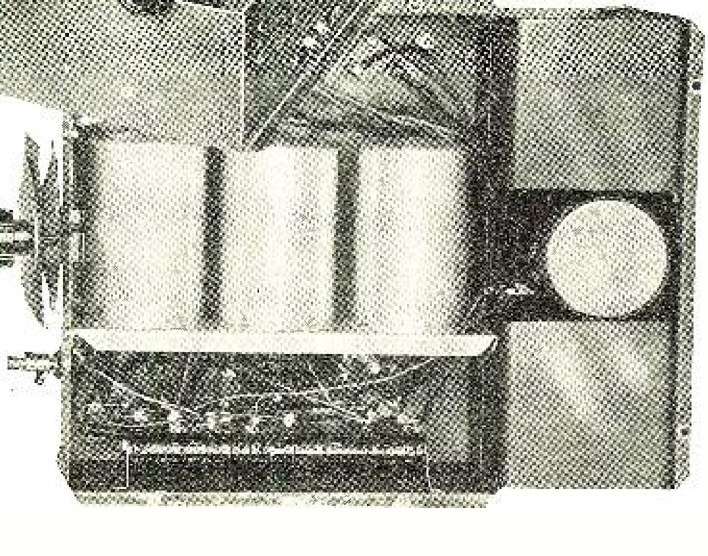
why many of the manufacturers of lower-priced chassis use a stage of resistance-coupled audio followed by a transformer-coupled output in their receivers. An outstanding example of a set of this type is the Atwater Kent.

Screen-Grid Tube Offers New Possibilities

But now a new factor has appeared. This is the screen-grid tube, which gives extremely high gain no matter whether it is operated in the usual manner or as a space charge amplifier. As in the case of power detection, extremely high values of impedance must be used in the coupling circuit, so high in fact, that transformer coupling is rather out of the picture. It is with this type of tube that resistors have come into their own. For one stage of resistance-coupled screen-grid audio has more gain than the usual transformer coupled stage, and this high gain is accompanied by splendid tone, a flat frequency characteristic, and low cost. Once more the demands of the public are met by the laboratory.

The modern resistor, fortunately, is quite capable of meeting the exacting requirements of the designer. This certainly could not be said of the resistors of ten years ago. Thanks to the chemist, non-inductive resistors are now being made which will carry heavy currents at high voltages without overheating or noise.





Two views of the compact assembly of the receiver whose circuit diagram is shown above

Next Year's Sets—And Resistance Coupling

As an indication of what the sets of next year may be like, the little set illustrated on this page may be of interest. As is evident from the circuit diagram of Fig. 1, the audio channel is resistance-coupled throughout and is most interesting. The 224 tube is operated as a space charge amplifier. This means that the usual grid connections are reversed; the signal is impressed on the outer screen grid and a fixed voltage is impressed on the inner grid. This gives very high gain—about sixty—so that only two stages are necessary. The second stage is a 245 output tube. Although both tubes are supplied from the same B supply tap, the 224 is coupled through a ½-megohm resistor, which provides the necessary impedance in the plate circuit, and cuts down the voltage for the plate.

Another interesting feature is that all filaments are supplied from the same transformer winding. If this were done with the tubes connected in the usual way, it would impress a voltage between the cathode and filament of the heater tubes. This potential could be equal to the grid bias voltage on the 245 tube, which is ten times the maximum value that can be safely impressed. To avoid this, the filaments and cathodes of all the tubes are operated at approximately ground potential, and the "B—" is operated at 50 volts below ground. The 245 tube gets its bias from the "B—" potential, thus accomplishing the desired result without the expense of an extra filament winding.

New Manufacturing Methods Provide Accurate Resistors

A few words about the manufacture of resistors may not be out of place. The illustrations on this page show the plant of one large manufacturer. In making the resistors, a specially selected glass is coated on the inside with a mixture of metallic ores. These glass rods are fixed in an automatic muffle furnace which smelts the deposited ores and at the same time fuses the metallic coating to the glass.

The resistance of this coating varies from a few hundred ohms to many megohms per inch, depending on the formula used. After cooling, the coated glass rods are cut into lengths a few inches long. Each piece is then put on a special lathe and rotated at two thousand revolutions per minute. This lathe has an insulated head and tailstock, and leads are brought from these to a Wheatstone bridge circuit. The resistance of the coat glass piece can thus be measured while it is rotating. A guiding tool is then inserted through the hollow tailstock and the coating is slowly ground away. A continuous reading of resistance is taken, and when the exact value is reached, the piece is taken out. It is then capped on both ends with a high-melting solder, so that leads can later be soldered on without loosening the joint. Each resistor is then again checked to make sure that the resistance was not changed in the capping operation.

Due to the nature of the coating, these resistors can be run at very high temperatures without damage, although the practice is not recommended. Such resistors are non-inductive, and have a wide range of voltages and temperatures.

Although predictions are notoriously fallible in the radio industry, it seems to us that resistance coupling is certainly coming back. It is a development that we can welcome without misgivings, for in its modern form it assures both volume and quality.

Special lathe on which coated glass tube resistors are brought to the proper resistance values

Aviation Radio Is Forging Ahead

BOTH aviation interests and radio interests are alive to the need for better radio communication facilities for airplanes in flight. As has often been pointed out, this country lags far behind Europe in this subject. Abroad, no passenger-carrying plane is permitted to operate unless it has facilities for maintaining communication with the ground; this ruling being rather rigidly enforced by the various air ministries of European nations.

As yet, the U. S. Department of Commerce contents itself with a strict watch on the airworthiness of our commercial planes, the fitness of pilots, and with an ever-growing aviation beacon and aviation weather report program.

Meanwhile, without waiting for compulsory legislation, several of our big air transport companies have installed two-way communication equipment on their planes, while a large number of radio engineers and manufacturers are working to improve this type of apparatus. The Radiomarine Corporation, whose plane is shown here, is one of these.

E. N. Pickerill, in charge of this plane, has been a pioneer radio operator since 1905, was chief radio officer of the *S.S. Leviathan,* and served as a first lieutenant in the U. S. Air Service during the war.

The Fokker plane was bought by the Radiomarine Corporation to assist in the development of, and to test and demonstrate, aircraft radio apparatus. Mr. Pickerill, who is in charge of the plane, plans to fly to the principal aviation centers of the country and demonstrate the newly designed radio apparatus which the plane carries.

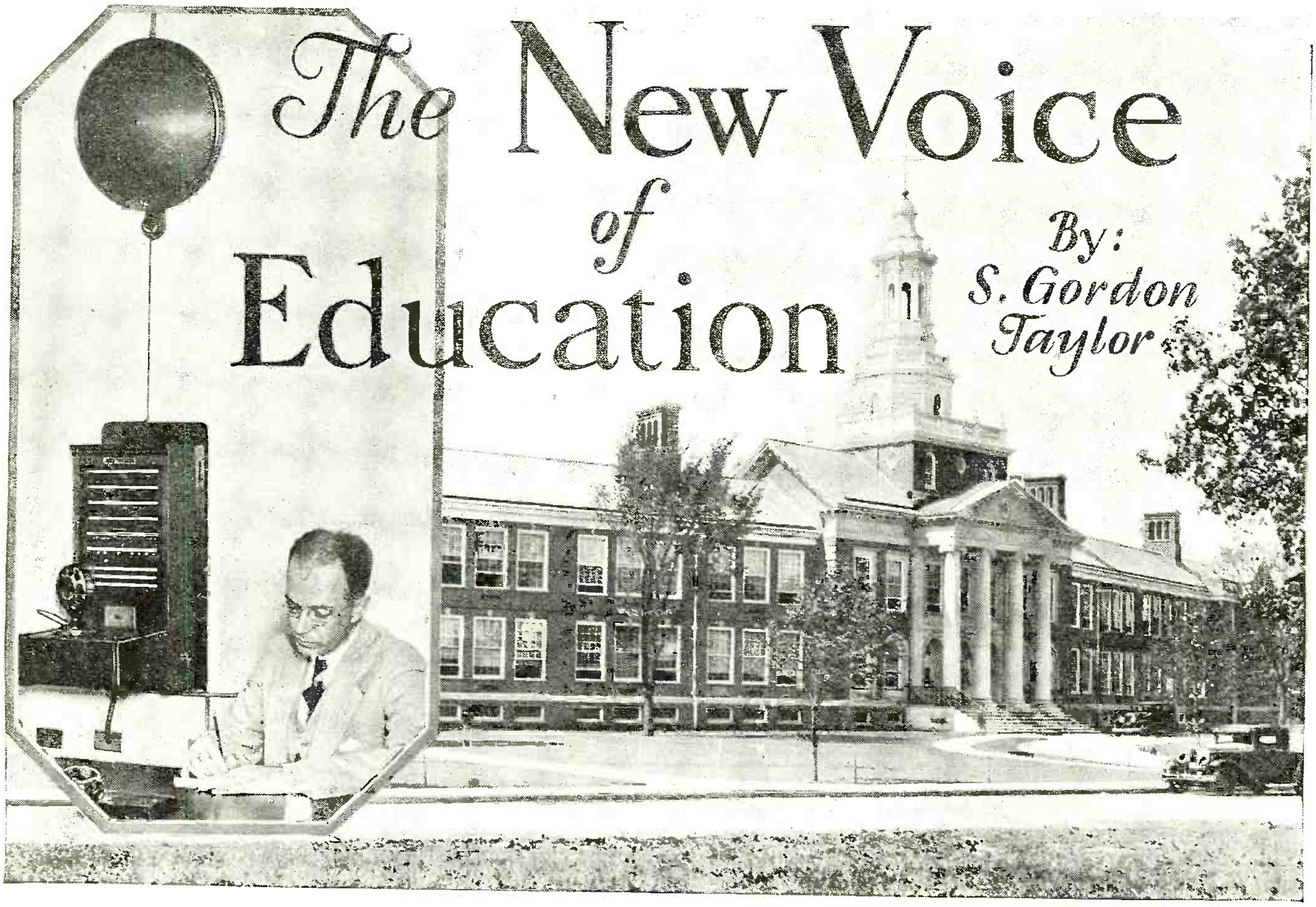
Most of the radio equipment has already been installed, and after about a week of flight testing, the plane will be ready to begin its country-wide tour. Mr. Pickerill hopes to be able to arrange his itinerary so that he may attend the Cleveland Air Show with his plane this summer.

The RCA plane is powered with a 425 horsepower Pratt & Whitney Wasp motor with a maximum speed of approximately 140 miles an hour. It has a cruising radius of 700 miles and room for six cabin passengers and two persons in the pilot's cockpit with dual stick control.

Most of the radio apparatus has been compactly assembled on a light but rugged duralumin frame fastened in the fuselage. This equipment includes two transmitters of the master-oscillator power amplifier type. One transmitter derives its power from a wind-driven generator mounted in the slipstream, and the other is energized from a dynamotor on the floor of the plane. The transmitters are rated at 100 watts for radio-telegraph work and 75 watts for radio-telephone operation. They each employ a UX210 Radiotron as a speech amplifier and three UV211 Radiotrons which function as master oscillator, power amplifier, and modulator respectively.

The wind-driven generator supplies 1,000 volts for the plate, and 10 volts for the filaments in one transmitter. The dynamotor operates from the plane's 12-volt landing light battery, and supplies 1,000 volts of direct current for the plate. The filament supply is also taken from the 12-volt storage battery.

The plane is also equipped with two receivers, one called a communications receiver for use with special short wave stations between 45 and 90 meters, and a beacon receiver for intercepting signals from aircraft and ground stations in the waveband of from 550 to 1050 meters, and for listening to ship and shore and other stations in the 600 to 950 meter range. The beacon receiver is mounted in the tail of the plane at the base of an unobtrusive antenna pole which extends six feet above the fuselage.



The New Voice of Education

By: S. Gordon Taylor

MUCH information on sound amplifier installation work may be obtained from a study of some typical installations now in use. It is for this reason that a comprehensive description of an installation recently completed in the Great Neck High School at Great Neck, Long Island, New York, is to be given in this article.

This installation is perhaps the most modern and complete that has ever been made. There is a loud speaker in each class room throughout the school, with additional high-volume speakers in the auditorium and cafeteria. The circuits are so arranged that these loud speakers may be used for the reproduction of radio broadcasting, phonograph selections or microphone input. To this extent the installation is not particularly unique because there are a number of schools throughout the country which provide these facilities.

One of the outstanding features of the Great Neck High School installation lies in its extreme flexibility. In the principal's office is a switchboard which resembles the ordinary telephone switchboard. This switchboard provides individual control over each loud speaker in the building. Thus a spoken message from the principal can be carried to any single room or any combination of rooms by simply switching into the circuit the loud speakers in these rooms which it is desired to reach. Thus, if the principal has a message for all of the upper grade classes he simply throws the switches controlling the loud speakers in these rooms with the result that he can talk directly to these classes through the microphone

The Great Neck, Long Island, High School is shown above, and the principal, M. P. Gaffney, is shown above in his office, and below at the radio switchboard

mounted at the switchboard in his office.

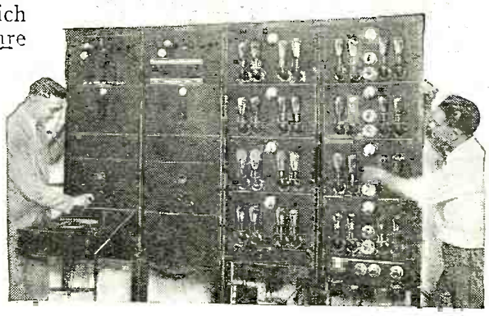
This same flexibility applies to the reproduction of either radio programs or phonograph selections. That is, if there is a broadcast program on the air which would be of special interest to part of the student body this can be connected into the loud speakers in the rooms constituting this portion of the student body. At the same time the other loud speakers which are not connected in on this program are available for some other program or for any other use to which it is desired to put them. This latter is made possible through the fact that two distinct channels are provided in the system with a switching arrangement so that any of the loud speakers may be connected in on either of the channels.

School Work Facilitated by Use of Speech Amplifier System

Before going into a technical consideration of this installation it is interesting to note the comment on the facilities offered by this installation, as quoted from a letter just received from Mr. Matthew P. Gaffney, the principal of the school. Mr. Gaffney writes as follows:

"Because our building is new and the year has just started, we are slowly learning to take advantage of such mechanical appliances as our new radio equipment.

"Even up to this point it has proved to be a marvelous time saver for the prin-



The radio receiving and amplifying panels located on the stage of the auditorium of the Great Neck High School

cipal. In perfecting the organization of a school it is necessary, in the first few weeks, to divide classes, shift schedules, place new pupils, correct mistakes and take care of a thousand details.

"Instead of sending mimeographed announcements from room to room or waiting for the next session or calling assemblies for routine announcements, I have been able within two minutes' time to speak to the entire building, giving my announcements or requesting pupils to come to the office. This opportunity for the principal to make immediate contact with the entire school will be of great value.

"Probably more important than this, however, will be the opportunity to give the pupils the benefit of any program brought in over the air which the teacher desires to have them hear without leaving their class room. It is possible to send a program into any class room or any combination of class rooms and, since there are two circuits, two different programs could be given at the same time in various parts of the building. It will take us some time to make the best use of this remarkable device."

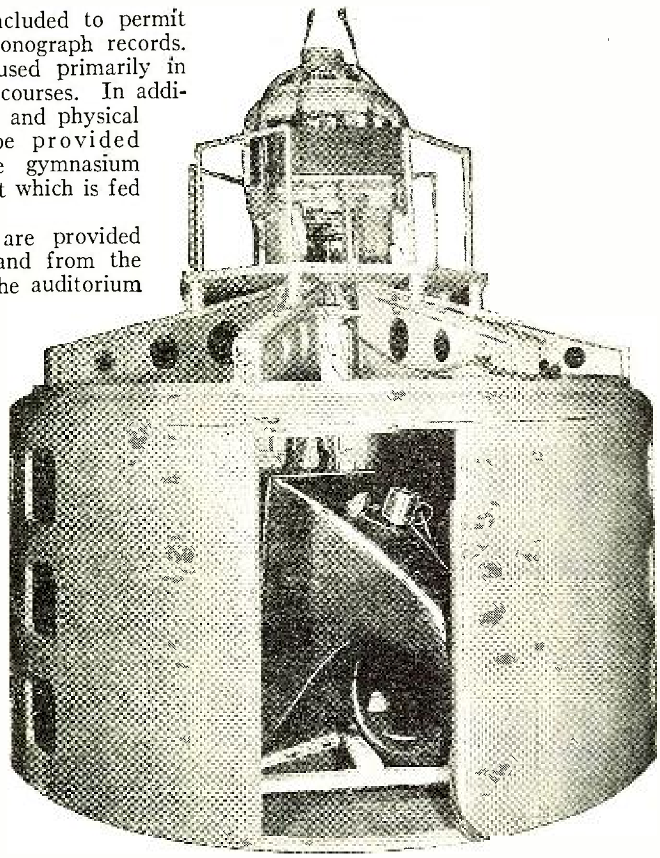
Local Man Installs Complete Amplifier System

An interesting feature of the business end of this installation lies in the fact that the entire contract was handled by a local radio man, Mr. William Barrow, Jr. Mr. Barrow "sold" the school authorities on the advantages to be obtained from an adequate sound amplifier installation. The equipment was purchased complete from the Stromberg-Carlson Company and installed by Mr. Barrow's organization. This situation simply goes to prove the stand originally taken in these articles, that sound amplifier installation work is not necessarily limited to the large contracting and engineering concerns. Even the largest installations are within the ability of many professional radio men.

From the schematic layout shown in the accompanying wiring plan of the Great Neck installation, an excellent idea of the equipment may be obtained, especially if studied in conjunction with the second schematic drawing showing the amplifier rack equipment. As shown in these drawings, the inputs consist of two radio receivers to permit simultaneous reception of two different broadcast programs. A phonograph with pick-up is also included to permit the reproduction of phonograph records. This feature will be used primarily in connection with music courses. In addition music for dancing and physical training classes can be provided through switching the gymnasium speakers into the circuit which is fed from the phonograph.

Microphone inputs are provided from the auditorium and from the principal's office. In the auditorium there is a group of three microphones so arranged that one, two or three can be cut in as desired, depending upon what is to be picked up. Through this means addresses or musical programs originating in the auditorium can be distributed to other parts of the school as desired. The usefulness of the microphone in the principal's office is made clear in Mr. Gaffney's letter quoted above.

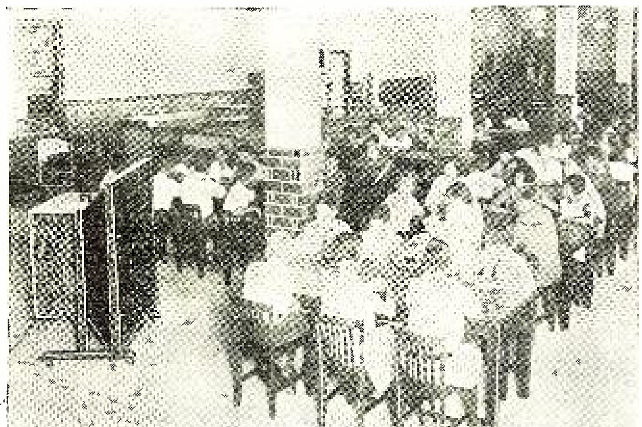
In addition to the amplifier equipment the racks include all auxiliary equipment required in conjunction with the operation of the installation. The completeness of the equipment is clearly indicated by the rack layout drawing, Fig. 1, on which the purpose of each individual panel is marked. Tho two racks at the right include the four power amplifiers with their attendant power supply units. The left-hand rack includes one of the radio receivers, the phonograph and the equipment associated with the group of microphones in the auditorium. This equipment includes a volume indicator, a mixer panel and a speech amplifier, and on these panels are found the associated control units to regulate the volume and quality of the microphone input.



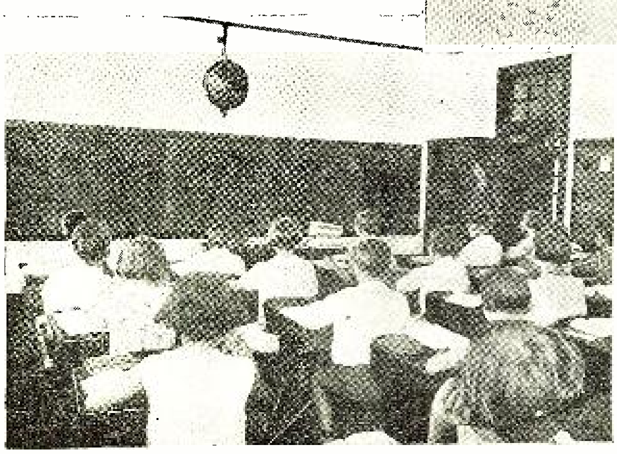
A loud speaker used in connection with Eugene O'Neill's play "Dynamo"

The sound rack from the left is similar to the first rack except that it contains the equipment associated with the microphone located in the principal's office. The amplifier rack, the third from the left, includes four separate amplifiers. The top one is used to supply the input for the six auditorium type dynamic speakers concealed in the organ loft in the auditorium. The second and third amplifiers from the top provide input to the loud speakers distributed throughout the class rooms, while the lower amplifier operates a pair of heavy duty dynamic speakers mounted in a mobile unit in the cafeteria. This unit is on wheels so that it may readily be set up in any location desired.

Each of these power amplifier panels makes use of four 350 type power tubes in a parallel push-pull arrangement so arranged that the four tubes constitute a single stage. Each panel is equipped with a meter to provide a ready check on tube operation.



Dynamic speaker furnishing music to the school children in the cafeteria at Great Neck High School



At the left note the loud speaker on the wall, by means of which the principal is able to address the classes throughout the building

Correcting Some Erroneous Impressions on Wiring

The method of wiring the installation offers some good pointers to installation men. Many installation men are under the impression that individual output circuits must be carefully shielded from all other circuits if cross-talk is to be avoided. That such precautions are not necessary is clearly proven in this installation by the fact that all of the loud speakers in the class rooms are fed through a single cable which includes the wiring of both channels and which, therefore, carries two separate programs without either interfering with the other. Each individual circuit consists of a twisted pair and these twisted pairs are bunched in the same manner as telephone wiring. As a matter of fact this particular installation actually uses telephone cable, in some cases consisting of as many as fifty individually twisted pairs.

Some installation men have been guilty of employing a common return for several loud speakers. This is bad practice and is one very common cause of cross-talk and other interference. It is far better to provide two wire leads for each loud speaker because, when twisted, it is next to impossible to pick up interference.

Success Depends Upon Business Sense, Too

To service men who are interested in undertaking extensive installations, such as the one described, a word or two concerning the business end of the transaction will not be amiss. A contract for a large installation is usually undertaken on the basis of guaranteed satisfaction. The outlay for equipment is necessarily rather extensive unless the serviceman enjoys a satisfactorily established credit rating. This means that a project of this size, unless it is to show a loss, must be capably handled. The installation man cannot afford to take chances. On the other hand, the manufacturers of equipment are willing to coöperate in every possible way with anyone undertaking a contract such as this. The manufacturer's engineers will lend technical assistance in determining the equipment requirements and will go so far as to assist in closing the contract. Beyond this, they will provide a supervisory engineer at a nominal fee who will check the installation and provide any other supervisory or consulting service required. Thus the service man does not have to depend upon his own knowledge entirely, but has the advantage of the equipment manufacturer's experience to aid him both in designing the installation and in the actual making of the installation.

Another case which proves the fact that extensive sound amplifier installations are within the ability of capable servicemen is found in the experience of Mr. Roy Baumann of Chicago. Mr. Baumann, who carries on his business under the name of "Radio Contractors," started out in September, 1926, as a retail radio dealer. He

(*Continued on page 552*)

PRECEDING articles in Mr. Taylor's series have taken up the various practical and technical considerations of interest to the serviceman in connection with installing speech-amplifying apparatus.

The present article "points the moral and adorns the tale" by showing what has actually been done in two typical instances: one on Long Island and one in Chicago; either or both of which can be duplicated in almost any community in the United States.

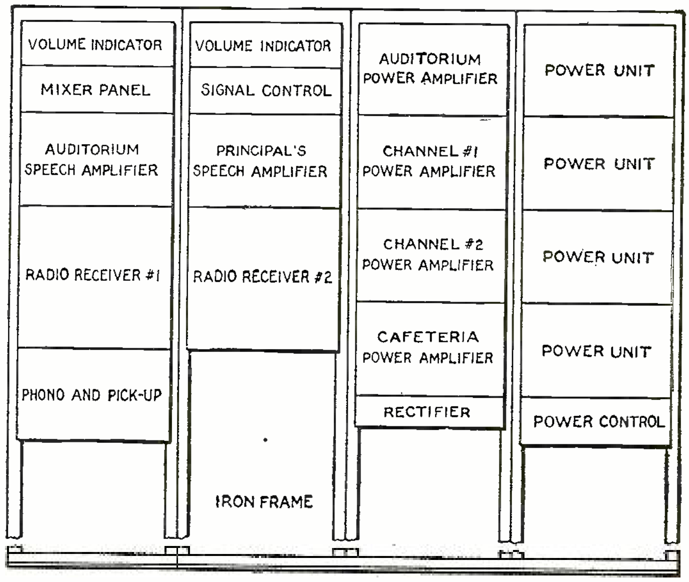
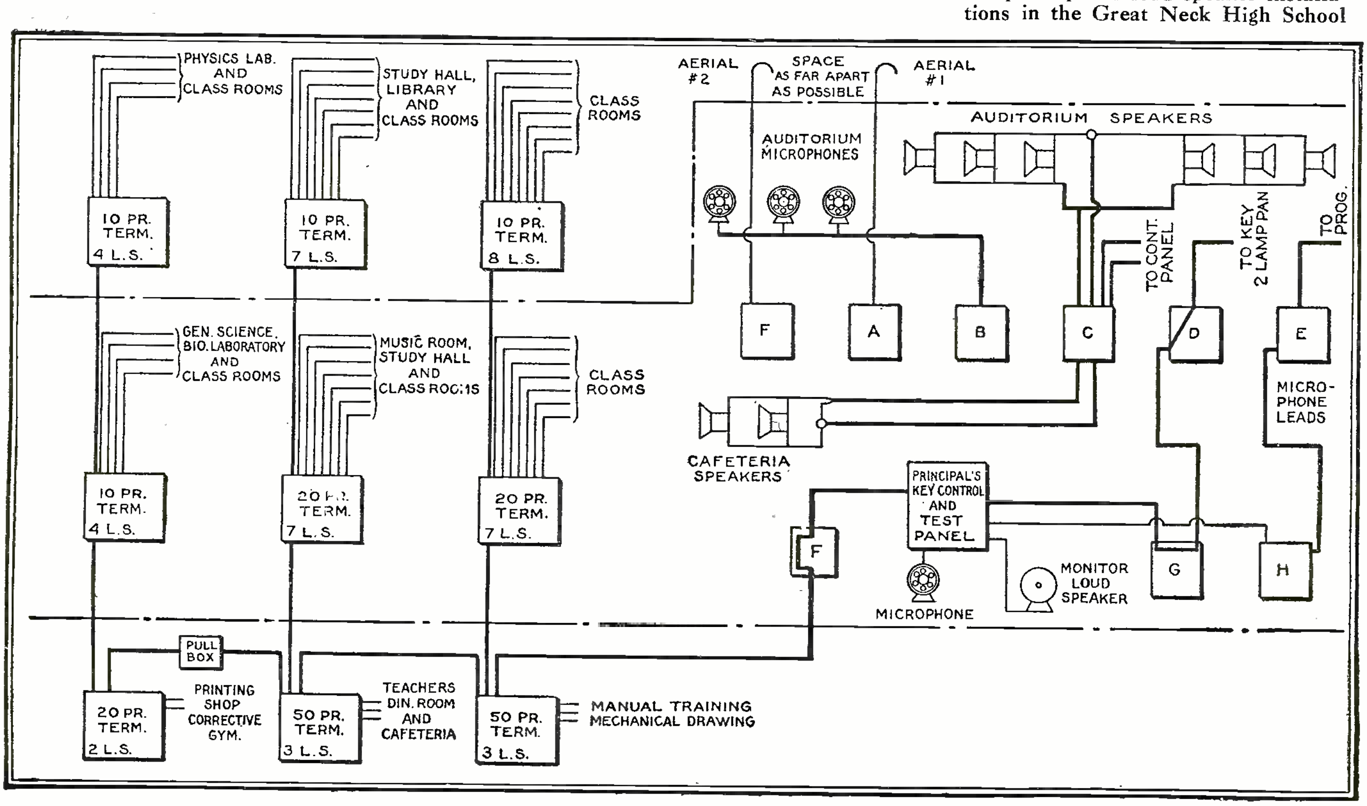


Fig. 1—Here is shown the layout of the control panel in the Great Neck High School installation

Fig. 2—A circuit diagram of the various pick-up and loud speaker installations in the Great Neck High School



A RADICALLY New *Radio Circuit*

NO—

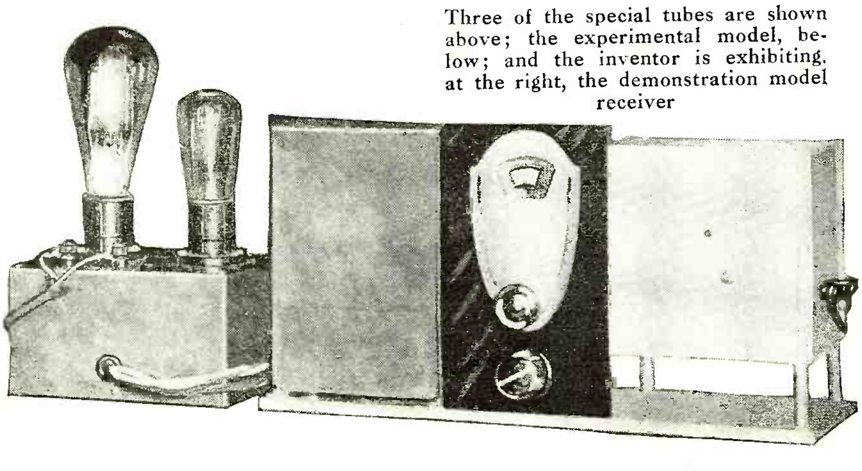
Negative Grid Bias
Grid Leak and Condenser
Tuned Radio Frequency
Regeneration or Reflex
Neutralization

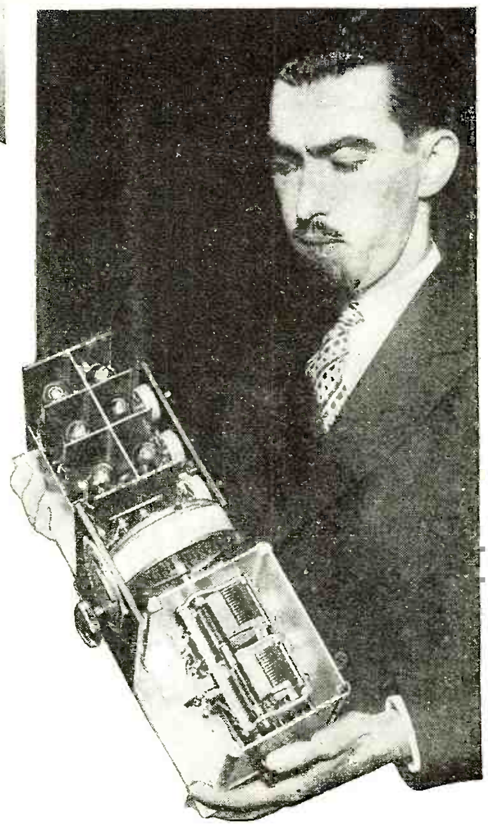
JUST as radio engineers are convinced that there cannot be anything really new in radio circuit design, along comes Dr. Alger S. Riggs with a receiver which is without question fundamentally new and revolutionary.

While circuit details are jealously guarded, the inventor is backed by sponsors and patent attorneys whose standing is a sufficient guarantee of good faith.

At a demonstration in New York, engineers agreed that the performance of this receiver was equal to that of some of the well-known standard receivers with which direct comparison was made.

Operating with tubes of special design (these being really the heart of the circuit), Dr. Riggs' receiver operates on revolutionary principles, so far as existing radio knowledge goes. Needless to say, engineers are waiting with deep interest the details which the inventor and his backers are withholding for the present.





Three of the special tubes are shown above; the experimental model, below; and the inventor is exhibiting, at the right, the demonstration model receiver

SILVER-MARSHALL'S NEW

Band-Pass Tuner

The 712 Is Designed for Use With Any Good A. C. Power-Supply and Audio Channel

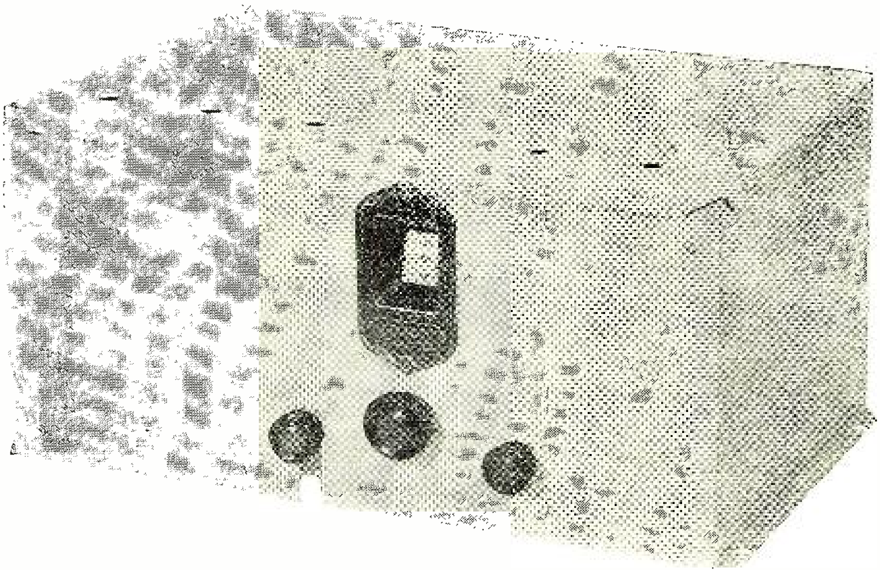
THE popularity of the idea, if not of the application, of band selector circuits is attested to by the frequency with which such expressions as "flat-topped tuning characteristic," "band selector circuit effect" and similar phrases appear in the current literature. On close inspection the circuits are found to run the gamut of everything from single r.f. circuits with regenerative detectors to straight cascade tuners with five tuned circuits.

We have just gone through a cycle of audio-frequency amplifier developments, with the result that it is now possible to build an amplifier using comparatively inexpensive transformers having an overall curve flat within two D.B. (a barely perceptible amount) over the range of from 50 to 5,000 cycles. Since the ear is unable to appreciate further improvement in this direction, the experimenter's attention has been focused on the design and construction of radio-frequency tuners having high gain, a high order of selectivity, and what now seems to be even more important, a tuner which will permit good overall fidelity. In this connection the term "band selector" seems to have become the panacea for all r.f. ills.

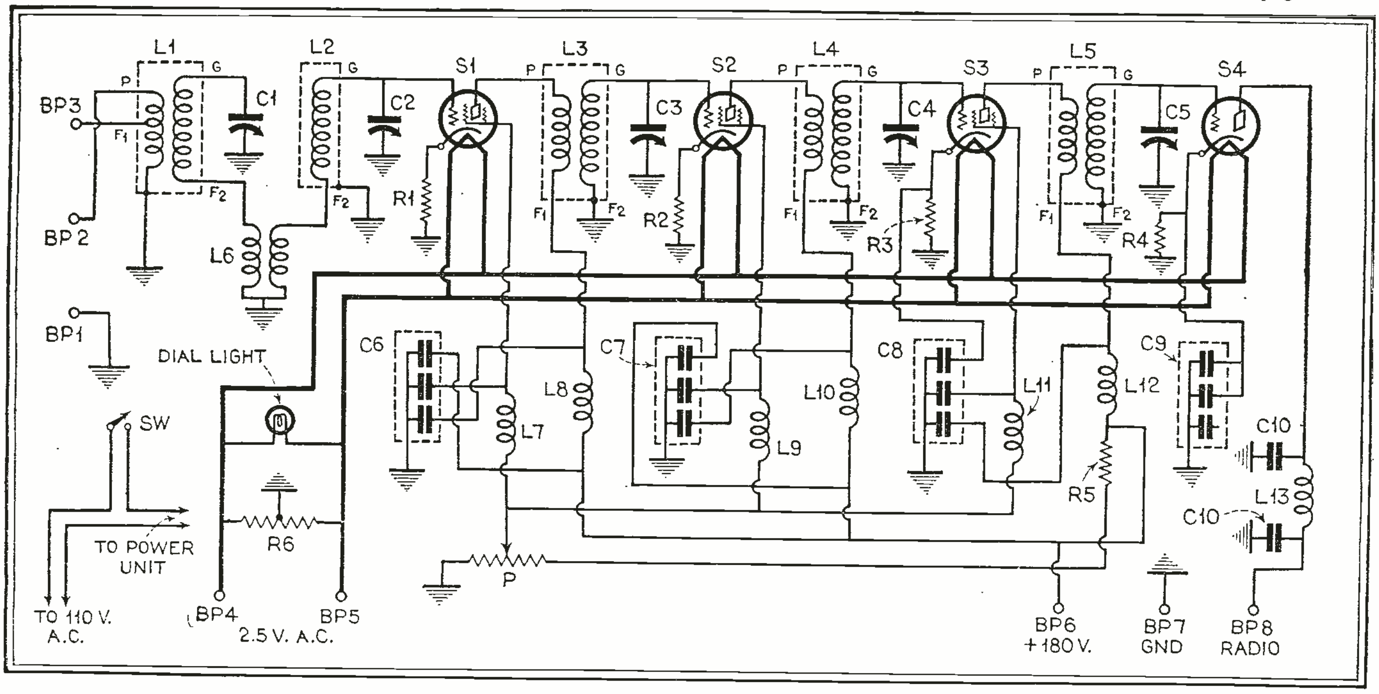
The tuner described herein was built with the object in view of providing a high performance radio-frequency end which could be used with many of the high quality audio-frequency amplifiers which are now available. Due to the fact that developments in the audio-frequency end have come almost to a standstill and that the obsolescence of a complete receiver unit is due largely to the radio-frequency end, it is logical to replace the obsolete unit rather than the complete receiver. A separate unit has the further advantage of giving the experimenter a large latitude in the selection of an audio-frequency end, this selection being governed largely by the output required and by general design details of amplifier.

Detail of the Circuit

The 712 Band Selector Tuner designed by the engineers of Silver-Marshall uses two electrically symmetrical circuits in a band pass or "Siamese" antenna coupler arrangement. This circuit was placed ahead of the first radio-frequency tube, due first to the fact that any slight misalignment which might arise in unusual

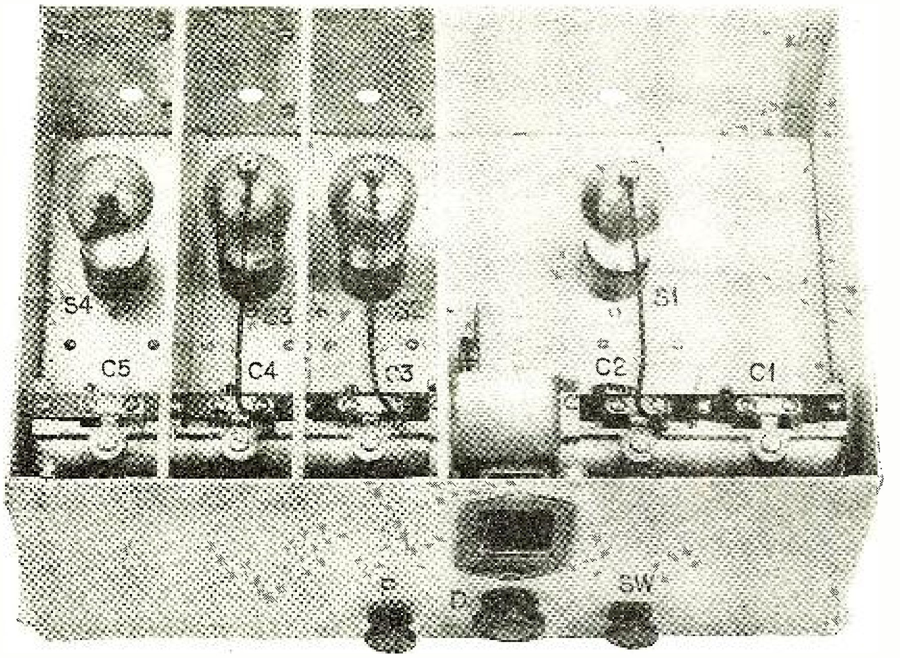


To the left the new Silver Band Selector tuner, while below is the circuit which is employed. The lettered parts may be readily identified in the photographs on the next page



Unit

By
H. S. Knowles



Only the screen-grid tube cap wires are visual looking in on the top of the chassis. Note that with the exception of the antenna stage at the right, each stage has its tuning condensers totally shielded

THE receiver described here is but another concrete evidence of the rapidly growing acceptance of the band-selector principle. This particular kit job has been designed as a unit to permit the experimenter or custom set builder to avail himself of the most modern tuning method without discarding his existing audio channel and power supply.

cases (due to very large antennas) would least affect the general performance. Also, in a high gain receiver of this type it is very important to have all of the selectivity possible ahead of the first tube input so that stations having a high local field strength will not impress sufficient voltage across the input of the first tube to give any distortion which would produce interference at harmonic frequencies. It has also been determined empirically that the "signal-to-stray" ratio is improved by having a highly selective circuit ahead of the first tube, although the two receivers under consideration may have identical selectivity factors.

At the cost of a comparatively small amount of gain in the first tuned circuit coupled to the antenna it was found possible to reduce the misalignment introduced by antennas having capacities up to two hundred mmfds. to a small fraction of the value secured in the first experimental designs.

The symmetry of the two "Siamese" circuits which is essential to perfect band-pass operation is insured by having the coils mounted in similar shields and coupled through a small external bifilar coupling coil. In this way, the capacity to ground of the two circuits and the exact value of coupling can be carefully controlled.

Although the method of using the mutual coupling between the two principal inductances in the band selector circuit has the advantage of requiring only one shield for the whole stage, it does not usually permit the coils to be mounted in such a fashion that the materials in the fields of the two coils (which influence their effective inductance and resistance) are identical. It is also very hard to keep the capacity from the coils themselves to ground identical.

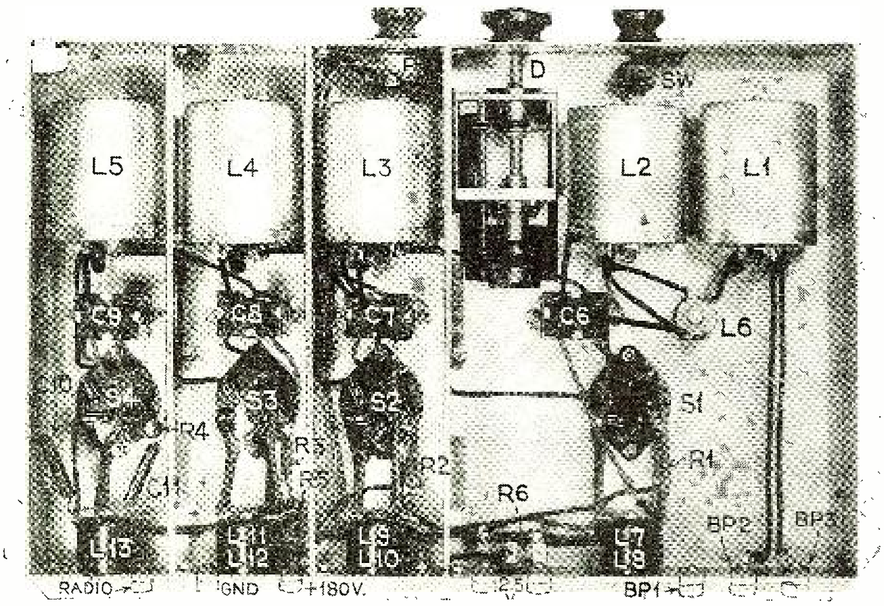
The band selector stage is followed by three straight tuned interstage transformers. Since a total of five tuned circuits were to be used, the gain per stage could be made very high without making the apparent selectivity low. High gain interstage transformers require a greater degree of coupling to insure the high gain and a consequent increase in the reflected resistance from the tube plate circuit which results in a lower value of Q (gain). However, the actual selectivity of the tuned circuit at a screen-grid potential which will give the same gain as the low-gain coil may be very good due to the increased plate resistance of the tube at the lower screen-grid potential.

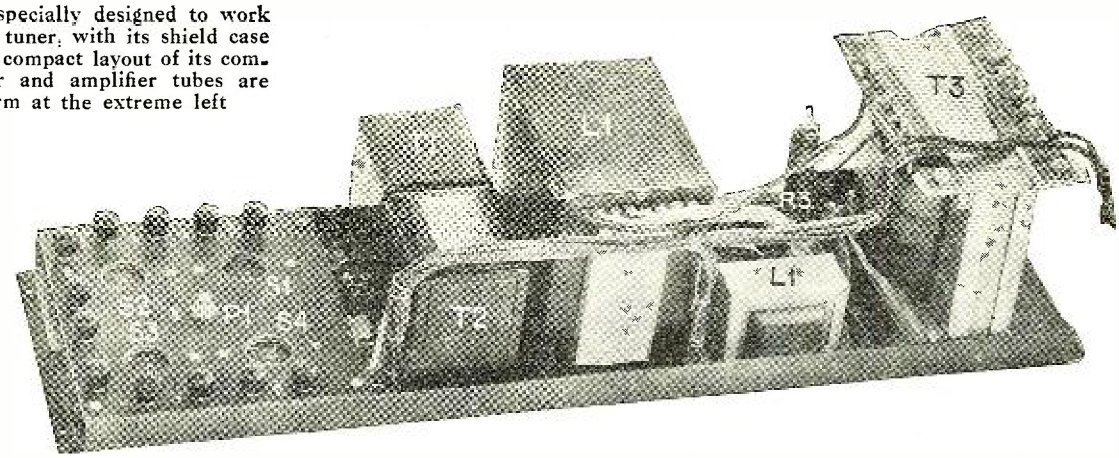
Practical Tests Proved Circuit's Fidelity

In the preliminary design, two stages of the band selector types were tried. It was found perfectly feasible to use a circuit of this type when the condensers were held within the limits that have since been established and with the coils carefully matched and mounted in the present type of shield. The improvement, while it could be demonstrated in an over-all fidelity curve, was not sufficient as far as the average listener was concerned to make its use advisable.

A slight amount of misalignment or staggering in the three tuned stages can be used to improve the band selector characteristic at or near a given fre-

Looking at the under side of the tuner chassis reveals the shielded coil units, by-pass condensers, chokes, etc. Their position in the circuit is shown in the circuit diagram on the preceding page





The power amplifier, especially designed to work with the Band Selector tuner, with its shield case removed to indicate the compact layout of its component parts. Rectifier and amplifier tubes are located on a platform at the extreme left

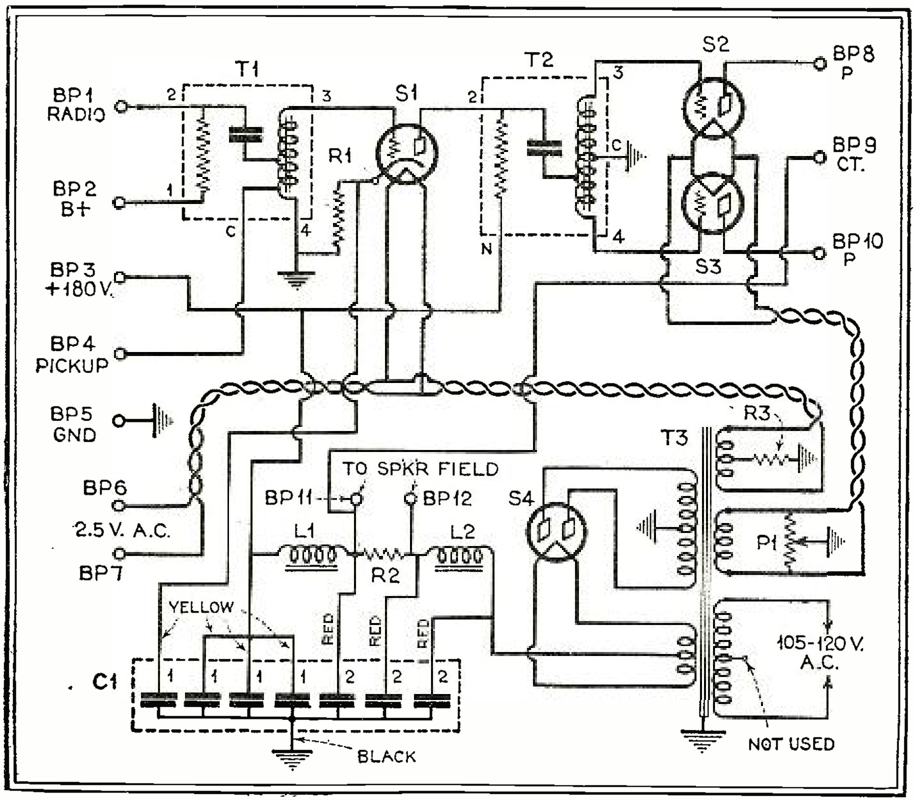
quency. This is usually desirable at the low-frequency end. In theory, the same action can be made to apply over the whole broadcast band. Actually the limits within which a variable condenser can be held commercially limits this application to a comparatively narrow band of frequency. Variations in the resonant frequencies of the circuits, due to the variations in the different circuit capacities, are of the same order as those required for proper staggering. The improvement resulting from the use of a single band selector stage is desirable even from a pragmatic viewpoint. If this receiver and its justly famed predecessor, the Sargent-Rayment 710, are both tuned to a station broadcasting records and the station is tuned in at the same level, the needle scratch can be heard quite distinctly in the case of the 712, whereas it is just audible in the 710. The latter uses five straight tuned circuits.

All of the circuit refinements which have been found necessary in the production of a high gain receiver, intended for operation on a small screen antenna, have been used in this tuner. An inspection of the pictorial wiring diagram will show that great precautions have been taken to confine the radio-frequency currents to their respective stages; each stage has its own ground return and is well shielded from the other stages. The result is a tuner which has an average sensitivity of the order of three-quarters of a microvolt per meter (when used with the 677 amplifier and power supply), and yet the stability is not dependent upon stray coupling effects which are so frequently used in high-gain receivers. While it is possible to stabilize a single laboratory model by taking advantage of the stray coupling effects, the resulting receiver is hard to duplicate and is anything but a production model.

It is our conviction that a stable higher gain production receiver cannot be built without resorting to radical changes in the present isolation methods.

A 227 power detector tube was used because the additional gain which can be secured from a 224 detector could not be used and because a low impedance detector tube was necessary to permit the unit to be used with any standard amplifier input transformer. The use of a 224 tube would have necessitated a modification of the input circuit of any of the present amplifiers.

The circuit employed in the power amplifier. It consists of two stages of a.f. amplification, the last comprising a pair of 245's in push-pull, and a power unit employing the 280 full-wave rectifier



Audio Channel-Power Pack Especially Designed for Band Selector Tuner

The 677 amplifier was built primarily as a high quality amplifier and power supply unit to work out of the 712 tuner. It supplies 40 milliamperes at 180 volts to the tuner and 7 amperes at 2.5 volts to the filament heater circuits.

A 227 tube is used in the first stage and two 245 tubes in a push-pull power stage operated at full voltage to provide maximum output. No output transformer is provided since the amplifier will normally be operated into a dynamic speaker with a push-pull input transformer. The S-M type 851 dynamic speaker or its equivalent having a d.c. field resistance of from 1,800 to 2,000 ohms and a high effective field inductance (since the field is used as the first section in a two-section filter) should be used.

Working out of a 10,000-ohm detector tube and into an 8,000-ohm load across the 245 tube, the output is down 1.7 D.B. at 50 cycles and 1.3 D.B. at 6,000 cycles. This is measured with a quarter of a volt input which provides the output normally used.

There is a wide variation in the effective inductance of the field coils of dynamic speakers, even in those having resistances between 1,800 and 2,000 ohms, for a.c. voltages of the order secured in the first section of a filter. In order to make the filtration as independent as possible for the type of speaker used, a choke coil having an inductance of four henries, at the d.c. current used, is connected in series with the field of the speaker. Where a slight amount of hum can be tolerated, as is usually the case with pick-up input, the speaker field binding posts can be short circuited. In this case a speaker with separate field source should be used.

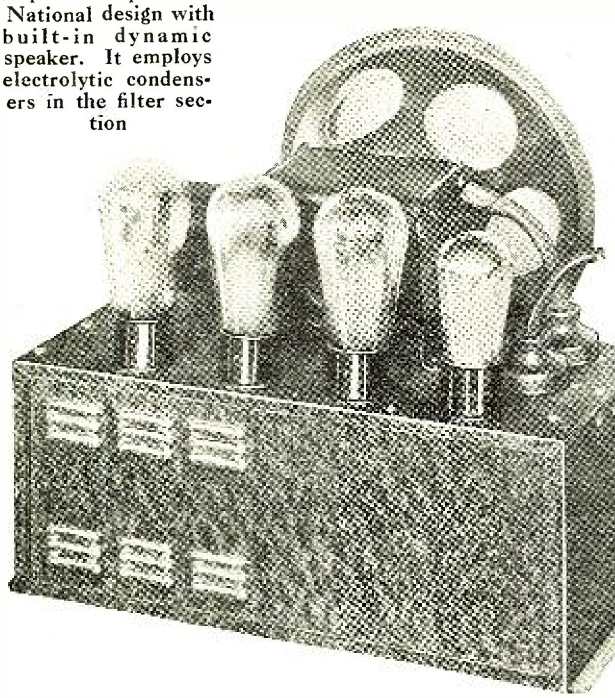
Through the use of a push-pull output stage, carefully oriented transformers, and good filtration, the hum has been reduced to 25% that of a similar unit built in the same type case having approximately the same overall gain but

(*Continued on page 567*)

Power Amplification and the 245 TUBE

A Phono-Radio Socket-Powered Amplifier Which Utilizes An Improved High Safety Factor Filter Section

By R. U. CLARK, 3rd.



A power amplifier of National design with built-in dynamic speaker. It employs electrolytic condensers in the filter section

WITH the introduction of the new 245 intermediate power tubes the urge for superior reproduction comes very near to being satisfied, for these tubes will deliver undistorted energy of sufficient magnitude to the loud speaker to fulfill any sound projection requirements up to and including the volume called for in halls, small theatres, clubs, ballrooms, and restaurants.

Because of the unusual efficiency of the 245 tubes in reproducing accurately notes of extremely low frequency and also because of the relatively large plate current required by these tubes, it is highly desirable that the power pack filter, to be used in conjunction with such tubes, should contain filter condensers of high safety factor with a total capacity of not less than 10 mfds.

The average good condenser block of this type is rather costly and in view of this fact it is very natural that the use of electrolytic filter condensers should become very common in the 245 type of pack.

Many manufacturers have adopted the electrolytic condensers for the coming season's requirements and results have been so highly satisfactory that it is very probable that the radio custom set-builder will find something of interest in the outline which follows. It describes in some detail the essential constructional features of a very successful radio power pack, giving the data worked out by the engineers who designed it.

Before going into exact details it might be mentioned that all the values submit-

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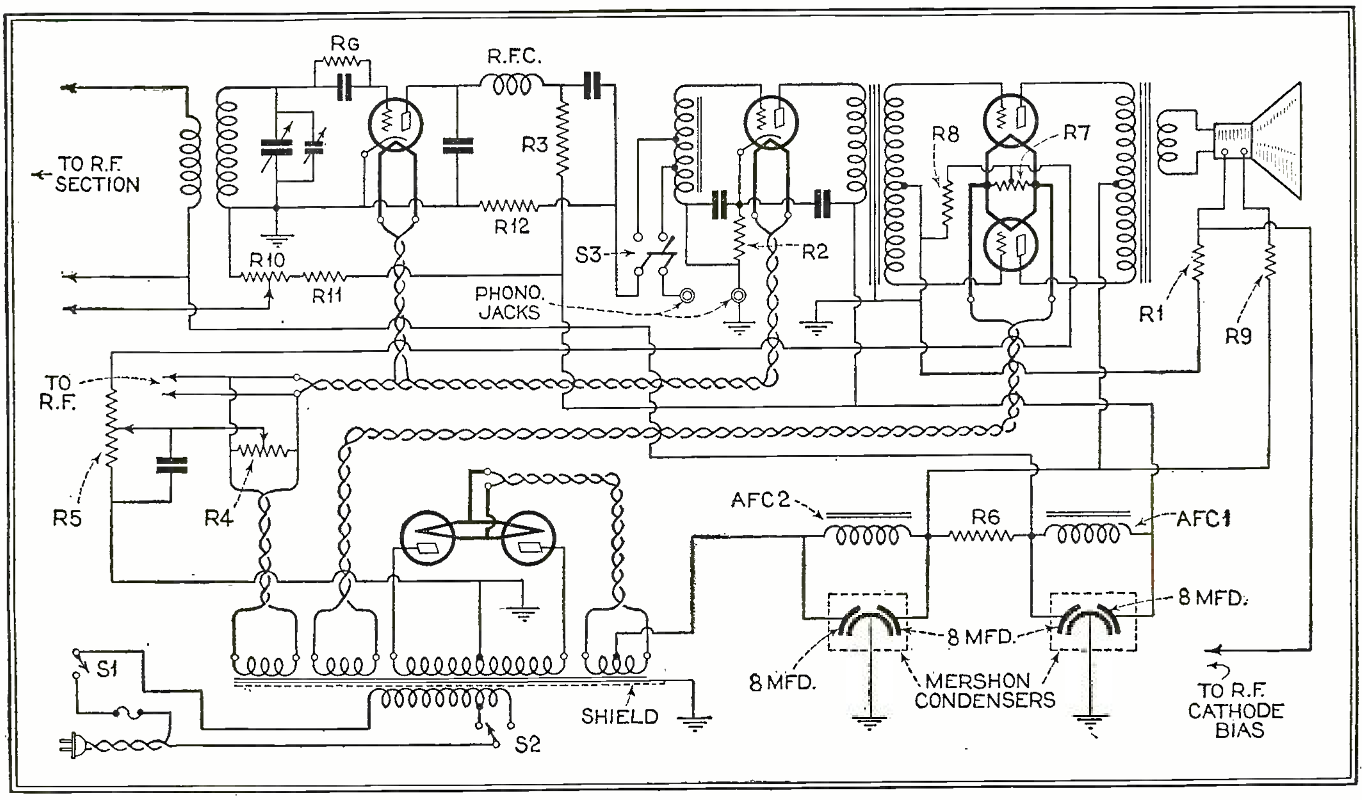


Fig. 1—The circuit of the power amplifier described in the text. The numbered parts may be identified from the Parts List

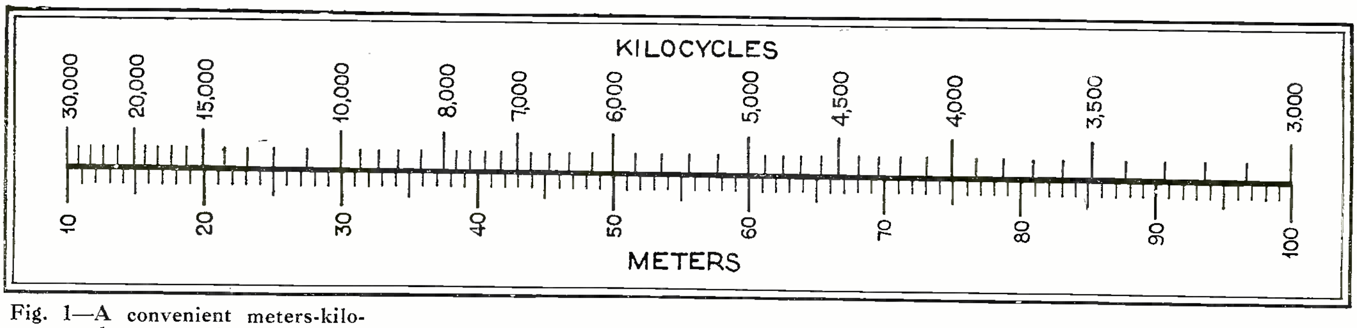


Fig. 1—A convenient meters-kilocycles conversion chart

Ready for a Short-Wave Chat

Putting the Home Transmitter on the Air

By Lieut. William H. Wenstrom

TO those of our readers who have followed Lieut. Wenstrom's preceding articles, the present one is of particular interest because it carries on from the mere building of a practical short-wave transmitter (described in last month's RADIO NEWS) to the actual job of putting it into operation.

If you have not read the earlier articles of this series, we can only say that you have missed something worth while—and there are more to follow, in succeeding issues of RADIO NEWS.

LAST month's article covered the construction and preliminary tests of the Home Transmitter. This month we put it into actual use, and examine in addition some of the methods of short-wave operation. The subject is a large one, and it will be necessary at times to burrow rather deeply into technical intricacies. For this we ask the reader's indulgence; may the result be a sufficient foundation for practical work.

It will help somewhat in the first tests if we can locate in the same town, or a nearby one, another amateur who is willing to spend some time listening to our signals and working with us. If this is not possible, we can get along anyway, though it may take some time and patience to make the first outside contact. A new transmitter seems to suffer from inhibitions for a few days. The truth is that the signals are getting out, but we lose confidence when no one answers them. Then, one day, we hear our own call pounding in from somewhere below the horizon's rim. The ice is broken; the new transmitter has found itself.

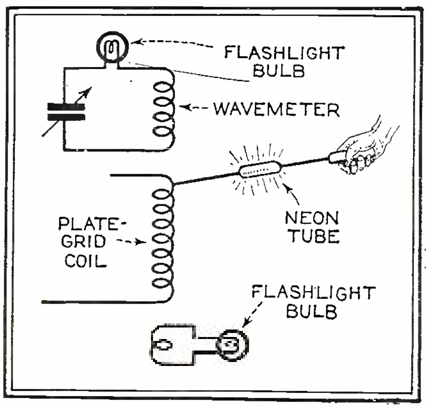
First Results

We report here a few desultory tests with the writer's Home Transmitter, carried out under the difficulties of hot, humid summer weather, the interruption of travel, and the indolence of a vacation state of mind. The results are nothing out of the ordinary, but are good enough when we recollect that the plate voltage was around 200 and the output about 3 watts. All the tests were in the daytime, as the nights showed prohibitive static, if not actual thunder showers.

The 80-meter coil was tried out first, with the oscillator set at 78 meters. At about 5 p. m. we connected with W8AKD at Walton, New York, about 75 miles away. Both stations were QSA4 (which indicates readability through static, etc., rather than audibility)—very good, considering the maximum is QSA5. This station had a fine d.c. note and reported ours pure d.c. also. We held communication for about two hours without a break. W2CX changed wave up to 85 meters, with no change in signal strength at Walton. We also tried phone for a short time with the output around 2 watts. W8AKD could hear the words faintly, but could not understand them.

The next tests were with Lieut. Bullene, W2BEI, two miles away in Highland Falls. His low-powered transmitter, shown in the photograph, follows exactly the "home transmitter" design. Of course we had no difficulty in working code back and forth under any kind of atmospheric conditions. We used break-in practically all the time, and worked back and forth as quickly and smoothly as could be desired. Then we tried phone, each station using about 2 watts output. This of course did not give the superlative transmission of short-range code, but we understood practically every word that was spoken, and had no difficulty in raising each other with phone at scheduled times. The final test was "break-in phone," suitable only for short distance and low power. The two transmitting wavelengths must be separated as widely as the narrow phone band permits. We left both transmitters and receivers on continuously, the microphones in front of our mouths and the headphones on our ears. Of course one's own transmitter comes in fairly loud, but not loud enough to prevent hearing the other operator if he interrupts. When we finally got the system working, it gave all the speed and certainty of a commercial telephone call—with the advantage that it could be held by the hour, and no overcharge!

Two more 80-meter tests were made. At about noon we raised W2AFV on



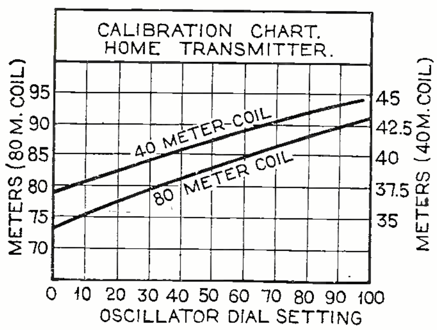


Fig. 3—Above, calibration curves for the author's transmitter. With such curves (plotted for the individual transmitter, of course) adjusting to any desired wave band is simplified

Fig. 2—The essential circuit for a home-made wave-meter is shown at the left

Staten Island, 60-odd miles distant. He reported our signals as QSA2 while his were QSA4, but he was using much more power, about 100 watts input. W2CX was near the bottom of the band on 78 meters. In a later test on the same wave we raised W1PF at Stamford, Conn. This was about 4 p. m. and both stations were QSA3. The static was very bad—several thunderstorms were growling in the distance.

The first test with the 40-meter coil in place met better luck. At about 9:00 a. m., with the sun well up on its morning climb, we connected with W8ADS at Findlay, Ohio, 500 miles out. The output was still about 3 watts. Both stations were QSA4 and pure d.c., and except for some interference from broad raw a.c. notes, the communication was perfect. The day was bright and clear, with a high-pressure area overspreading the eastern half of the country. It is only fair to say that after this contact we spent the next hour calling without raising anybody; but such are the vagaries of low-power, short-wave transmission. Many complicated factors make wave transmission an exceptionaly interesting study which we hope to explore in a succeeding article. We shall report, also, some further tests with the home transmitter.

Preliminary Tests

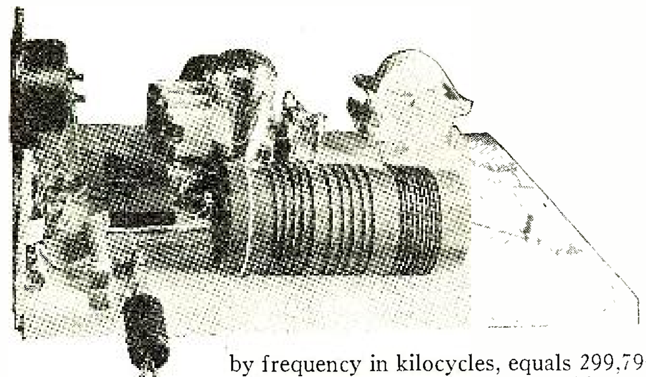
We assume that the transmitter has been completed, bench-tested for circuit continuity and oscillation, and installed in some convenient location near a window. The receiver has been long since installed in another room and has its own separate antenna; the remote control circuits are all in. The first transmitting antenna may be almost any single wire about a quarter-wavelength long, with either a conductive ground or a counterpoise.

It is easy enough, of course, to throw on the current and hope for the best, but there is far greater pleasure in running a small transmitter with some care and skill. For this reason voltmeters should be placed across the plate and filament circuits. It is also well to start with a high resistance in the plate circuit, which will cut down the voltage to about half normal value. With local control switches set for code, we turn on the filament current and, after allowing the tube a minute or two in which to warm up, the plate current. With the oscillator condenser set at the desired wavelength we tune the antenna circuit until the current-indicating bulb lights brightest. This very close resonance tends to make the signal unsteady, so that the best setting is about ⅔ maximum current, at which the effective coupling is decreased until antenna changes have little effect on the oscillator frequency.

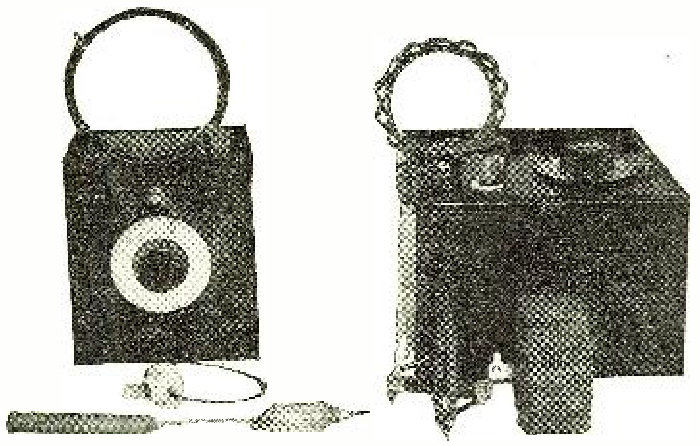
In addition to watching the bulb and the meters, we should glance occasionally at the plate of the tube; it should never get hotter than a barely visible red, and at plate voltages below 300 no heating should be visible. The plate current of the UX210 runs from around 40 mils with antenna completely detuned up to 50 or 60 mils with antenna tuned to resonance. We should note all the voltage and current readings, making up a list similar to Table 1, which gives the actual performance of the writer's transmitter. If plate voltages over 300 are used, the grid leak value should be changed from 5,000 ohms to 10,000 ohms, so that plate currents will not be excessive.

We can estimate the output fairly well by calling it ⅓ of the input. It is well to try tuning the antenna at several settings of the oscillator condenser, noting the tuning differences. With the antenna disconnected, the oscillator condenser should go from 0 to 100 with only very small changes in plate current. The tests are repeated on all working wavelengths that the operator expects to use, and on 85 meters the tests are repeated with the switches set for phone. Here we need a milliameter in the modulator plate circuit, so that the grid bias can be adjusted for normal plate current. In addition, we whistle and talk into the microphone, checking for amplitude distortion in the same way we would with the last stage of an audio amplifier.

If at any time we can get no indication of antenna current, we test the plate-grid coil for oscillation by coupling to it a single turn of wire ending in a flashlight bulb, or touching it with one terminal of a sensitive neon tube (see Fig. 2). If the bulb lights or the neon tube glows, the tank circuit is oscillating; getting antenna current is a matter of adjusting the length of the antenna-counterpoise system.



At the right, the "breadboard" transmitter at W2BEI, using a 245 tube. This transmitter co-operated in many two-way tests with the author's home transmitter



At the left are shown a home-made and a commercial wavemeter, with flashlight bulb and neon tube oscillation indicators

Frequency Measurement and Monitoring

Two or three years ago various groups of radio engineers and operators decided to use kilocycles instead of meters in speaking of radio waves, and the announcements at that time indicated that anyone who breathed anything about "meters" or "wavelength" after a reasonable interval would be in the same class with Rip Van Winkle. The precise relation between them is expressed by the formula: wavelength in meters, multiplied by frequency in kilocycles, equals 299,796.

The chief argument for the kilocycle system is that it makes channel allotment and other technical calculations easier. Yet today practically all laymen, and some engineers as well, cling to the meter nomenclature. And it has some undoubted advantages. Wavelengths can be expressed conveniently in three digits, as 305, 45.5, 5.76; a wavelength of some meters is physically conceivable more readily than a frequency; antenna lengths can be more readily calculated; and there is a closer analogy with light rays. Because the meter system appeals to a far greater number of people, we use it in this article, but include (Fig. 1) a conversion chart of meters to kc.

We can measure roughly the wavelength of the transmitter by disconnecting the receiving antenna and listening to our own signal on the receiver. That is one great advantage of low-power combined with remote control—we can always check our signal on the receiver. Other arrangements would require a separate monitor, which is simply a low-amplification receiver, completely shielded in a metal case. If the 80-meter signal is too loud, we can pick up its harmonic with the receiver 40-meter coil. By listening to other amateurs we can get a fair idea of the extent of a band on the receiver dial, discounting the outer fourths. If we then tune our own transmitter until its signal falls within the inner half of the range of copied amateur signals, we are reasonably certain of being in the required band.

This matter of "monitoring" our signal with the receiver is very important. We can send a test each day before starting

(*Continued on page 568*)

Circuit Details of an A. C. Operated Screen-Grid Superheterodyne

The H.F.L. Mastertone

By Hal Welches

BOTH to the set builder and to the experimenter the circuit and constructional details of manufactured receivers are of interest. With this in mind we are presenting the first of a series of brief descriptive articles on manufactured receivers of modern design. Others will follow in succeeding issues.

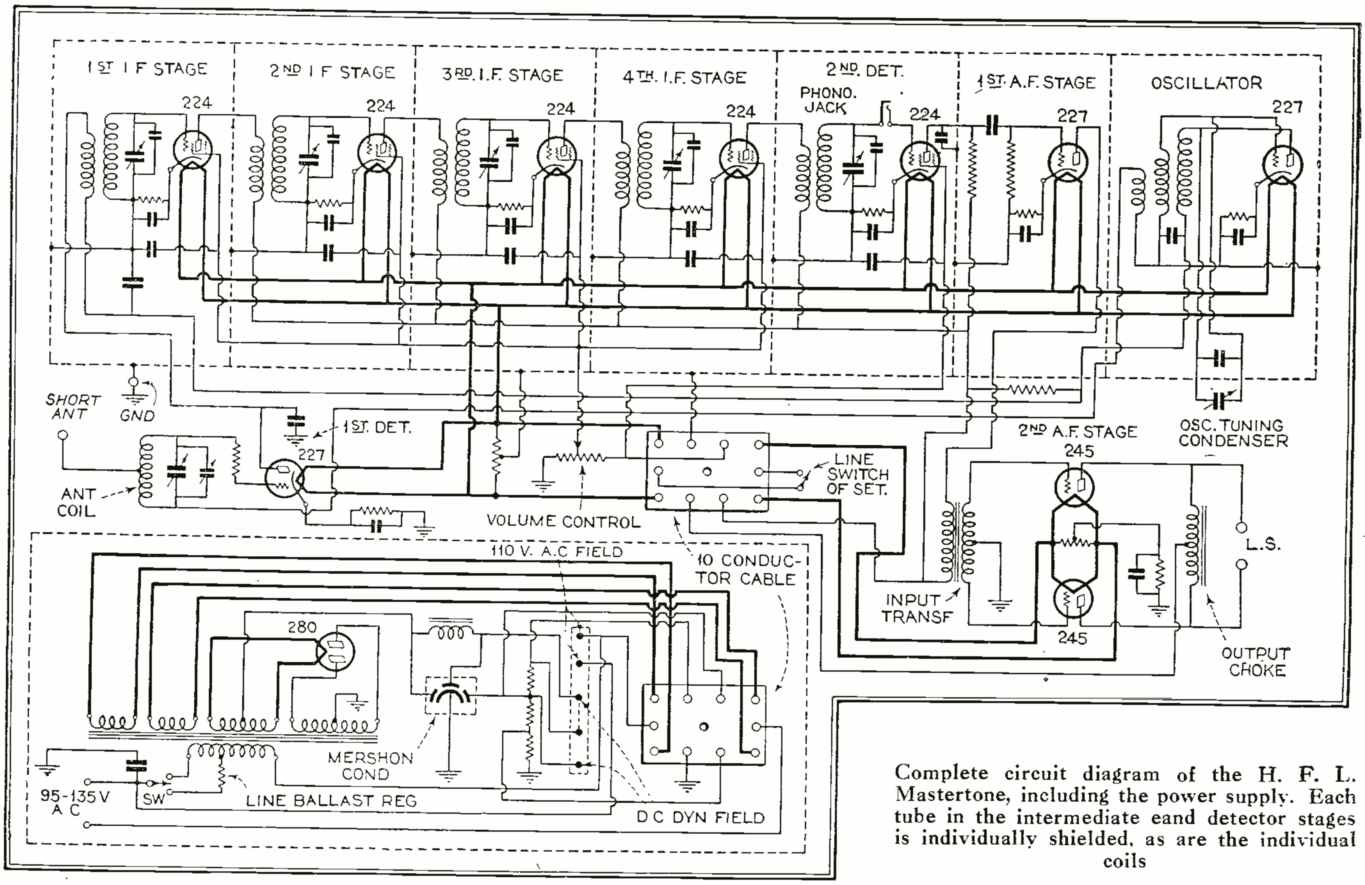
The receiver here described is a completely a.c.-operated superheterodyne utilizing '27 type tubes in first detector and oscillator sockets, four '24 type tubes in the intermediate stages, a '24 detector, feeding into a first audio stage utilizing a '27 type, and with push-pull output incorporating a pair of '45 type tubes.

IN practically every dissertation on the tremendous strides which have been made possible in receiver design by the advent of the screen-grid tube there is a paragraph tucked away somewhere stating how, by virtue of the relatively low impedance of the plate coils of circuits using these tubes, the full practical gain of the tubes is never fully realized or even remotely approached. True as this may be, it may be well for the moment to review the fundamental facts concerning the functioning of this very interesting and important addition to the radio art—the screen-grid tube.

From our experiences with Ohm's law we know that if a voltage is applied to two resistances connected in series, one larger than the other, a greater voltage drop will be found to exist across the larger than across the smaller one. Suppose now that we have a tube and its plate coil, each with its own particular value of resistance, or in this case, impedance. If the impedance of the plate of the tube is greater than that of the plate coil which is attached to it, then when a voltage is applied to the plate the greater voltage drop will be found to exist across or in the plate, instead of across the plate coil, where it may perform a useful function.

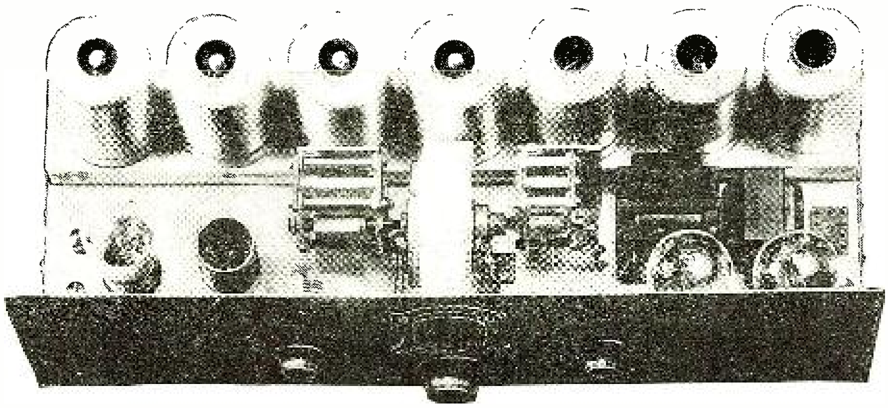
Because the screen-grid tube has such an enormously high plate impedance, something in the neighborhood of 400,000 ohms, and because the commercial type of coils which are available or which can successfully be used with such tubes are limited in the maximum impedance which they can attain, the full practical amplification properties of such tubes are merely approached but never fully realized.

When we consider the technical fea-



Complete circuit diagram of the H. F. L. Mastertone, including the power supply. Each tube in the intermediate eand detector stages is individually shielded, as are the individual coils tures involved in the design and construction of a superheterodyne, though, our picture is quite materially changed, for in such receivers, with the intermediate stages employing coils having a far greater number of primary turns, the impedance relations between the plate coil and the plate of the screen-grid tube are more nearly approached, with the result that a very much higher order of amplification is thus obtained.

Consider, then, the receiver whose circuit details are described in detail here. In general it comprises six distinct units, as follows: a first detector using as a signal collector a long or short antenna; an oscillator whose function is to generate a frequency to beat with that of the detected signal, and of the value of frequency which will be admitted by the next unit, the four-stage intermediate frequency amplifier. The radio-frequency signal thus amplified by the i.f. amplifier is again detected by the second detector stage, a fixed-tune circuit adjusted to the same frequency as that of the i.f. amplifier. Next in line comes a first audio amplifier stage and then a second stage employing a push-pull arrangement for signal handling capacity and the production of good tone quality. Lastly there is a power supply unit furnishing plate and filament voltages to all the tubes in the receiver proper.



Looking down over the panel of the complete receiver. Note the individual shield cans over each tube excepting the first detector and the push-pull audio tubes

All of the tubes are a.c.-operated. In the first detector, first audio stage and oscillator circuits the a.c. 227 tube (heater operated) is employed. The four intermediate-frequency amplifier stages and the second detector employ the 224 or a.c. screen-grid type of tube. The final audio stage makes use of a pair of 245 intermediate power amplifier tubes, while in the power supply device is used a full-wave 280 rectifier tube. An inspector of the circuit diagram, Fig. 1, will make these points quite clear.

Provision is made in the second detector circuit for the connection of a phonograph pick-up for the reproduction of phonograph music through the regular audio channel of the receiver.

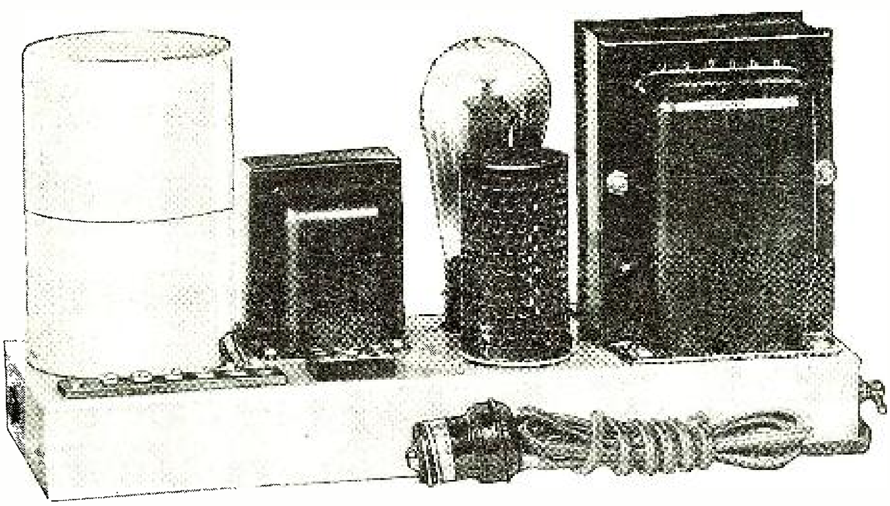
A 50,000-ohm potentiometer with center arm connected to the screen-grid elements of the intermediate amplifier tubes, constitute the volume control.

In the intermediate-frequency amplifier, tuning of the several secondary circuits is accomplished by a parallel arrangement of the tuning condensers. In each stage, besides a fixed condenser to bring the frequency adjustment to an approximately correct figure, there is shunted across the coil and fixed condenser a second or midget condenser by which each of the tuned circuits may be readily adjusted and peaked, all to the same frequency, thus making possible the satisfactory operation of the complete i.f. amplifier not only as an amplifier but also as a band pass filtering unit to produce the desired 10-kilocycle selectivity without sideband cutting.

In the power supply unit the line transformer has its primary tapped to allow the use of a line voltage regulator so as to obtain automatic control over the meanderings of the house line supply, thus insuring against blown-out tubes and other damaged supply apparatus. The filter condenser used is of the Mershon electrolytic self-healing type having a total capacity of 25 microfarads arranged in the filter circuit as shown in the diagram. Only one actual filter choke is provided, provision being made for connection into the circuit of the field winding of a dynamic speaker to serve as the other filter choke.

Filament and plate voltages for the tubes in the receiver proper are brought out to a rubber-covered connector cable plug, the cable acting as a connecting link between the power supply unit and the receiver.

The power supply incorporating a voltage regulator is a separate unit, not mounted on the set chassis. The voltage regulator can be cut out of the circuit where the a.c. supply is within 10 per cent. of normal



Constructional Features

Completely shielded coils and tubes (in the tuning end of the receiver) are one of the items which contribute to the receiver's overall efficiency.

The catacomb, located at the rear of the chassis, and the chassis itself is of the sturdiest construction. A combination of copper and steel sections are used, all cadmium plated.

In order to provide single-control tuning, the condensers for the oscillator and detector circuits operate on the same shaft. Compensation for variations is provided by having the stator plates of the detector tuning condenser so mounted that this stator may be rotated through a small arc of a circle, by means of a knob on the panel. In actual practice, very little compensation is required, as the circuits are well matched throughout the scale.

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Applying the BAND-PASS *to* SUPER-HETERODYNE *Design*

Data on the Calculation of Electrical Characteristics, Construction and Circuit Placement of the I. F. Band-Pass.

By John Rider

THIS is the third article from the pen of John Rider on Band-Pass Filter calculation and design. The subject, as treated here, deals specifically with the application of proper types of band-pass filter to superheterodyne circuits.

The author discusses the problems incident to the application of a properly designed filter to an intermediate frequency amplifier of a superheterodyne.

The tables accompanying the text provide a valuable source of design data for the construction of filters for various intermediate frequencies.

THE band-pass filter for use in a superheterodyne receiver, when manufactured by an organization, is usually cloaked in a veil of mystery. However, in contrast to the band-pass filter for use in a radio-frequency receiver, the "super" arrangement has received notice now and then in the radio press. This article shall describe the design and utility of a band-pass filter suitable for use in the superheterodyne receiver.

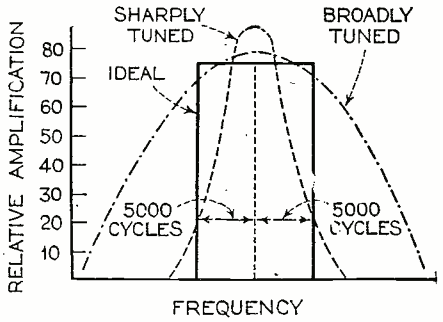


Fig. 1—The relation response or amplification obtained when a circuit is broadly tuned and when it is comparatively "sharp" in tuning

The unit, if it may be called by that name, is suitable for use at all peak frequencies, whether it be 25 kc. or 88 kc. or 115 kc. or any other intermediate frequency below or above the limits mentioned. Its application, just as in the t.r.f. receiver, affords certain definite advantages. If we enumerate these benefits, we have:

1. Better selectivity.
2. Better audio output because of retention of full side bands.
3. Elimination of noise.

The latter consideration is non-existent in the tuned radio-frequency receiver, but present in the superheterodyne because of the method of operation. Whereas in the former system, the radio-frequency stages operate the carrier frequency, amplification in the superheterodyne is carried out at a "beat" frequency. The value of this beat frequency is much lower than the initial carrier, and in certain cases the operating characteristics of the devices operated at the beat frequency are such that noise frequencies are amplified with the signal and thus interfere with normal reception. The noise frequencies minimize the amplification possible because they tend to add to the total input voltage, thus limiting the magnitude of signal voltage. In sum and substance, the noise frequencies must be eliminated.

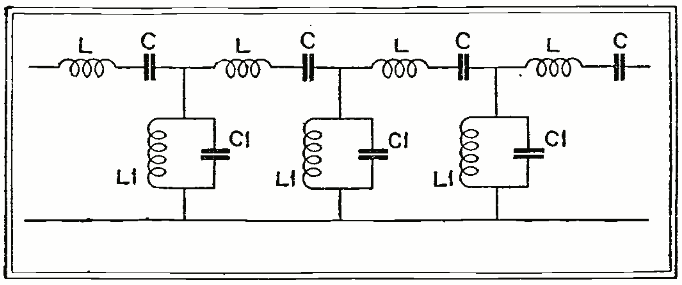
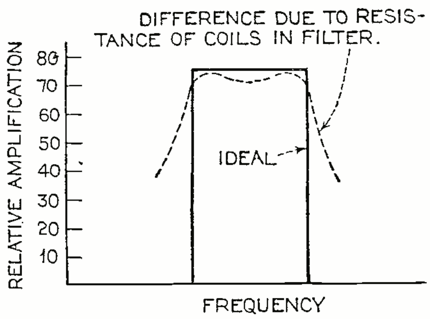


Fig. 3—In this general interpretation of a filter L and C constitute a series impedance and L1 C1 a shunt impedance, the two comprising one complete filter section having predetermined response characteristics

If we succeed in securing the above three advantages, the financial expenditure involved is well worth while. As it happens, these advantages may be realized and, strange as it may seem, with very little trouble. The band-pass filter is nothing more than an electric wave filter, just as the conventional tuned radio-frequency band-pass filter or any tuned stage. However, the electrical design is different and the system described here is due to the work of G. A. Campbell. The filter is just what the name denotes. Let's use as an analogy, the filter on a kitchen faucet; the function of the device is to pass clean water and to withhold or retard the passage of dirt. Electrically the filter passes the desired frequencies and withholds or rejects the undesired frequencies. The design of the filter in each case governs the power of rejection. The finer the structure, the greater the power of rejection and the more effective its operation. In the electrical circuit, we can arrange for any power of rejection.

Each of the three advantages enumerated in a preceding paragraph is based upon the power of rejection. However, in addition to the power of selectivity, the characteristic of the filter is such that it responds uniformly over the band of frequencies which are to be passed through the filter and are predetermined in the design. Just as in the conventional tuned radio-frequency receiver, wherein each of the tuned stages is made resonant to a certain frequency, the intermediate-frequency amplifier in the superheterodyne receiver is made resonant to a certain frequency, the beat frequency. This beat is produced by combining a locally generated signal with the incoming carrier signal. The power of selectivity in the "super" is based upon the fact that the frequency of the locally generated signal must be such that the difference between the two frequencies is equal to the resonant frequency of the intermediate amplifier. The incoming signal and the locally generated signal are "mixed" in one of the tubes

Fig. 2—Due to the inherent resistance of filter units, the ideal response cannot be obtained, but only approached, as shown here



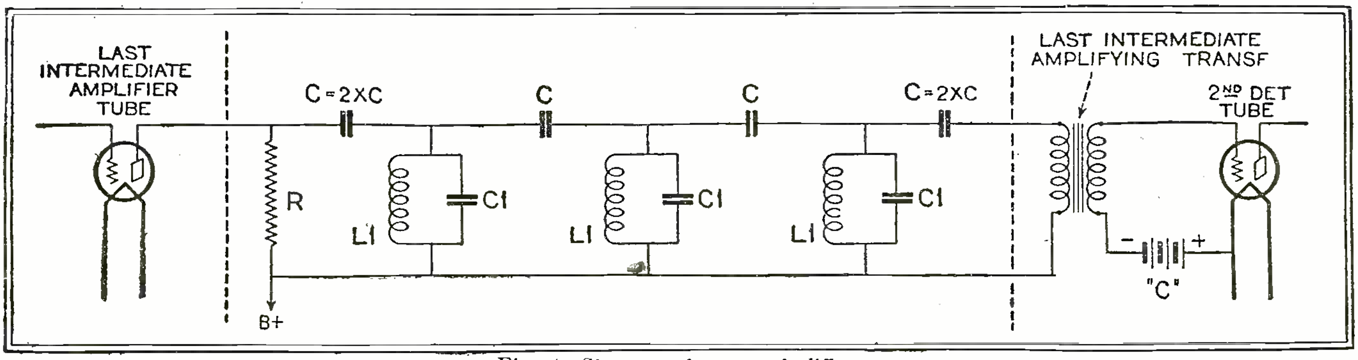


Fig. 4—Since condensers of different values are more easily obtained than inductances, the simplest form of band-pass filter employs the circuit shown here

in the receiver and the resultant "beat" is then passed into the intermediate amplifier. This beat carries the modulating frequencies, just as the carrier frequency has its side bands due to the modulating frequencies.

Some Characteristics of I.F. Amplifiers

Since the intermediate frequency amplifier represents an amplifying system tuned to a certain frequency, the beat must be of this frequency in order that it pass through the system. Now, since we have the equivalent of a resonant circuit (the intermediate amplifier), this circuit will possess a definite characteristic. If its response curve is too broad it will respond to frequencies other than that necessary for good reception and two forms of trouble will become evident. One will be lack of selectivity and other, noise. The former because the locally generated signal will produce, say, an 88-kilocycle beat with the desired station and a 105-kilocycle beat with some undesired station. If the response curve of the intermediate amplifier covers both frequencies, both signals will pass through the amplifier and will be audible in the output. Under such conditions, the amplifier would be known as being "broad." Such a state is indicated by the dot-dash line in Fig. 1. The noise frequencies would likewise pass through the system if they are within the band admitted by the amplifying system.

The illustration in Fig. 1 shows response or relative amplification against frequency. The vertical dash line within the solid line structure represents the peak frequency of resonance. The two sides for the upright box represent the limits

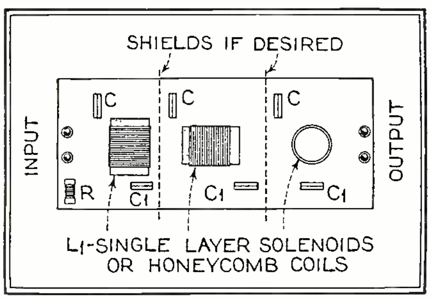


Fig. 6—A complete filter showing the suggested layout of its component parts for best operation

for 5,000-cycle sidebands. It is evident in the graph that the broadly tuned transformer will provide very satisfactory retention of side bands and that in this respect the transformer system is very satisfactory. However, the other two defects defeat the system.

Now, one method of securing satisfactory selectivity and at the same time the elimination of noise is to employ a sharply tuned intermediate amplifier, as shown by the dash response curve, designated as "sharply tuned." But this arrangement, like the other, possesses a distinct disadvantage. The sharply tuned circuit will cut sidebands! This is very evident in the graph. For example, if the numerals on the ordinate represent amplification, the amplification secured at 5,000 cycles is about 17.5% of that available at say 60 cycles. These frequencies are the modulating frequencies constituting the sidebands. Such non-uniform amplification of the sidebands would extend from the zero sideband frequency, the beat frequency of the system to the highest sideband

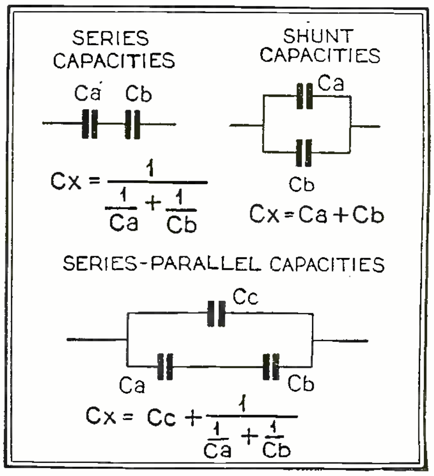


Fig. 5—Sometimes, in order to secure the correct capacity values, it is necessary to employ condensers in series, parallel or series-parallel. The method of connection and calculation of capacity is shown here

frequency, namely 5,000 cycles. Hence the advantages of better selectivity and elimination of noise are offset by the distortion introduced because of amplitude distortion. Such a system would cause the loss of the upper audio register and music would lose its brilliance and speech its intelligibility.

Types and Designations of Band-Pass Filters

Band pass filters are of various types, designated according to their response. First, we have the "low pass" filter, designated l.p., wherein the circuit arrangement provides for the passage of all frequencies *below* a certain cut-off frequency. Second, we have the "high pass" filter, designated h.p., wherein the circuit arrangement provides for the passage of all frequencies *above* a certain cut-off frequency. Third, we have the "band pass" filter, designated b.p., with which it is possible to pass a certain band of frequencies *between* two cut-off frequencies, an upper cut-off and a lower cut-off frequency. All frequencies *below* the lower cut-off frequency and all frequencies *above* the upper cut-off frequency are rejected. The fourth type is the "band ejector" filter, designated b.e., wherein all frequencies *between* two frequencies, a lower cut-off and an upper cut-off, are rejected and all frequencies above the upper cut-off and below the lower cut-off frequency are passed by the filter. Then we have filters which provide for the passage or the rejection of two distinct bands of frequencies. . . . Our interest is centered upon the third type of filter, where we pass a band of frequencies within two cut-off frequencies and reject all others.

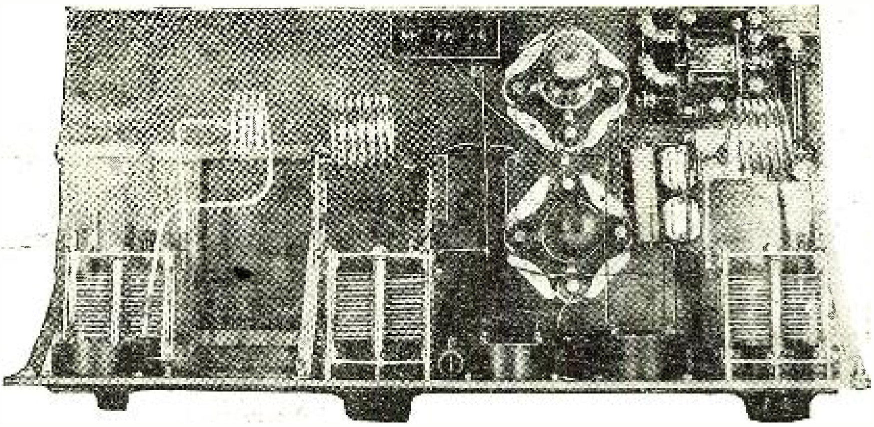
The circuits governing such operation are based upon an invention of electric wave filter by Mr. George A. Campbell, U. S. Letters Patent No. 1,227,113, which is available and may be purchased for ten cents from the Superintendent of Documents, Government Printing Office, Washington, D. C. (When writing, mention the patent number and enclose ten cents.) The material used in this article is based upon the above patent paper and upon an excellent book relating to filter circuits, namely, "Transmission Circuits for Telephonic Communication," by K. S. Johnson, published by D. Van Nostrand Company, N. Y. C. This book contains a wealth of information.

Filter Construction

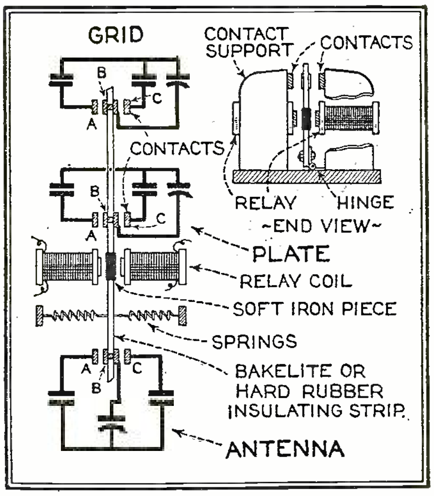
As is well known, filters in general consist of a number of inductances and condensers arranged in a specific fashion so as to provide the desired characteristic. Campbell's basic structure is shown in Fig. 3, wherein L and C constitute a series impedance and L1C1 constitutes a shunt impedance, the two combined comprising one filter section, with a desired response characteristic and with a certain degree of attenuation. Several such identical sections are employed in order to create the desired state of attenuation. This structure permits the passage of two bands of frequencies, within four cut-off frequencies. To provide a system which will pass but one band of frequen-

(*Continued on page 574*)

If You Are About *to* Build a Short-Wave TRANSMITTER—



Looking down on the top of the Binneweg s.w. transmitter. The oscillator apparatus is to the right, while the slide-coupled antenna coil and condenser is at the extreme left



A simple electromagnet with contact-carrying strip provides the electrically operated means for quickly changing the transmitter's wavelength adjustment

TRANSMITTERS for use in the present amateur short-wave frequency-bands require special design and construction to obtain the desired sharp, "unmodulated" wave of constant frequency. Unless particular attention is given to the electrical design factors necessary for a modern transmitter, amateur operators will have difficulty in working other stations equipped with modern receiving apparatus. Present amateur short-wave receivers have reached such a high degree of perfection that poorly adjusted transmitters will not be heard properly or will be entirely lost in the medley of whistles and background noises, too well known to be elaborated upon.

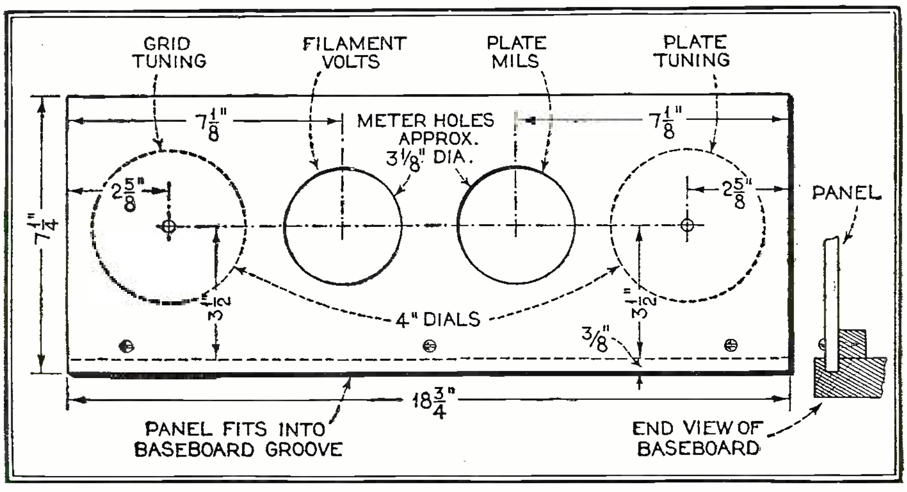
The 100-watt set illustrated will serve more as a target for the following general discussion, bearing on the design and construction of any short-wave transmitter. Amateur operators and other radio enthusiasts have too much native inventive ability to copy exactly any existing set. However, it is a good one to copy, for its electrical features are right and its mechanical construction is certainly pleasing to the eye.

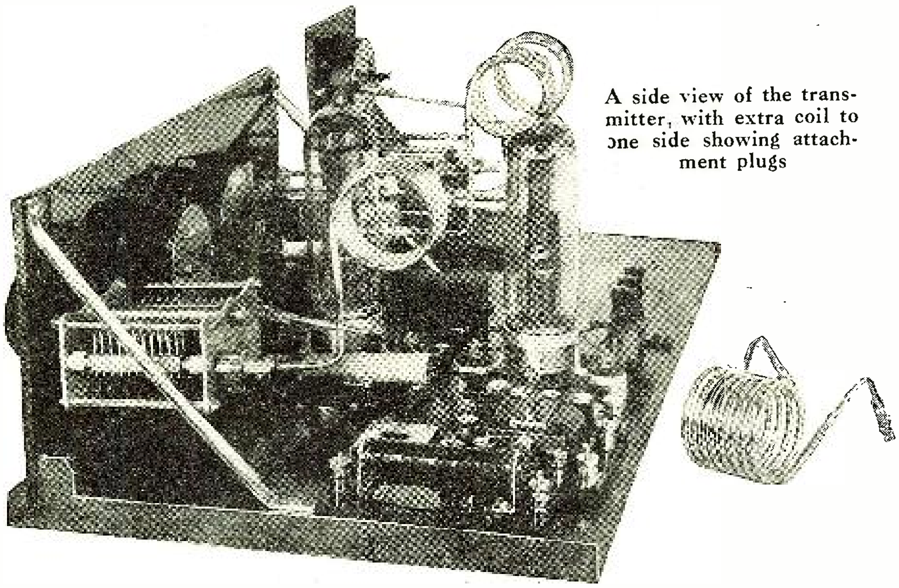
This set can easily be adapted for use with two 7½-watt tubes instead of the 50-watt size in the set by slight circuit changes. Smaller sockets and lower plate and filament voltages are necessary. For the smaller tubes, blocking condensers of about .0002 mfd. will serve for general short-wave use.

There are several important factors which must be considered in any design. It is well known that a high ratio of capacity-to-inductance will stabilize the emitted frequency; but this should not be carried to extremes, as the circulating currents become large and the efficiency falls off rapidly. Moreover, the best value of this ratio will depend upon the tube employed. In this set 43-plate condensers, having, originally, a capacity of .001 mfd. maximum, were double-spaced, giving a final maximum close to .0002 mfd., as the number of plates is halved and the spacing is doubled. These condensers are quite efficient. Although W. E. tubes are shown in the illustrations, R. C. A. 50-watt tubes were also employed, giving good results.

Another important consideration is the size of blocking condensers used. In the usual Hartley oscillating circuit, the blocking condensers are in series with the grid-plate capacity, the resultant capacity being in shunt with the oscillating circuit. This shunt arrangement carries a fraction of the oscillating current of the main "tank," this fraction depending upon the relative sizes. It is an advantage to limit the current through the tube, as this capacity does not compare in efficiency with the tank condenser. The power lost in the resistance of the distributed circuit also constitutes a waste. The blocking condensers cannot be made too small, as the tubes will not oscillate. These remarks apply also to the tuned plate-tuned grid circuit, but only the plate circuit carries the heavy currents. The correct size for blocking condensers depends, among other things, upon the tube used and the circuit constants. In the 100-watt set illustrated, the size of condensers used

This sketch shows the layout of the instruments on the main panel of the Binneweg transmitter





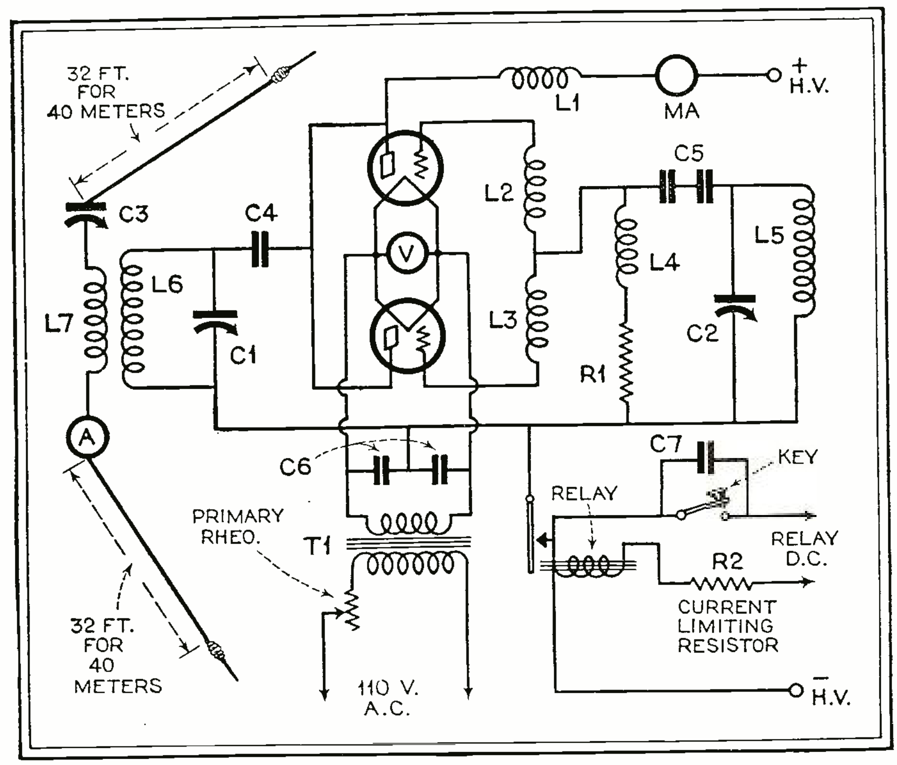
A side view of the transmitter, with extra coil to one side showing attachment plugs

Read These Design and Constructional Hints

By A. Binneweg, Jr.

INSTEAD of describing in detail how to build the short-wave transmitter which is illustrated here, Mr. Binneweg, a "ham" well known to the amateur transmitting fraternity, has used it as the basis for a discussion of good design and construction of transmitters in general, and points out the salient features which should be considered.

For those who wish to duplicate Mr. Binneweg's construction the several photographs will convey quite satisfactorily the constructional features which make this particular transmitter one of simple design yet of sure, dependable long-distance operation.



The complete circuit of the s.w. transmitter. Note the antenna-counterpoise dimensions required for best operation

for blocking is .0006 mfd., this value being obtained from a high-voltage tapped block, especially made for this purpose. It is important in a high-power oscillator that the condensers should stand up under the relatively high voltages used. The grid condensers are not subjected to such high voltages. In this set two good mica condensers of double the required capacity, connected in series, were used. Further details on circuit values can be found also in the List of Parts.

Few pay much attention to the design of the r.f. choke. In this set the choke, L1, is subjected to high voltages and was, accordingly, constructed with great care. If the choke is not considered of importance, note the difference in output when a good one is replaced by another of indifferent construction!

A coil, due to its inductance and distributed capacitance, will have a natural period similar to a wavetrap, or parallel circuit, in which the inductance and capacity are connected in parallel and considered as "lumped" in the coil and in the condenser. Such an arrangement has a high impedance with respect to the external "lines," and thus effectively blocks r.f. currents of the frequency to which it is tuned. One would not, however, use an impedance having a high value of capacity for the circulating currents would be high and the losses quite large. A single-layer winding has comparatively small capacity and will serve for the purpose. There may be opinions to the contrary as to the use of a choke at its natural period, but experimenters who have worked on the problem recommend this procedure, as no better method is at present at hand.

Winding the Choke

To resonate such a choke to the desired frequency is not a simple matter with limited laboratory facilities, but the most convenient way is to start winding wire on a ½-inch form and continue a few turns at a time until the natural period is obtained. This can be tested by placing the choke near a small auxiliary oscillator; a good dip of the grid-meter will indicate the natural frequency. The natural period thus found, however, will change somewhat when the choke is placed in the oscillator, the amount of change depending upon the factors of construction and constants, so that no exact specifications can be given. The choke used in the 100-watt set operated effectively; it consists of about 200 turns of No. 30 d.c.c. wire on a ½-inch bakelite tube. The grid chokes, L2, L3, and L4, are not so important, but can be made similar to the plate choke.

(*Continued on page 562*)

Circuit and Constructional Details

for a Universal Meter

By Blair E. Estes

A Four-Use Instrument Indispensable to the Experimenter and Serviceman

TIME and again the really serious experimenters and those who prefer to be called "servicemen" are confronted with a problem which cannot be solved by the use of one or more meters.

It takes a considerable amount of time and money to throw together rather haphazardly a "breadboard" instrument which will do the measurement work incident to diagnosing the peculiar ailments of whatever piece of apparatus is to be tested.

Mr. Estes, confronted with such a problem, had the foresight to anticipate other similar problems and so designed as a permanent piece of laboratory apparatus the instrument described here and which he prefers to label "A Universal Meter." As he explains, the "meter" consists of four parts: a vacuum tube voltmeter, a frequency meter, a tube tester, and a multi-range d.c. voltmeter.

To have any one of these four available at a moment's notice undoubtedly constitutes a distinct advantage to the radio man who, in the very nature of things, depends upon such pieces of apparatus to aid him in his work. Think, then, of the genuine aid which is his, to have all four combined in a neat, compact assembly such as that described here.

Servicemen and experimenters, alike, will do well to ponder over the simple applicability of Mr. Estes' "Universal Meter" to the every-day problems which confront them.

EVERY experimenter has cherished a desire for a well equipped laboratory in which he could conduct experiments and have the assurance of knowing that the electrical values he is using are somewhere near correct. However, most of us, due to limited finances, depend upon inaccurate instruments and guesswork for determination of our electrical values.

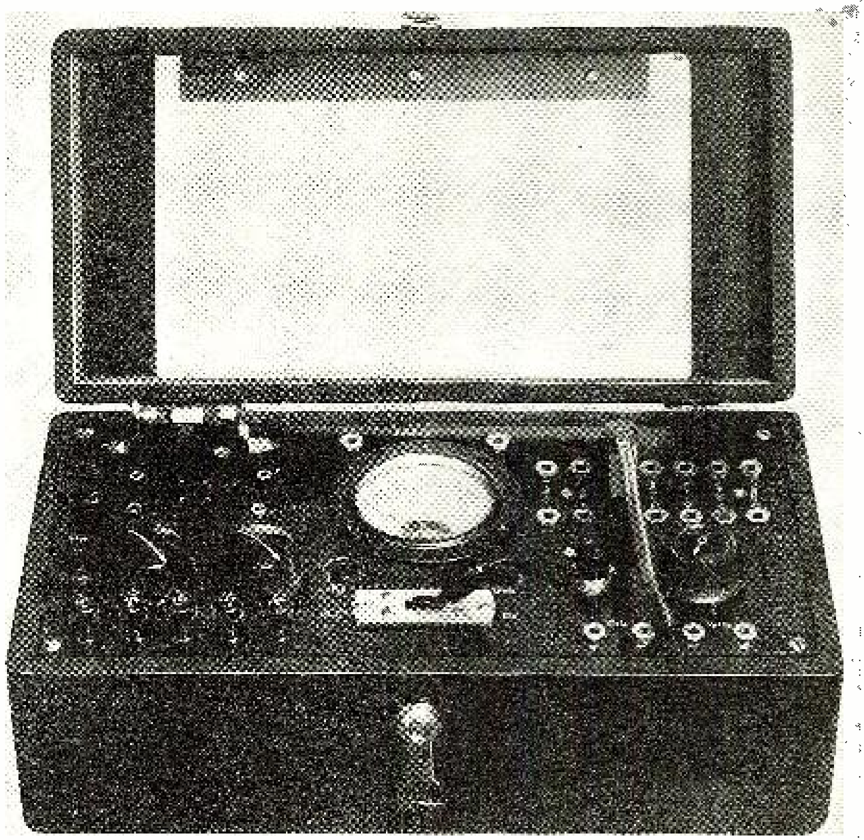
With this idea of the limitations of the average pocketbook in mind a "Universal Meter" was designed that will measure or can be adapted to measure practically all values of current and voltage used in radio work, as well as measuring frequency and checking the characteristics of vacuum tubes.

The meter consists of four parts, namely: a vacuum tube voltmeter, a frequency meter, a tube tester, and a multi-range d. c. voltmeter. Although each operation is a function of the complete instrument, the different parts will be dealt with in turn in order to avoid confusion as to the various uses of the instrument.

The instrument proper is contained in a carrying case with overall dimensions 7 inches wide, 13 inches long and 5 inches deep. This size was not chosen for any particular reason except that the author happened to have a case of that size on hand. The layout for this instrument is not given, as any convenient layout can be used. A good idea as to the location of the various parts may be obtained from the photographs.

The vacuum tube voltmeter used in this instrument is of the plate rectification type and depends for its operation upon the rectification which occurs in the plate circuit of a vacuum tube when the negative grid bias is increased to a point where the tube is working on the lower curved portion of the curve. The positive loop of an alternating current impressed upon the grid will cause a

The completely assembled Universal Meter in its carrying case. Note that the lid contains graph paper for jotting down one's findings



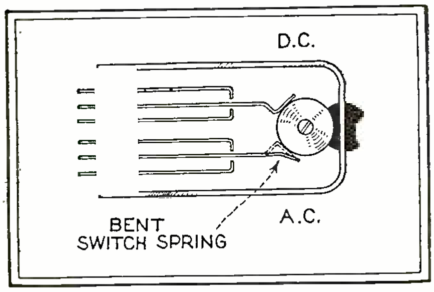


Fig. 2

greater increase in plate current than the negative loop will cause a decrease, and a direct current milliammeter connected in the plate circuit of the tube will indicate the difference between these two currents. As the increase of current is greater than the decrease, the meter reading will increase whenever an alternating current is applied to the grid of the tube. Naturally the greater the amplitude of the impressed alternating current, the greater will be the increase in plate current and the result will be a device capable of measuring alternating current voltage of any frequency. This meter, because of its very high input impedance, may be connected across any radio or audio-frequency circuit without appreciably disturbing the impedance relations of that circuit.

The meter used as an indicating device in this instrument is a Weston, Model 301 0-1 milliameter. This will give the vacuum tube voltmeter a range of 1 to 8 volts, which is sufficient for all ordinary resonance purposes and for measuring audio-frequency voltages. However, for measuring radio-frequency amplification, a more sensitive arrangement such as the accumulative grid rectification type meter must be used. This is essentially a grid leak condenser detector and the vacuum tube voltmeter may be changed to this type by using the connections shown in Fig. 3. In this arrangement the meter readings decrease instead of increase, due to the effect of the accumulation of electrons on the grid of the tube which makes the potential of the grid negative so that the plate current is decreased. This is somewhat inconvenient and if he can afford it, the experimenter should use a 0-200 microammeter connected to the external binding posts provided for this purpose. This meter should have its own bucking battery and be connected the reverse of the usual connection so the meter reading will increase with the voltage applied to the grid of the tube. However, this 0-200 microammeter would only be necessary for extremely small radio-frequency voltages.

The first step toward the use of a vacuum tube voltmeter is the calibration of the meter from any available source of 60 cycle alternating current. The best method is to connect the input of the vacuum tube voltmeter to the arm and one side of a 400 ohm potentiometer which is connected across a stepdown

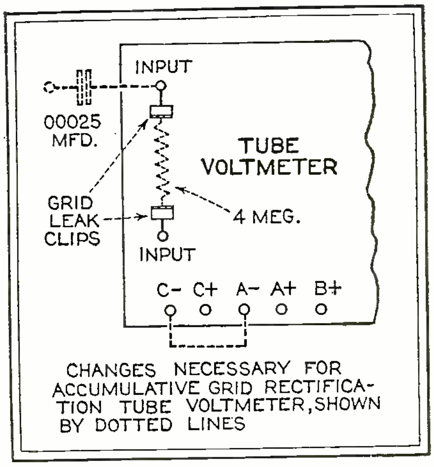


Fig. 3

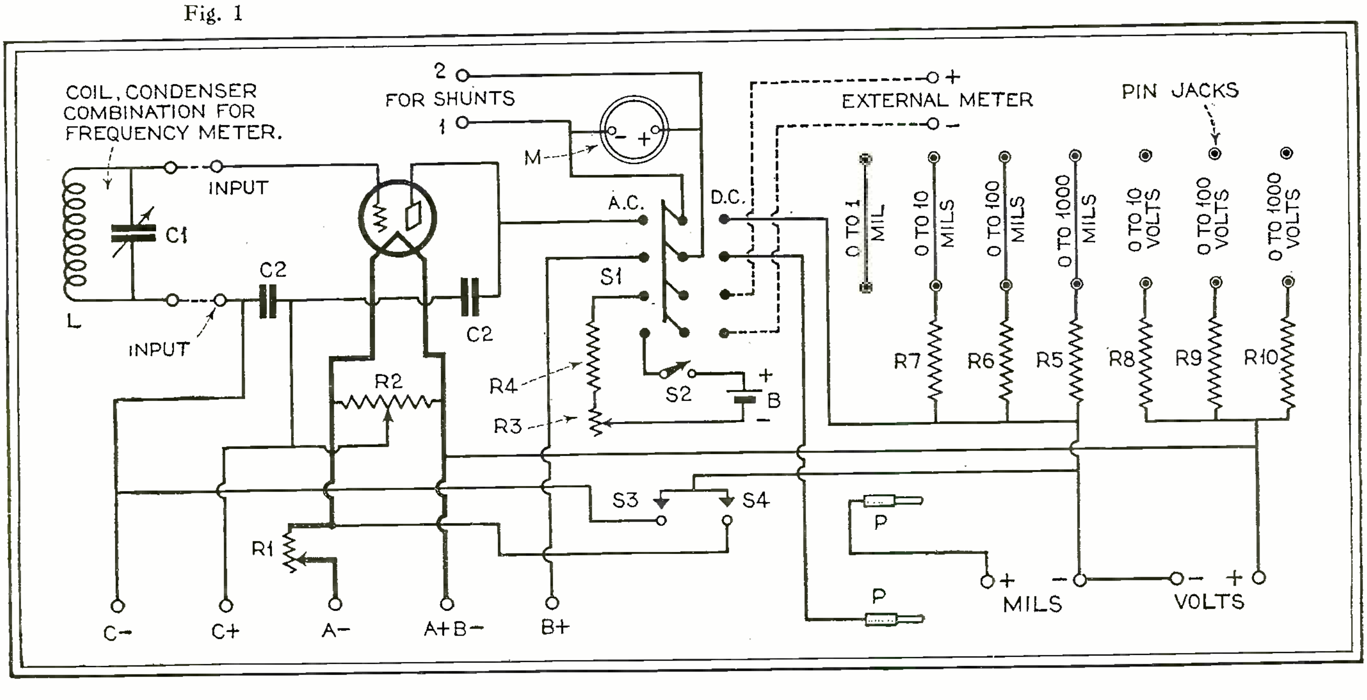
transformer delivering around 12 or 15 volts. The secondary of a trickle charger or tube rejuvenator would be satisfactory in this case. An a. c. voltmeter is then connected across the input of the vacuum tube voltmeter and a curve plotted by varying the input a. c. voltage and noting the plate current in microamperes.

If no a. c. voltmeter is available, a rough calibration may be made by using a filament lighting transformer designed for an a. c. receiver with voltages of 1.5, 2.5 and 5 volts. This calibration can only be considered as approximate, as the voltages from the transformer will vary with different line voltages and loads on the transformer. As most readings taken are only for comparative purposes, this should not detract any from the usefulness of the instrument.

In a radio or audio-frequency amplifier the voltage present is always in form of a voltage drop across an impedance or a resistance such as L1 or L2 in Fig. 4a and 4b or the resistance R in Fig. 4c. The input of the vacuum tube voltmeter is connected across points 1 and 2, making certain that the grid of the tube in the vacuum tube voltmeter is connected to point 1.

When it is necessary to measure an alternating current voltage where there is a direct current voltage drop present as well, some means must be used to keep the direct current voltage drop from affecting the value of the direct current negative grid bias used with the tube of the vacuum tube voltmeter. Such a case would be where it was desired to measure the alternating current voltage across a loud speaker or a choke coil. If the resistance of the windings was 600 ohms and there was a plate current of 20 milliamperes there would be a direct current voltage drop of 12 volts across the windings, which would put an additional negative bias of 12 volts on the grid of the tube in the vacuum tube voltmeter. As this voltage would affect the calibration of the instrument, it is necessary to use a condenser of about 1 mfd capacity in series with the grid of the tube as shown in Fig. 4d. This condenser will keep the direct current from the grid of the tube and will allow the alternating current voltage to be impressed upon the tube. In this case it is necessary to use a grid leak to keep the negative potential upon the grid of the tube at a constant value. This connection has the disadvantage that the calibration changes with frequency because of the change in reactance of the

Fig. 1



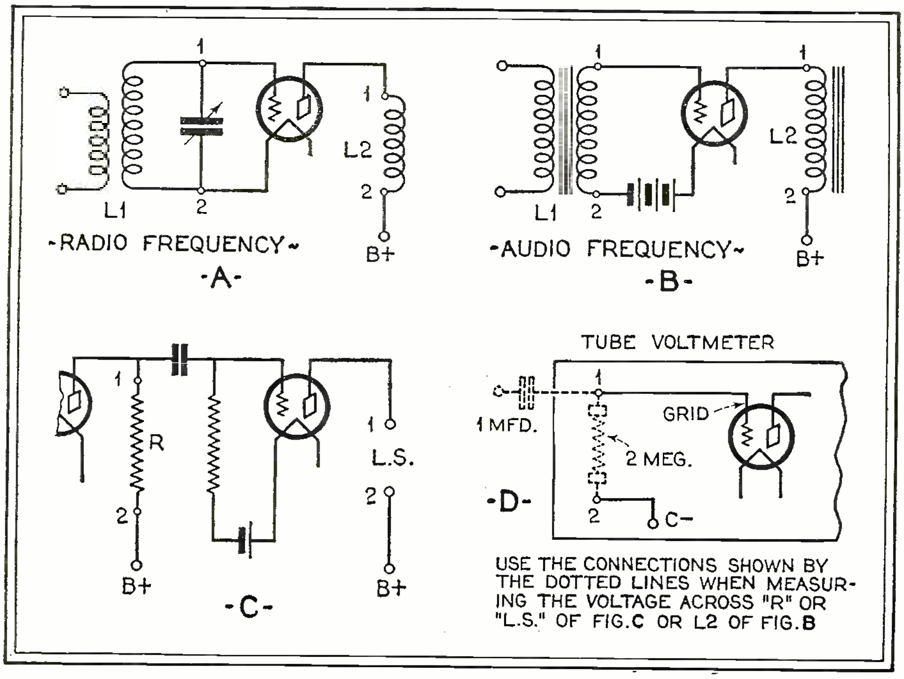


Fig. 4

condenser with frequency. However, if a large condenser of about 1 mfd capacity is used, the change in calibration will not be great.

A Federal four pole double throw anti-capacity switch is provided for disconnecting the meter from the circuit, except when a reading is being taken. This switch also serves the purpose of connecting the meter to the shunt and multiplier arrangement for direct current measurements. Two of the springs of the anti-capacity switch are bent as shown in Fig. 2, so that when the switch is in position for connecting the meter in the plate circuit of the vacuum tube voltmeter it will be necessary to hold the switch in to obtain a reading.

The apparatus used in the vacuum tube voltmeter consists of a UX tube socket built into the panel, a 20 ohm rheostat, R, which regulates the filament voltage and a 200 ohm potentiometer, R2, across the filament battery which provides a fine regulation of C bias voltage. By means of the push buttons S3 and S4, the grid and filament voltages may be read by plugging in on the proper voltage range and pushing the correct button. Of course it is necessary for the anti-capacity switch to be on the d. c. side to obtain these readings. By means of these push buttons it is comparatively easy to adjust the grid and filament to the voltages at which the tube voltmeter was calibrated, thus maintaining accuracy in the calibration of the meter. The tube used with this vacuum tube voltmeter is a UX 201A with 90 volts on the plate and 13½ volts negative grid bias.

These voltages allow a plate current of approximately .08 milliamperes to flow. In order to use the full scale of the meter, a bucking battery is used to balance out this plate current. It consists of a 1½ volt flash light cell and a variable resistance to adjust the value of the current. In order to obtain a fine adjustment of this current two resistances are used. One is a fixed, metalized resistance, R4,

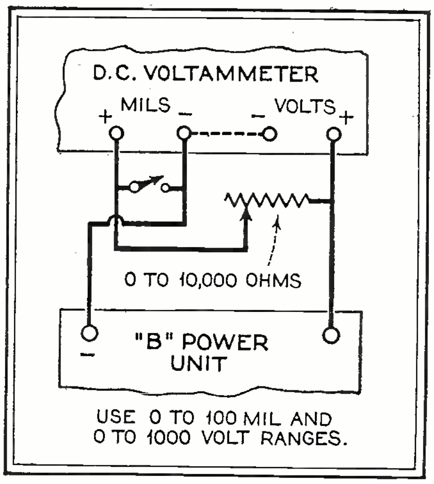


Fig. 5

to reduce the current to the approximate value and the other is a 1,000 ohm rheostat, R3, in series with it to obtain a final adjustment. The battery is connected to the anti-capacity switch in such a manner that the bucking battery is disconnected whenever the switch is in the d. c. or neutral position. An extra switch, S2, is used to disconnect the bucking battery whenever the meter is being used as a tube tester.

The Meter and Its Uses

The first operation in the use of the meter is to adjust the indicating meter to the zero position by means of the bucking battery. The input of the meter is shorted by placing a piece of ¼ inch brass rod the length of a grid leak in the grid clips which are connected to posts 1 and 2 of the vacuum tube voltmeter. (If the blocking condenser is to be used it is only necessary to put a 2 megohm grid leak in the clips.) This should be done each time the meter is adjusted as the milliammeter can be readily damaged if the tube voltmeter is operated without a negative bias on the grid of the tube. The anti-capacity switch is put in the d. c. position and the grid and filament voltages checked by means of the push buttons. The same voltage at which the meter was calibrated should always be used. Keep the switch for the bucking battery in the off position.

The lever of the anti-capacity switch is now gently pushed into the a. c. position. If the meter starts swinging rapidly to the other side of the scale, release the lever and it will spring back into the neutral position. Check the battery connections and voltages and try the lever again. When the connections and voltages are correct there will be about 80 microamperes of current indicated on the meter. The variable resistor for adjusting the value of the bucking battery is put in the off position and the switch for the bucking battery turned on. Adjust the variable resistor until there is no current indicating on the meter.

The meter is now ready to measure voltage. The anti-capacity switch is left in the neutral position and the input terminals of the vacuum tube voltmeter

(*Continued on page* 554)

Football Broadcast Schedules for 1929

November 9—
Army vs. University of Illinois: WEAF
Harvard vs. Michigan: WJZ
Northwestern vs. Ohio State: WABC, W2XE, WMAL, WHK, WKBW, WEAN, WNAC, KMBC, WKRC. KOIL, WADC, WSPD, WCAU, WCAO, WISN, WGHP, KDYL, KFPY, KVI, KLZ

November 16—
Yale vs. Princeton: WEAF
Notre Dame vs. University of Southern California: WABC, W2XE, WMAL, WHK, WKBW, WEAN, WNAC, KMBC, WKRC, KOIL, WADC, WSPD, WCAU, WCAO, WISN. WGHP, KDYL, KFPY, KVI, KLZ

November 23—
Ohio State University vs. Illinois: WJZ
Harvard vs. Yale: WEAF, WABC, W2XE, WMAL, WHK. WKBW, WEAN, WNAC, KMBC, WKRC, KOIL, WADC, WSPD, WCAU, WCAO, WISN, WGHP, KDYL, WKPY. KVI, KLZ

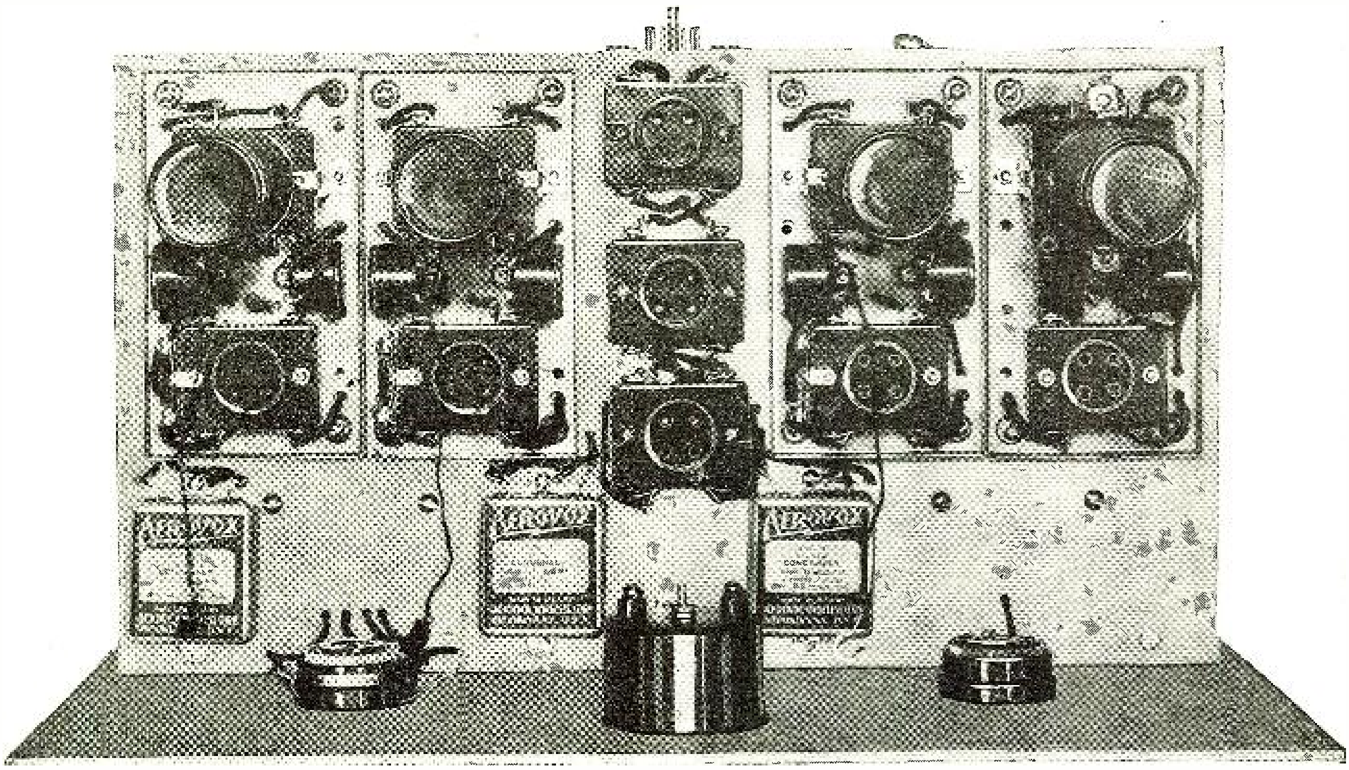
November 28—
University of Pennsylvania vs. Cornell: WABC, W2XE, WMAL, WHK, WKBW, WEAN, WNAC, KMBC, WKRC. KOIL, WADC, WSPD, WCAU, WCAO, WISN, WGHP, KDYL, WKPY, KVI, KLZ

November 30—
Dartmouth vs. Navy: WJZ
Army vs. Notre Dame: WEAF, WABC, W2XE, WMAL, WHK, WKBW, WEAN, WNAC, KMBC, WKRC, KOIL, WADC, WSPD, WCAU, WCAO, WISN, WGHP, KDYL, WKPY, KVI, KLZ

December 7—
Georgia Tech. vs. University of Georgia: WJZ

December 14—
Carnegie Tech. vs. University of Southern California: WABC, W2XE, WMAL, WHK, WKBW, WEAN, WNAC, KMBC, WKRC, KOIL, WADC, WSPD, WCAU, WCAO, WISN, WGHP, KDYL, KFPY, KVI, KLZ

December 28—
Army vs. Stanford: WEAF, WABC, W2XE, WMAL, WHK, WKBW, WEAN, WNAC, KMBC, WKRC. KOIL, WADC, WSPD, WCAU, WCAO, WISN, WGHP. KDYL, KDPY, KVI, KLZ



A top view of the stripped chassis

Low Filament Consumption Is a Feature of the

Second Small-Boat Receiver

By W. Thomson Lees, *Managing Editor, and* Edward W. Wilby, *Associate Editor*

ON board the Floating Laboratory, the week-end following Labor Day taught us some interesting things. We had set out from Sheepshead Bay on Saturday afternoon for a short run, out to sea. The weather was fair, but there was a feeling of dampness that presaged fog. Sure enough, when land had receded into the distance, visibility ahead began to be poor.

We had the receiver tuned in to a strong local station's program. Deciding to do a little fishing, we shut down the engine and drifted. In the course of the next hour, the fog thickened to such an extent that it was impossible to see more than some twenty feet on any side of the boat. Still our only concern was to be on the alert for any other craft which might be heading too close to us for comfort.

Out of the fog came the muffled sound of a motor. Our pilot immediately reached for our Klaxon horn button—and the horn failed to respond. Lung-power provided sufficient warning whistles, so that the approaching motorboat was warned of our proximity, and meanwhile our pilot discovered that the storage battery was too run-down to operate the horn. With the battery run down, starting the engine was something of a job; and, after having drifted for almost two hours, we had only a very general idea of our position.

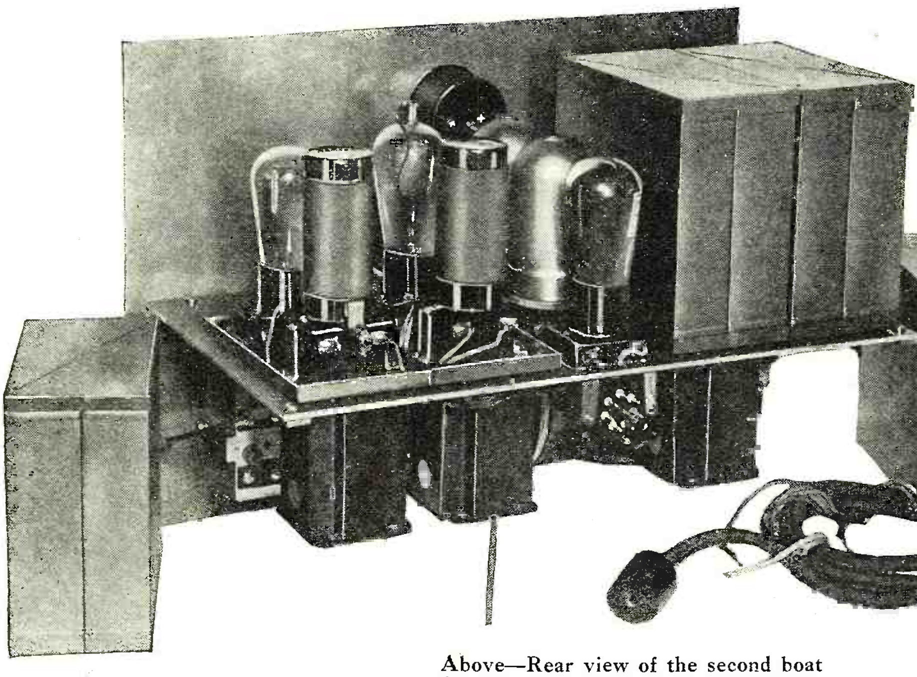
It was then that we had particular need for the direction-finding qualities of the boat receiver. Turning it on, we were able to get only the weakest whisper from even the most powerful local, on the antenna; and no recognizable signal whatever, on the loop. Measuring the filament voltage, it was found to be less than four volts (instead of six) although the generator appeared to be recharging the storage battery at a five ampere rate.

IN the first experimental receiver, described last month, we used heater-type a.c. tubes. Results obtained from that model left little to be desired.

However, there is a large field, among small-boat owners, for a receiver which imposes practically no extra load on the storage battery. This second model, with its total filament current of less than one and one-half amperes, is the answer to that demand.

At the moment, the important thing was to find our way back. The compass, of course, was indispensable; without it, there was no way of knowing in which direction to head. Even with it, since we had no means of knowing how far we had drifted, it was a case of heading very cautiously in the general direction of home. Fortunately, the fog lifted a bit, and we picked up our mooring without mishap.

Back at anchor, we proceeded to look for the cause of the battery failure. With the engine running at full speed, the charging rate was five amperes; at normal cruising speed it was only from two to three amperes. Assuming that the boat would normally be operated in much the same way as we had been operating it, there would be comparatively long periods when the engine would not be operating; especially at night. Roughly, then, more than half the time the battery would not be receiving any charge to make up for whatever drain was imposed upon it by receiver, running and riding lights, and cabin lights. To all practical intents, then, the battery was receiving an average charge of approximately 1½ ampere-hours for each hour the boat was in use. This, obviously, was nowhere near enough, when the radio receiver and amplifier tubes alone required 4¼ amperes.



Above—Rear view of the second boat receiver, with two of the shield cans removed

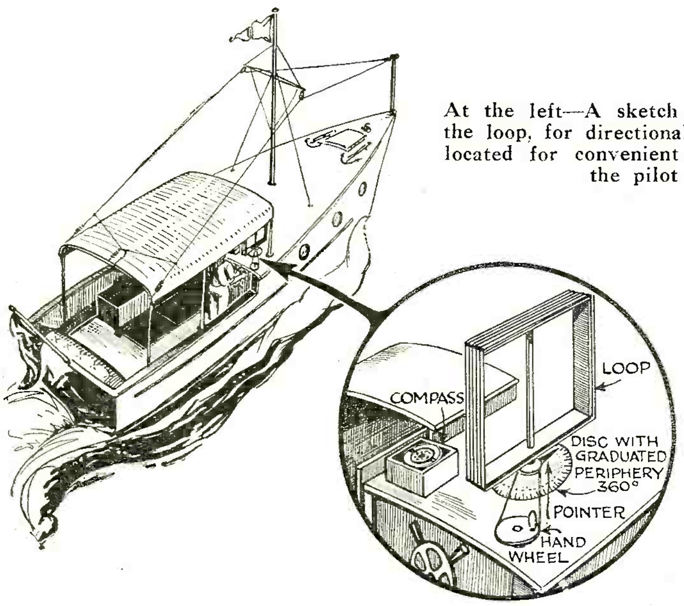
To almost every problem of this kind there is more than one solution. There is usually an ideal solution, which may or may not be practical, and there are various possible compromises. In this case, the ideal solution would be to provide a sufficiently high charging rate from the generator. In many cases, that can readily be done; but to do so on the Floating Laboratory would have involved installing a new generator.

We had to accept conditions as they were. Moreover, we had to recognize that hundreds of boat owners would encounter similar conditions. The thing to do, then, was to lay aside the first experimental model for the moment, and to design another receiver specifically to meet these conditions.

The experimental model of this second small-boat receiver has now reached the stage where it has been submitted to home laboratory tests. We are showing several views of the assembled chassis in the accompanying illustrations, and giving, also, a brief description of the circuit details. Total filament current demand, incidentally, is less than 1½ amperes. As this is being written, we are making certain refinements, dictated by actual experience, and for that reason are withholding the final circuit diagram.

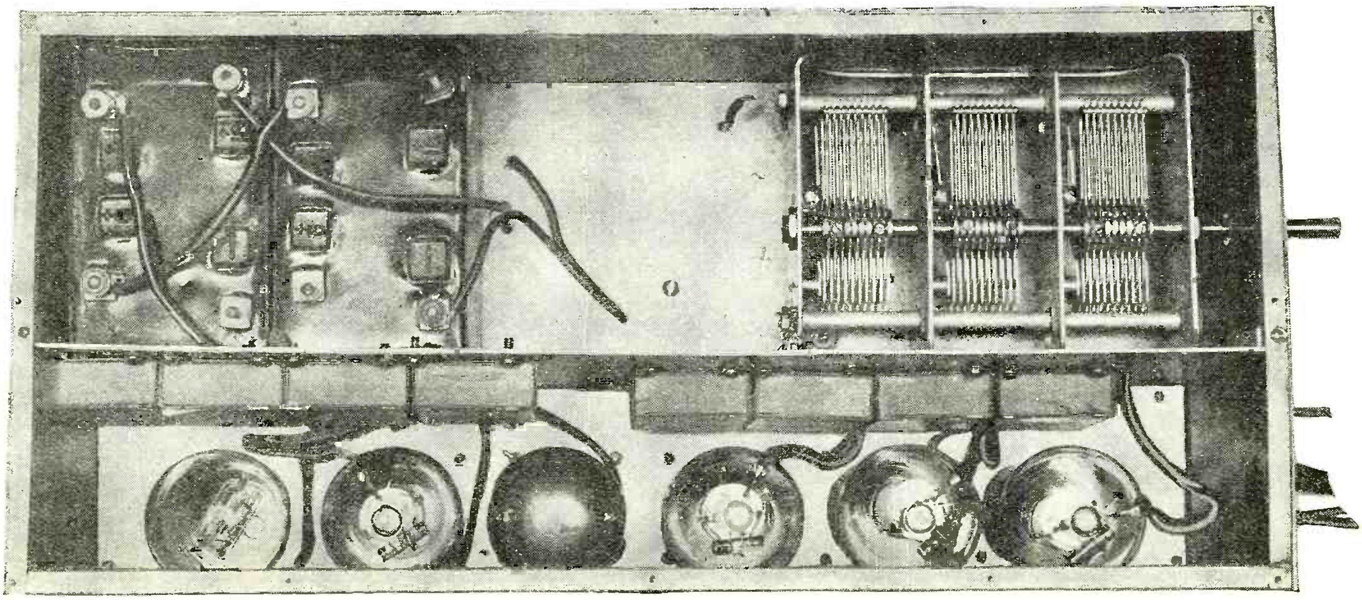
In the home laboratory, this receiver performed quite up to expectations; but previous experience had shown us that there is a big difference between a fixed location with a good antenna, and a 26-foot cruiser with a handkerchief-size aerial system. The exigencies of editing a magazine, plus a run of bad weather, gave us only one opportunity for a test on board. That test, however, was so successful that we want to say a word about it.

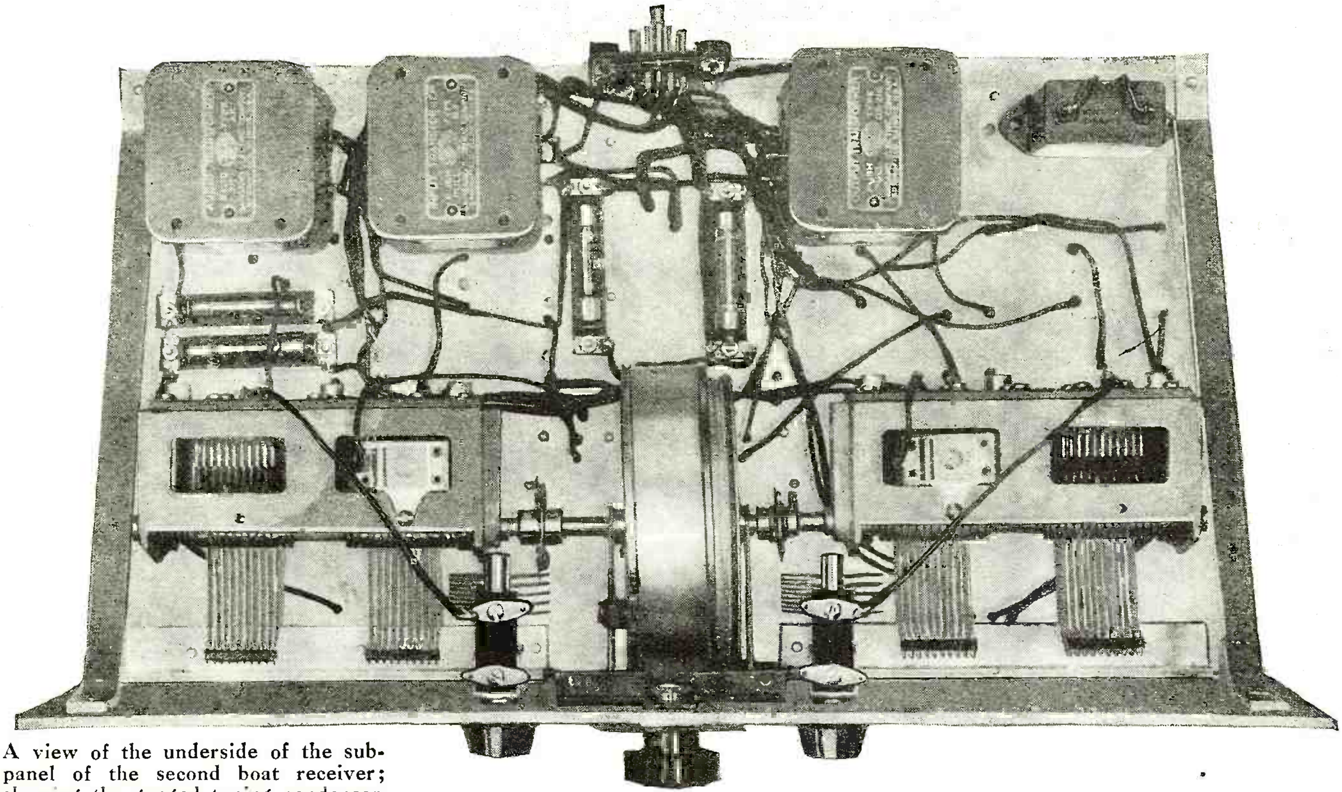
Intended for operation on 180 volts B battery, we found that our B supply had dwindled—due to the fact that one of our 45-volt layerbuilts on board had been



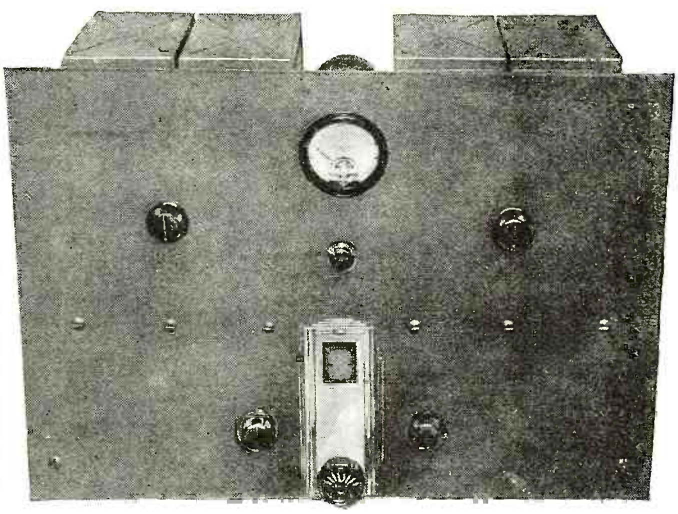
At the left—A sketch showing how the loop, for directional reception, is located for convenient operation by the pilot

Below—Top view of the "works" of the compact, lightweight receiver (now in the laboratory stage of development) for motor-boat or automobile use





A view of the underside of the sub-panel of the second boat receiver; showing the ganged tuning condenser, audio transformer, amperites, and trimmer condensers. Both front and sub-panels are of duraluminum. Below is a view of Ambrose Lightship, one of the many coastal beacon stations



At the right—Looking downward over the front panel. Note the meter, for aid in direction-finding work

installed where bilge-water got in its deadly work. That left us 135 volts available. The boat's storage battery was so run down that, when we came aboard on Columbus Day, the engine had to be cranked by hand. Both of these things were annoying; but they were exactly the kind of thing that would be "run of mine stuff" for the average small-boat owner. The larger boat, of course, would have greater battery and charging facilities, and the first experimental boat receiver would have been fine and dandy; but here, with both A and B supply 'way down, that particular receiver would have been nothing but an ornament.

On this particular occasion, there was no sign of fog. On the contrary, there was a constantly freshening breeze. We headed out into the open ocean, intending to combine business with pleasure by doing some deep-sea fishing. To make things even more interesting, the engine was behaving badly, it was getting rougher by the minute, and we were a little bit dubious about imposing any additional load on the storage battery, under the circumstances. Nothing venture, nothing have—so we hooked up the new set. Being old campaigners, we were quite ready to meet disappointment.

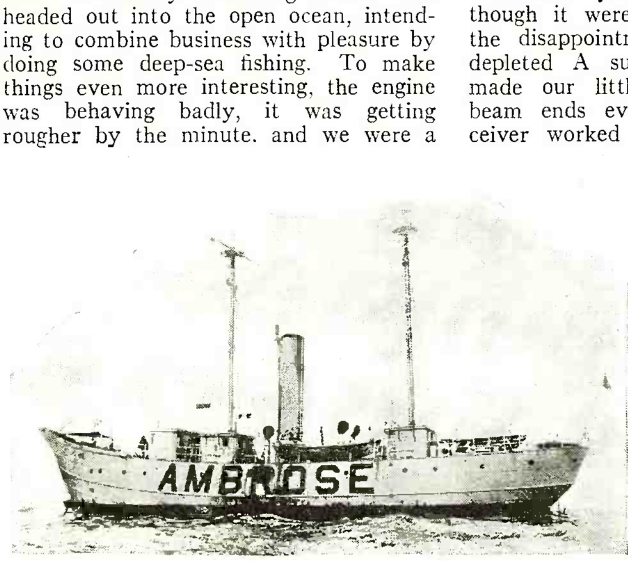
Instead—just as though it were trying to make up for the disappointments of low B supply, depleted A supply, and weather that made our little cruiser stand on her beam ends every little while—the receiver worked like a charm. All the nearby locals came in nicely. And this, mind you, with a run-down A battery, and with only 135 volts, instead of 180 volts, of B supply.

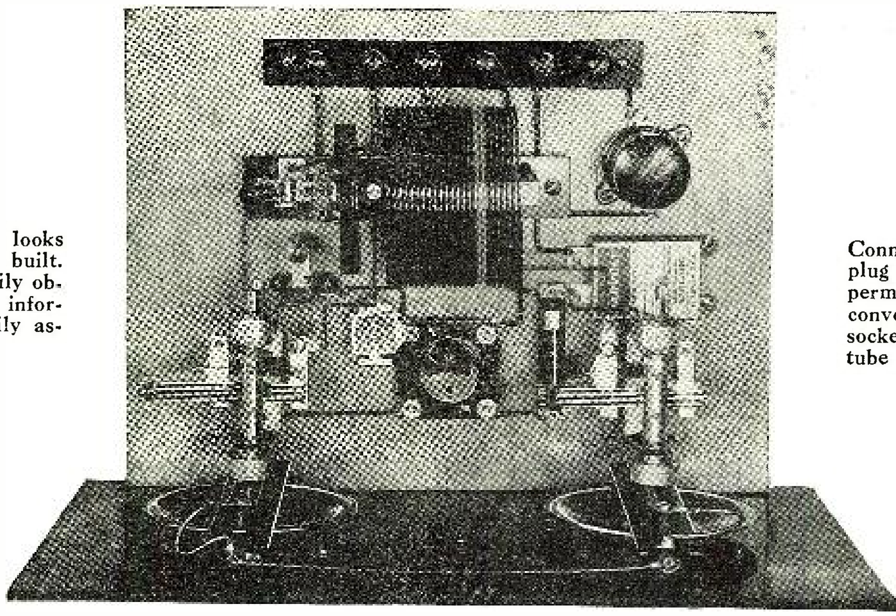
It so happened that practically every station in the country was telling a breathless world the details of the fourth game of the baseball world series. Unquestionably, Graham McNamee had many thousands of listeners; but we found ourselves wondering whether he had, anywhere, an audience that could compare with our little group.

The wind had been steadily increasing. We had intended to do some fishing; but the sea was kicking up to a point where our helmsman had all he could do to head her into it. We were some two hours and more from shore. Bait or no bait, it was obvious that there was no possibility of dropping an anchor and fishing. As a matter of fact, the mere job of turning around, in the sea that was running, assumed the proportions of a major feat. McNamee, all unconscious of this, was telling about the Cubs having an 8 to 0 lead over the Athletics. Meanwhile, we were trying to figure out a way to turn around without turning over.

The circuit? Oh, yes—pending some minor refinements, here it is. And it doesn't have to make any apologies to its

(*Continued on page 577*)





How the converter looks when it is completely built. All the parts are readily obtainable and from the information presented easily assembled

Connection of an adapter plug to the binding posts permits connection of the converter to the detector socket of the J. R. G. five-tube receiver previously described

The Junior RADIO Guild

How to Build a Short-Wave Converter *and* How to Use It

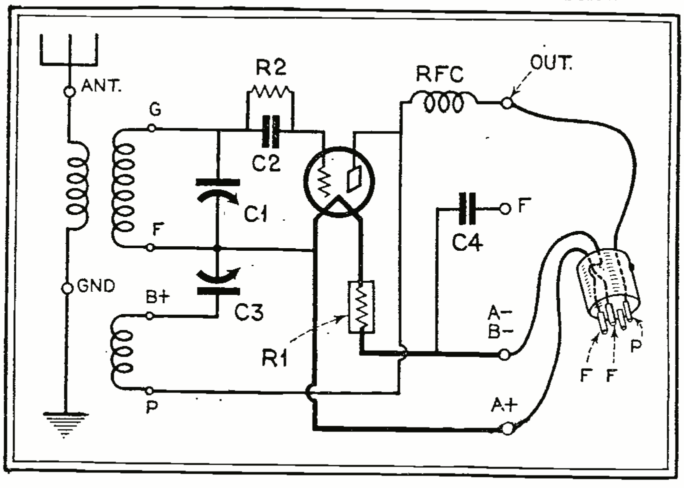
THE Junior Radio Guild is an organization which makes available to boys "from 4 to 40" the opportunity to equip themselves with a knowledge of radio.

The Junior Radio Guild furnishes to its members pamphlet lessons which tell in simple, understandable language the practical fundamentals of radio. The first course, consisting of five lessons, includes not only an exposition of principles, but tells how to build, unit by unit, a complete five-tube receiver with short-wave converter. Future lesson series will tell how to build other types of receivers. Elsewhere in this issue is a description of the Guild, and an enrollment blank, for those who wish to become members.

THE four lessons of the Junior Radio Guild Radio Instruction Course which have been previously published in the pages of this magazine describe step by step the construction of a complete five-tube broadcast receiver. This receiver, when completed, is capable of tuning in broadcast stations operating on wavelengths which have been set aside by the Federal Radio Commission in Washington, D. C., for this sort of work. There is still another classification of stations which broadcast music and speech for entertainment purposes and these operate on what are known as the short waves; that is, the wavelength adjustment of this latter group of stations is very much lower than the lowest wavelength station in the broadcast group.

With the broadcast receiver which we have already built, it is not readily possible to tune to these short-wave stations unless we provide some means for substituting other coils and condensers which are particularly adapted for this sort of work. There is, however, a way in which we can make use of part of the broadcast receiver and with the building of a separate unit listen in on the very interesting programs which are being transmitted over the short-wave broadcast stations. We need not disturb even one piece of apparatus which has already been wired into our broadcast receiver. All that is necessary to accomplish the task is to build what is called a "short-wave converter unit." Such a unit consists of a tuning system having coils and variable condensers which are specially designed to tune in stations on these short wavelengths. By means of a socket plug which is connected to this converter, connection is made from it to the audio channel of the broadcast receiver by first removing the detector tube from the socket in the broadcast receiver and plugging in

Fig. 1—Only one tube, a detector, is used in the short-wave converter whose circuit is shown below



its place this special socket plug. In this way, we cut out the front part of the broadcast receiver; that is, the two-stage radio-frequency amplifier and detector circuit, and in its place use merely the short-wave detector unit which comprises the converter. What we have, then, is a simple short-wave detector circuit followed by two stages of audio-frequency amplification.

Reception Over Great Distances Possible on Short Waves

Providing we go this far, here is what you can do with the short-wave receiver. First, you can tune to the broadcast programs which are regularly transmitted simultaneously with what we might call the long wavelength programs, from such stations as KDKA in Pittsburgh, owned and operated by the Westinghouse Elec. & Mfg. Company; WGY in Schenectady, owned and operated by the General Electric Company; WLW in Cincinnati, owned and operated by the Crosley Radio Corporation, and 2XE, a short-wave broadcast station at Richmond Hill, N. Y., one of the chain of the Columbia Broadcasting System. There are countless other short-wave broadcast stations which will bring to you music, speech and other forms of entertainment similar to that received on the regular broadcast receiver. A surprising thing, though, is that much greater distances are covered by such short-wave transmitters, resulting in reception from stations sometimes 2,000 and 3,000 miles away, a feat that is not ordinarily the case with the regular broadcast receiver.

Then, too, you can listen in on the television signals which are now being sent out by a number of short-wave broadcast stations, in particular that of the Jenkins Television Laboratories in Washington, D. C., and the DeForest Television System, located in Jersey City. Added to this are countless thousands of short-wave transmitters which are operated by the "amateurs," a group of radio enthusiasts who are forever experimenting with various forms of transmitters and receivers and who maintain regular communication between their own stations and stations sometimes situated half-way around the globe. If you have been following the articles by Lieut. Wm. H. Wenstrom which have been published in the past few issues of RADIO NEWS, undoubtedly you are already familiar with the great distances which are covered by these exceedingly small low-powered transmitters. It is not at all unusual to be able to sit at your receiver, located perhaps in the northeastern part of the United States, and listen to the code signals being transmitted to you by some fellow amateur in South Africa, Australia, New Zealand or some other equally distant place on the earth. This, of course, only sketchily outlines to you the vast possibilities of short-wave transmission and reception, and to be in on it, you need only to construct the short-wave adapter which is described here.

THE lure of short-wave reception—the ability to listen in on signals being transmitted from stations situated sometimes half-way round the globe—that's the kind of stuff that makes the blood tingle, for novice and oldtimer alike.

This, the fifth in the series of Junior Radio Guild lessons, tells you in plain, simple language how to build a "converter" which changes your five-tube broadcast receiver built from the preceding lessons into one of the finest short-wave receivers you can construct.

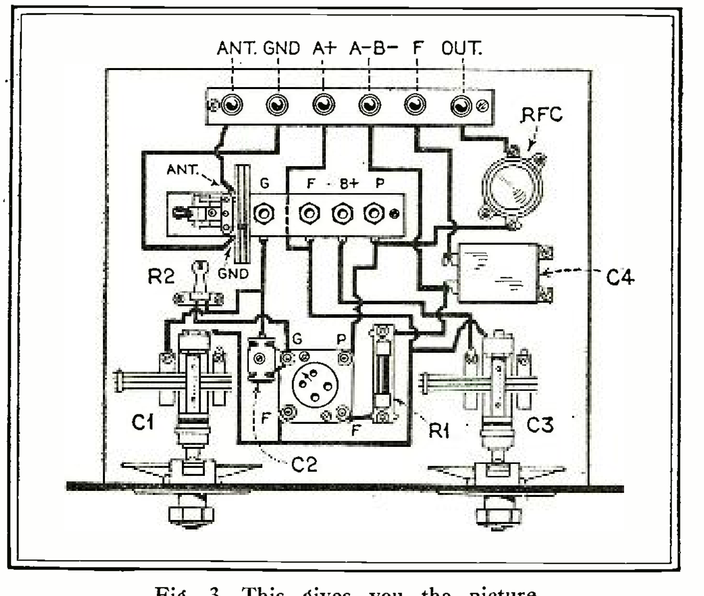


Fig. 3—This gives you the picture wiring diagram of the Junior Radio Guild short-wave converter. If you cannot wire the converter with the aid of the circuit shown in Fig. 1, then the picture diagram will help

Building the Short-Wave Converter

There are many types of receivers and converters which may be used, but the one described here is the simplest form that can be built. The circuit employed in the short-wave adapter uses only one tube, and that as a detector. To it are connected such pieces of apparatus as the tuning coil, tuning condenser, grid leak and radio-frequency choke coil. A glance at Fig. 1 will show to you the features of the circuit. Compare it with the photograph showing the actual layout of these parts on the baseboard. The condenser at the left side of the panel is the main tuning condenser, and depending on whatever tuning coil is inserted in the coil base, it will tune to the short-wave stations which fall within the band covered by this coil and condenser combination. If it is desired to listen to a short-wave station which is either higher or lower in wavelength than those covered by this band, then it will be necessary to remove that particular coil and insert in its place either a larger or smaller one. (Three different sizes of coils are supplied in the kit used.) For instance, if it is desired to listen to a station whose wavelength is between 17 and 31 meters, then it will be necessary to use the 20-meter coil, the smallest of the three. On the other hand, if you wish to listen to a short-wave station whose wavelength is somewhere between 30 and 60 meters, then it will be necessary to use the 40-meter coil, the second largest, or if you wish to listen to a short-wave station whose wavelength lies between 50 and 110 meters, then it will be necessary to employ the 80-meter coil, the largest of the three. By means of plug pins which are fastened to all three of the coils, it is merely necessary in changing from one coil to another to remove one coil from the coil socket and insert that one which is desired for use.

By means of the binding posts with which this converter is supplied, it may be used separately as a short-wave tuner, or if a suitable socket plug is connected to it, it may be connected in place of the regular detector tube which is in the regular broadcast receiver, thus adding to it a two-stage audio amplifier by which the volume of the received signals is greatly amplified. Of course, it is not necessary that the converter is used only with the five-tube receiver previously described in the past Junior Radio Guild lessons. It is so constructed that it will work with any type of radio receiver which has a regular detector tube in it.

Constructional Hints

To construct the short-wave converter, first obtain all of the parts which are listed in the parts list. Take the panel and temporarily place in position the tuning

(*Continued on page* 579)

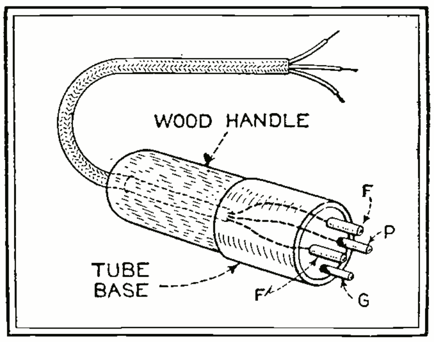


Fig. 2—For connecting the converter to the detector socket of the five-tube receiver make a plug adapter such as that shown here

The Radio Forum

A Meeting Place for Experimenter, Serviceman and Short-Wave Enthusiast

The Experimenter

Television

Among the many ideas for improving present-day television is one from Mr. Harald Ostvold of St. Paul, Minn. For those having a twelve-inch scanning disc and its associated motor the following is a method of efficiently controlling the motor speed. First cut from a rubber inner tube a disc of about 2½ inches in diameter. Place this between 2-inch diameter washers or flanges on a hub that will fit the shaft of the motor. Mount

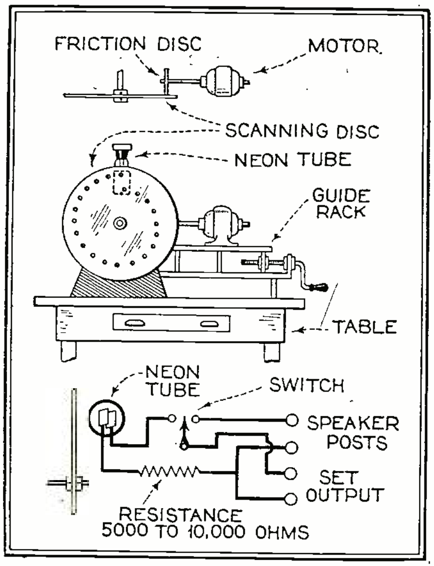


Fig. 1

the motor on a frame sliding between guides in such a manner that the rubber disc is at right angles against the back of the scanning disc and about three inches from the center of the disc center, as shown in Fig. 1.

The manner in using this idea is to tune in the television station and adjust the speed of the motor by sliding the supporting rack out from the center line until the picture is synchronized. It is very easy to hold a picture in frame with a little experience. The disc may chatter a little as the motor starts, but this will automatically stop once the desired speed is reached. Fig. 1 shows the relation in position between the motor rack and the synchronizing disc.

The neon glow tube is connected to the output of the amplifier. In a number of cases the operator of the television receiver wishes to change from the picture to loud speaker for announcements. This is easily accomplished with the use of a throw-over switch also shown in Fig. 1.

The receiver should be adjusted for good reception on the speaker which will result in good clean-cut pictures. For the experimenter, who has not as yet had the pleasure of receiving television pictures, it may be well to say here that the pictures will be received in black with a pinkish background. The intensity of the picture will to some extent be dependent on the "C" bias applied to the grid of the output power tube. When tuning in on a television signal, first only black and pink dots will appear, later the picture itself will replace the dots. When the scanning disc of the receiver is in synchronism with the transmitter, if by any chance the picture is upside down, it is merely necessary to reverse the face of the scanning disc or in other words turn it inside out.

Musical Pillow

There is a steadily increasing demand for radio and phonograph music in hotels, hospitals, pullman and ordinary day coaches. Those of us who have had the consolation of head phones during an illness or a sleepless night, can speak mightily of the power of radio to help a person forget their troubles.

In hospital wards, a loud speaker is objectionable, because, of course, of some wanting radio music and others too sick both bodily and at mind to be bothered with any interfering element. In some of the newer hospitals radio equipment has been installed with provision for head phones at each of the beds. This, however, in a number of cases is objectionable, as the head band is uncomfortable, interfering with sleep; and if by chance one does doze off, the head set may slip off and jab one in the eye. During a recent illness Mr. L. Fenner of Chicago, Ill., solved the above problems with a very neat device called a musical pillow. To make such a pillow the experimenter should obtain a very soft pillow as well as two rubber bath sponges, with either square or rounded corners. These sponges may be purchased in a number of stores at 10c each. Soft rubber bath sponges measure about 5 x 3 x 1½ inches. A pair of sponges should be placed side by side, making a pillow 6 x 5 inches. With shears, cut out a half-inch rectangular notch through the

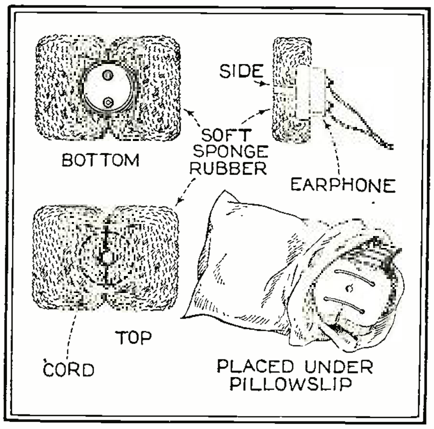


Fig. 2

center of the sponge pillow, making a hole for the music to come through. An inverted headphone is now placed over this hole and an outline made for the circular hole to be cut in which the headphone is placed. Usually a cut one-half inch deep is all that is required, as only the hard rubber cap of the headphone is buried in the sponge pillow. Cord or ribbon, using a hairpin for a needle, will finish the job in holding the two sponges firmly together side by side (Fig. 2). The constructor is now ready to lift the top of the pillow slip and insert the sponge pillow, making room for it among the feathers.

If you would keep your storage battery in tip-top position, make a frequency measurement of the specific gravity of the electrolyte and when necessary add pure distilled water so that the level of the electrolyte is about one-quarter of an inch above the top of the plates

Ohm's Law and Calculations

Ohm's law is an electrical formula concerned with three factors always present in a direct current circuit, namely: resistance, measured in ohms; electrical pressure, measured in volts; and current, measured in amperes.

The relation between these factors in any direct current circuit is expressed in any one otf the following three methods:

(1) $E \text{ (volts)} = I \text{ (current)} \times R \text{ (resistance)}$

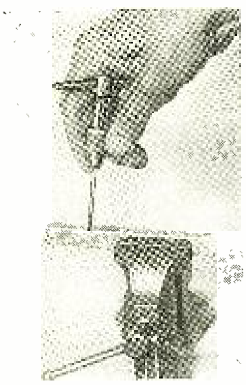
(2) $I \text{ (current)} = \dfrac{E \text{ (volts)}}{R \text{ (resistance)}}$

(3) $R \text{ (resistance)} = \dfrac{E \text{ (volts)}}{I \text{ (current)}}$

It will be seen from these three methods of expression, writes Mr. D. A. Brown of Marion, Ohio, that Ohm's law permits the finding of one unknown factor when the other two are known. One of the common problems in the use of resistance banks used in power units is to find the current through a resistor at a given potential. For example, a resistor of fifty ohms is placed in a circuit with a potential drop of 100 volts across it. To find the current in this circuit we choose the second formula:

$$I = \frac{E}{R}$$

Solving the equation, the resulting answer is two amperes.



In tapping a hole to obtain a thread, fasten the work to be tapped in a vice rather than hold it in your hand. In this way, you can be sure that your work will be accurate

Many resistors on the market are rated for both current carrying capacity and watts. Watts in direct current work is the product of the potential drop across the resistor and the current flowing through it.

The formula is $W \text{ (watts)} = E \text{ (volts)} \times I \text{ (amperes)}$. As the Ohm's law, there are three possible arrangements of the above formula:

$$W = E \times I$$

$$E = \frac{W}{I}$$

$$I = \frac{W}{E}$$

Another and more useful formula by which the watts dissipated in a current may be calculated is as follows: $W \text{ (watts)} = I^2 \text{ (current)} \times R \text{ (resistance)}$.

By using these axioms of direct-current practice, it is possible for the experimenter to learn all of the conditions in a power supply circuit.

Referring to the new 24 type a. c. screen grid tube—Mr. Allen B. Dumont, Chief Engineer of the DeForest Radio Company, Jersey City, N. J., says: "When the screen grid vacuum tube was first introduced, great plans were made for its amplification possibilities. These plans are being, in a large measure, borne out. Briefly, while it is possible to obtain very high amplification with the screen grid tube, the last stages of the tuned radio frequency amplifier have a tendency to draw grid current, resulting in broad tuning and modulation of the carrier wave. That is to say, that some stations will modulate the carrier wave of a weaker station, resulting in station interference.

Now the high amplification of the Screen Grid Tube is due to reduction of the grid to plate capacity in the tube to a very small part of the value in the former three element tube. This feature makes it possible and practical to design a tube which in itself has a high amplification factor. In the case of the type 24 tube, this amplification factor is 420. It would be possible to obtain a high amplification factor in the ordinary three element tube also, but it would be of small value since the circuits would oscillate with such a high gain.

The Screen Grid Tube as originally conceived and as presented to the public, in practically all the a. c. Screen Grid tubes today, have the following ratings:

Filament	2½ volts
Control grid	1½ volts
Screen grid	plus 75 volts
Plate	180 volts

When its investigation was undertaken, it was soon found that when operating at the foregoing ratings, the grid commenced to draw current anywhere between ½ and 1 volt. The point at which this tube draws grid current is very similar to that at which the 27 or Heater Type a. c. tube starts to draw grid current. However, due to the much lower bias employed on the screen grid tube, a much smaller voltage swing will start the grid current. For instance, a 27 type tube operating with 2½ volts on the filament, and —13½ volts on the grid and 180 volts on the plate, would not start to draw grid current until the grid voltage had changed from —13½ to —1 volt. The screen grid tube, on the other hand, could only go from —1½ to —1 volt when it would start to draw grid current. It is due to this fact that, when great amplification is obtained, the last stages of the radio frequency amplification are likely to draw grid current, broadening the tuning.

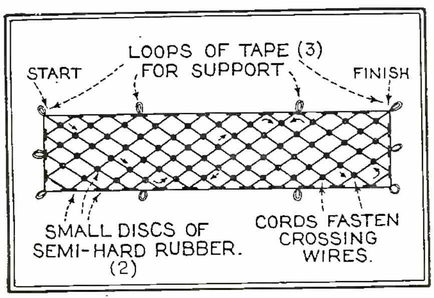
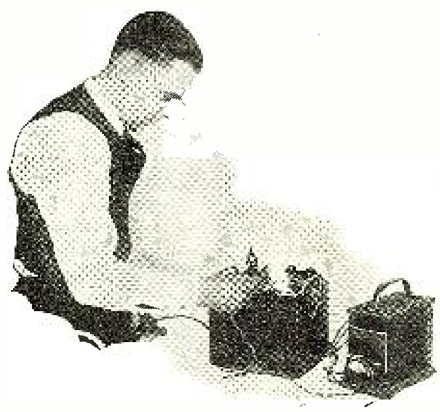


Fig. 3

In charging a storage battery especially so from a d.c. source, always disconnect the d.c. line plug before removing the battery clips from the battery, otherwise you will "pull" an arc which, if any acid fumes are present, might cause a slight explosion



With these points in mind the serious minded experimenter will therefore require a tube similar to the new DeForest 424 a. c. Screen Grid Tube whose characteristics are:

Filament	2½ volts
Control grid	3 volts
Screen grid	plus 90 volts
Plate	180 volts

At the new voltages, the characteristics of this tube—the amplification constant, plate resistance, mutual conductance, plate current and control grid current—are eventually the same as in the old rating. The raising of the Screen Grid voltage compensates for the additional control grid voltage. The advantage of the change is in the fact that an additional 1½ volt grid swing is obtained. With the new rating, the grid voltage can change from —3 to —1, instead of from —1½ to —1 volt, before the tube draws grid current.

Compact-Net Antenna

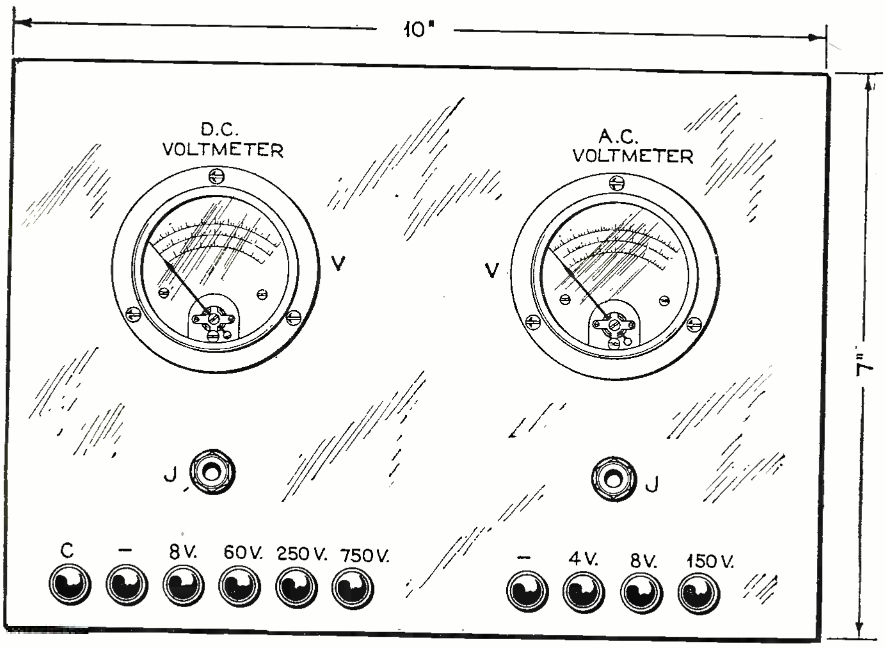
There are undoubtedly many of us who have often wished for an antenna which, when completed, would look like a set of bed springs. Some hesitancy is very likely due because of the sturdy construction necessary in the supporting masts. Mr. D. A. Meeks of Green Forest, Ark., has designed such an antenna which may be mounted flat against a wall, ceiling or in the roof of a motor car, thus eliminating the usual unsightly appearance of an outdoor antenna as well as the hazard of falling masts. Mr. Meeks' antenna, Fig. 3, has the efficiency of a very large loop, the wires crossing nearly at right angles have very little effect in the tuning qualities of the antenna, and permit a wide spacing of the wires within a small area. The complete antenna consists only of a loop of wire, small discs of hard rubber and loops of insulating material for holding the antenna in place. Practical dimensions of the antenna suitable for broadcast receptions are 6 to 8 ft. in length and 8 to 16 inches in width. This size of antenna would require about 100 ft. of wire for construction. The designer of this antenna writes that he has found it unequalled in efficiency by any other type of antenna occupying the same amount of space.

The Serviceman

An Inexpensive A.C.-D.C. Tester

Realizing that a number of the "boys" who are just starting in the service business have not the means to purchase high-priced testing outfits, which they need to make accurate and quick tests of sets and power units, Mr. William H. Kleinberger of Philadelphia, Pa., has designed a testing unit which permits the serviceman to locate 95 per cent. of the trouble in sets and power units quickly and the tester to be described can be made at a very reasonable cost as well as simple in construction.

The unit consists of only two meters, the first being of the high resistance type having a three-scale range with a reading of 0-8, 0-60 and 0-250 volts d.c. The second meter is also of the three-scale range, having a reading of 0-4, 0-8 and 0-150 volts a.c. The meters are mounted on a panel of hard rubber, 7 inches by 10 inches by ⅜ of an inch. Two holes were cut in the rubber panel, 2½ inches in diameter to accommodate the Jewell meter, to accommodate the panel mounting type. Directly below the meters two ⅜-inch holes were drilled for the single circuit short jacks. Eby binding posts are mounted on the front panel also and may be placed symmetrically to suit the constructor's taste. Under-panel wiring, using braidite hook-up wire, made a finished-appearing outfit. The negative lead from both meters is common, so only one wire needs to be used from the negative on the meters to the negative binding post. Let us run the leads on the d.c. circuit meter first. From the negative of meter to the negative of binding post, from 8 volts on meter to 8 volts on binding post, the same with the 60-volt terminal as well as the 250-volt terminal. A second wire starts on the 250-volt terminal of the meter and is connected in series with the 250,000-ohm resistance R, Fig. 1, and terminates at its own binding post. It might be well here to explain the need for this 250,000-ohm resistor. The meter in itself provides a reading of 250 volts, but by the simple application of Ohm's law, we find that the above-mentioned resistor in series with the meter permits a full scale reading of 750 volts, allowing the serviceman to test a power pack of the 210 or 250 type. Of course, a variable resistance could be used, but it would be necessary to have a calibration chart run up for each individual position that the variable resistance is used. We are now finished with the wiring of the binding posts on the d.c. portion of the testing outfit.



The binding post arrangement on the front of the panel of Mr. Kleinberger's tester provides an easy method of testing batteries, transformers, chokes, etc.

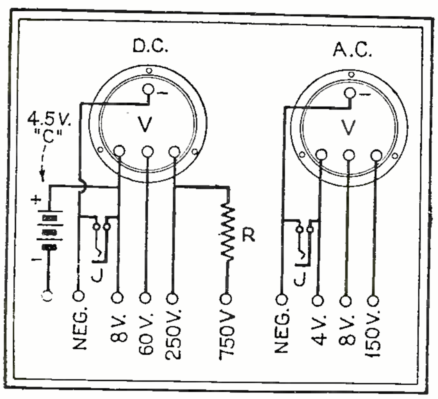


Fig. 1

Next is the single-circuit jack, which is inserted in the negative and 8-volt post of the meter. This jack will be found very handy for providing exact filament voltage readings to each of the tubes of the serviced receiver. This is easily accomplished by making up a cable and an attachment plug, Fig. 2. The attachment plug is a socket of a burnt-out tube and then soldering leads from the filament prongs of this tube socket in connecting the leads to a phone plug. The test is performed by simply removing the tube from its socket, inserting the attachment plug and inserting the plug in either the a.c. or d.c. single-circuit jack. Only three different types of sockets are required for present-day tubes, namely, five-prong type such as used in the 227 and 224, the four-prong type similar to the well-known 201A type, and the third one, the UV199.

For making tests on transformers, coils and condensers, a "C" battery is used in conjunction with the 8-volt scale, and will be found extremely valuable. There is not much to say for the a.c. meter, other than what has already been said for the d.c. meter. The low-voltage taps may of course be used for filament readings, and the 150-volt scale for line voltage. This is extremely important in some localities where the line voltage is variable anywhere from 90 to 130 volts.

The serviceman can expect lots of trouble in the a.c. set where surges are very great. Tubes are said to be no good because they burn out, transformers also go west, being designed for 110 volts and operated considerably over their rated value. Numerous noises, usually referred to as interference, are due to line surges. The conscientious serviceman will readily build up his clientele by installing automatic voltage regulators in districts where line voltage surges occur. In making the leads used for testing, I would suggest using plain rubber-covered stranded wire, either 14 or 16 gauge. The points or probes are fashioned from No. 8 gauge solid copper wire from lengths of ½ to 2 inches long. To these are soldered the stranded leads and taped, but when testing over 100 volts, remember the fingers are apt to be tender, so hold the test leads on the taped portions. A more elaborate testing unit may be constructed by using a d.c. milliammeter along with the two meters of our tester, but for the sake of economy and portability, it was decided in my case to use only the two referred to above.

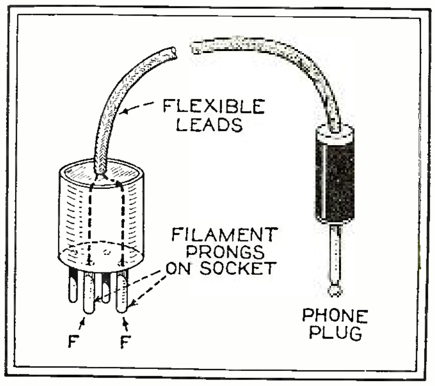


Fig. 2

On Short Waves

A Super-Regenerative S-W. Receiver

In the United States the average broadcast listener who owns and operates a short-wave receiver uses it more as a novelty and does not rely on it for his reception. This is not so in Australia, where the only reliable source of obtaining American broadcasting is by making use of the short-wave receiver. Mr. E. O. Kelly of Adelaide, South Australia, enjoys the American brand of music from American transmitters. So let us repeat just what he has written of his latest short-wave receiver. "I have built a short-wave receiver which, as far as I know, has not been attempted before, and which brings to the fore again my much-maligned favorite—'Super-Regeneration.'

"For the last four years on and off I have been experimenting with supers, so can claim to have some idea of their eccentricities and here is the story.

"The receiver itself is fully screened, being entirely enclosed in a brass cabinet, with the screen-grid circuit isolated from the rest of the receiver. The arrangement of components afford a symmetrical panel layout. The arrangement as shown in diagram being similar to that of the set I have at present. One point about the screen-grid circuit is the use of a midget condenser for tuning. This is, I think, a compromise between the untuned grid circuit and the using of a large condenser for tuning. The midget, whilst making for compactness, does not detract in any way from the efficiency of the circuit, as tuning is uncritical. The unorthodox detector circuit undoubtedly requires a word of explanation. The reason for adopting this circuit was the advantage of smoother reaction control it held over the orthodox arrangement—the reaction being practically identical with the movement of the grid condenser. With the orthodox arrangement, reaction is more or less located as the one spot, irrespective of wavelength. With the ordinary short waver, this would probably not be a disadvantage; the smooth approach to the critical point is, however, more apparent with the super.

"The audio circuit is conventional with the exception of the valve, which is a pentode, whose design permits practically the amplification of two audio stages.

"The last circuit to be treated, the super-regenerative, is one that has been proved. You will no doubt recall that it was a receiver employing just such a S. R. oscillator that took first prize in a competition held by RADIO NEWS some time ago. I have tried every S. R. circuit I could lay hands on, but where this particular oscillator scores is in stability. A point that I notice, however, is that while the plate takes about 35 volts on broadcast waves, on short waves 90 volts seem to improve the oscillation control of detection circuit.

"As far as I can judge, the only components requiring mention are the detector valve and S. R. oscillator valve. The former may be a low-impedance valve and the latter a general-purpose tube. A general-purpose valve will, however, oscillate on lower wavelengths (around 15 meters) better than the power valve, the plate voltage being identical. A semi-power valve in the S. R. stage alters the frequency at which this oscillates and makes the very slight hiss in the speaker even less noticeable.

"The plate coil of screen-grid is wound between turns of grid and reaction coils of detector circuit, that is starting at beginning of grid coil; it finishes at end of reaction coil.

"There is some overlap in wavelength, but as soon as I get sufficient stations to calibrate the receiver I will get the coils to a nicety.

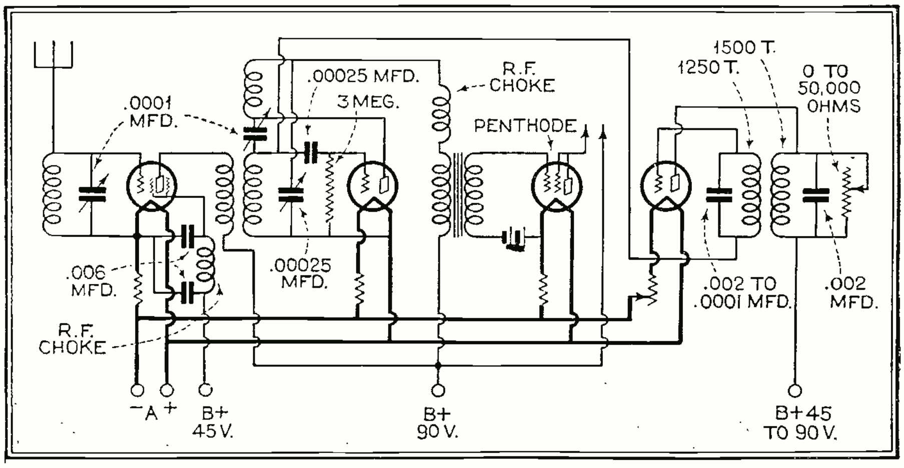
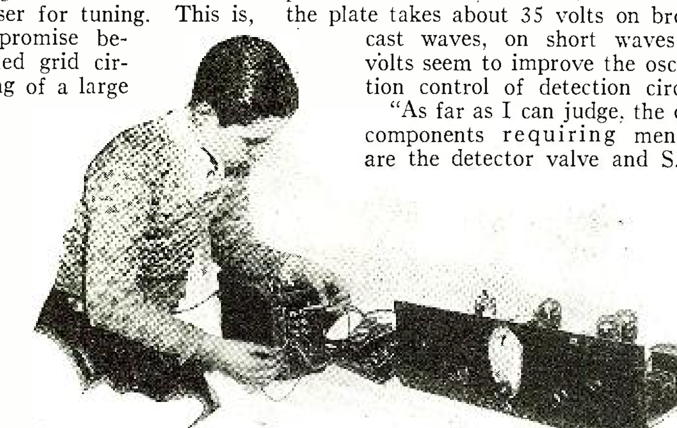


Fig. 1

"The tuning of the receiver is simple and there are several different ways of getting a station. The best method, probably, is to turn off the super rheo., get the carrier wave in the usual way, bring to maximum intensity by means of midget condenser. Then turn super rheo. on, when all trace of carrier will disappear and the station will come in at full strength after slight adjustments. It's like magic, turning on the super rheo., after the usual trouble of resolving a carrier, and there is no such thing as a squeal. A matter of note is that the reaction condenser, instead of 'going over' to the critical point, 'comes back' to it; that is, it operates on the 'other side' of oscillation.

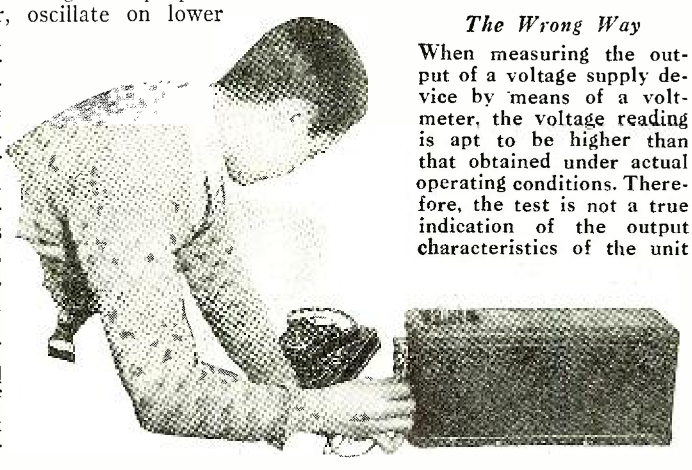
"The performance of the receiver has been most pleasing. For the last three Wednesdays KGO has been brought in on an Atwater Kent speaker (same type as

(*Continued on page 573*)



The Right Way

So that you may know the true voltage output of a B power supply device measure it at the conditions under which it will be used. In other words, connect the receiver to the power unit, turn both on and then measure the voltage output at the various taps



The Wrong Way

When measuring the output of a voltage supply device by means of a voltmeter, the voltage reading is apt to be higher than that obtained under actual operating conditions. Therefore, the test is not a true indication of the output characteristics of the unit

The Trade Announces:

New Equipment and Manufacturing Trends

A Connector Plug of the National Company

As a companion unit to the much used screen-grid grip, the National Company of Malden, Mass., have developed a semi-soft rubber connector plug, as shown in Fig. 1. This handy article will appeal to the experimenter as well as the set

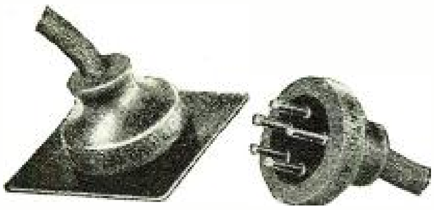


Fig. 1

manufacturer as an inexpensive and exceedingly effective method of connecting a chassis or dynamic speaker field to the power pack, etc. The receptacle fits a standard tube socket of either the four- or five-prong type.

Crosley A.C. Screen-Grid Monotrad

The Monotrad, the first a.c. screen-grid receiving unit of the Crosley Radio Corporation. is the announcement received from Cincinnati. Ohio. Figs. 2A and 2B.

The Monotrad makes use of the new Crosley triple-range control device designed to produce greater sensitivity on

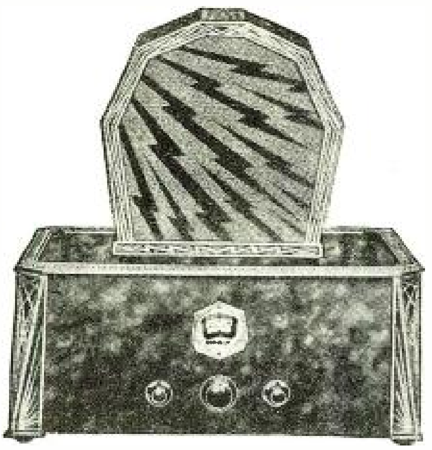


Fig. 2A

distant stations and better quality on nearby stations. The necessary tube equipment consists of two a.c. screen-grid tubes for the radio-frequency stages, two heater type 27 tubes, one to act as a power detector, the other as a first-stage resistance-coupled audio; two 245 tubes in the power push-pull stage and a 280 full-wave rectifier in the "B" unit. The Monotrad employs the patented neutrodyne circuit and the mechanical features are:

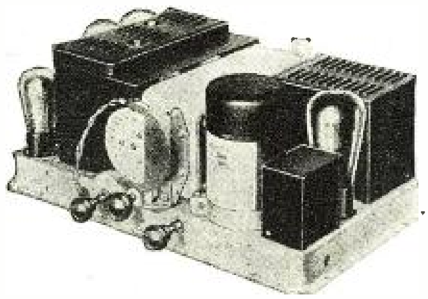


Fig. 2B

Completely shielded gang condenser and illuminated dial, carbon type volume control regulating amplification, a Mershon condenser in the filter system and a metal chassis enclosed in a decorative metal cabinet for use either as a table model or with the addition of legs becomes an attractive end table.

A 245 Power Transformer

A power transformer for use in conjunction with two 245 power tubes is the announcement of the Dongan Elec. Mfg. Co. of Detroit, Mich. (Fig. 3). The trans-

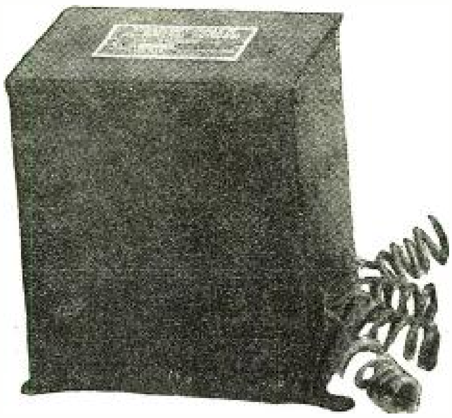


Fig. 3

former is provided with two secondaries of 350 volts each, having a current capacity of 125 mils. as well as low-voltage secondaries of 5 volts 2 amperes, center-tapped for the 280 full-wave rectifier, a 2½ volt center-tapped for the 245 in the push-pull and 2½ volts 10½ amperes center-tapped for the heater type tubes in the radio receiver proper. The transformer is housed in a crystallined finished steel shielding box. Extra heavily insulated leads are provided, insulated from the shielding can by rubber eyelets.

* * *

The Amperite Corporation, formerly known as The Radiall Company, is now located in new and larger quarters at 561 Broadway, New York City.

The executive offices of the Radio Service Managers Association are now located at 1400 Broadway, New York City. where examinations for servicemen and service managers are held daily between the hours of 9 A. M. and 1 P. M., exclusive of Saturdays.

Insuline's Lightning Arrester and Selectuner

The Electrostatic lightning arrester announced by the Insuline Corporation of America provides protection against lightning and static charges as well as acting as a double fuse protection for the radio receiver (Fig. 4). It employs the usual high resistance leak from aerial to ground, offer-

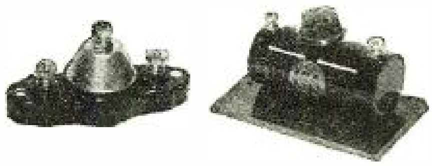


Fig. 4

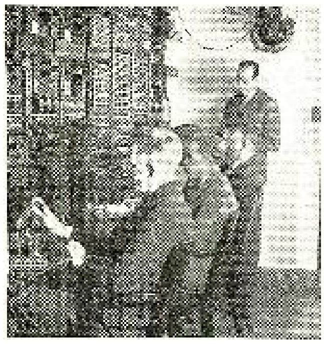
ing the very high resistance to weak radio currents and low resistance to powerful static and lightning discharges. Hence, the high potential currents pass easily to the ground, whereas the radio currents. being of low potential, pass into the set. Static shield, which is a distinctive feature of this arrester, is placed over the ground terminal and is so shaped that it shields the set connection from the electrostatic field set up across the aerial and ground connections by the high-frequency atmospheric electricity. Excessive static is thus passed by to ground. preventing direct sparking between the antenna and set terminals. Choke coil and condenser are also incorporated in the arrester, being connected between the antenna and second terminals. The constants of the coil and condenser have such values that they permit the radio currents to pass into a set unobstructed. yet offer a very high impedance to the static discharges of high frequency. Furthermore. according to Mr. Alex G. Heller, designer of the unit, the additional loading effect produced by the choke coil and condenser tends to make the antenna system more efficient. resulting in increased sensitivity and volume.

A second unit is anonunced by the Insuline Corporation of America in the Selectuner. An inexpensive device that materially aids in cutting through interfering local stations and tunes out conflicting distant stations and at the same time reducing static. The elementary engineering principle employed in the design of the Selectuner is that a tuned circuit will offer infinite impedance to currents of frequency at which it resonates, and will pass all others with little or no attention.

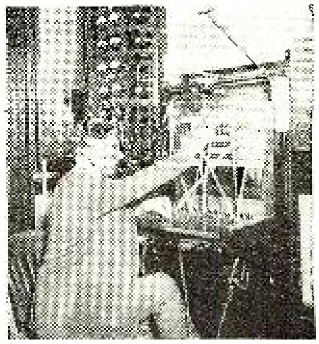
(*Continued on page* 544)

Radio Inspectors $2000 to $4500 a Year.

Radio Operators $90 to $200 a month (board free).



Broadcast Operators $1800 to $4800 a Year.



Radio Repair Mechanics $1800 to $4000 a Year.

Fill one of these BIG MONEY RADIO JOBS

many do it in 9 months!

SAY "Good Bye" to long hours and low-paid work. Pick yourself a big-money job in Radio! Hundreds of men just like you earn from $2,000 to $25,000 a year in this giant world-wide industry . . . It's the livest money-making business of today!

The Whole World is Calling for Trained Radio Men

Broadcasting stations and manufacturers all over the country are eagerly seeking trained men . . . Thousands of ships require experienced operators . . . and now comes nation-wide radio telegraph service, telephony, television, photo-radiograms! . . . Thousands of opportunities like this are waiting for you.

Easy to Learn at Home With This Magnificent Laboratory Outfit

There's no need for you to know a thing about Radio. The Radio Corporation of America sponsors this marvelous, simplified home-training course . . . by means of which you, too, can now prepare for success in every phase of Radio . . . You learn by actual experience with the remarkable outlay of apparatus given with this course . . . learn how to solve every Radio problem . . . such as repairing, installing and servicing fine sets. That's why you, too, can easily have the confidence and ability to hold a big-money Radio job.

Only Course Backed by Radio Corporation of America

The progress of Radio is measured by the accomplishments of the great engineers in the huge research laboratories of the Radio Corporation of America. This gigantic organization sets the standards for the entire industry . . . and sponsors every lesson in the course. That's why graduates of this school are always posted in newest up-to-the-minute developments in Radio. That's why they are always in big demand.

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Free . . . everything you want to know about Radio . . . 50 fascinating pages . . . each one packed with pictures and descriptions about the brilliant opportunities in this fast-growing profession. See for yourself why R. I. A. training has placed thousands of men in well paid positions—usually from 3 to 10 days after graduation. Mail this coupon now and receive your Free Book.

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Gentlemen: Please send me your FREE 50-page book which illustrates the brilliant opportunities in Radio and describes your laboratory-method of instruction at home.

Name..

Address..

A Chassis by Bosch

In Fig. 5 is shown the chassis of the new screen-grid Bosch radio receiver. Several features predominate in this new chassis, the screen-grid tubes and condensers are completely isolated; three a.c.

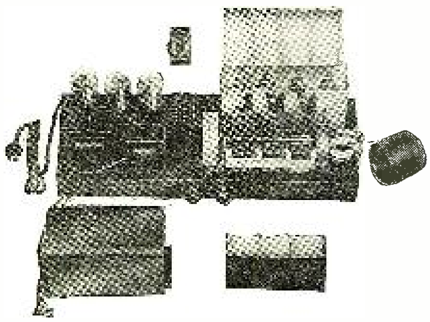


Fig. 5

screen-grid tubes in the radio-frequency circuit; a heater type tube as a power detector; two 245 tubes in push-pull arrangement in the output stage and knife-edge selectivity, due to the correct engineering design of the coils, condensers, type and size of shielding.

A Broadcast by Amplion

A new microphone is the result of the efforts of the engineers of the Amplion Corp. of America to produce a unit unaffected by weather and usage (Fig. 6A). The metal diaphragm and carbon buttons have been eliminated by the use of a narrow molded bakelite channel across the face of the microphone, at each end of which is a carbon electrode, the in-between section being filled by a special imported granulated carbon, held in place by a very thin rubber membrane. The microphone for maximum operation requires about 25 volts d.c. and having an internal resistance of 500 ohms, it passes a current of only 60 mils., making possible an ex-

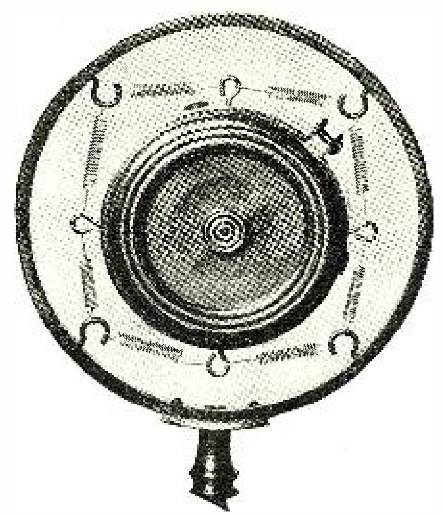


Fig. 6A

tremely high sensitivity. Sounds, according to the Amplion engineers, produced at average voice amplitude can be heard as far away as 60 feet.

To operate in conjunction with the microphone is the Amplion microphone input amplifier (Fig. 6B). It consists of one stage

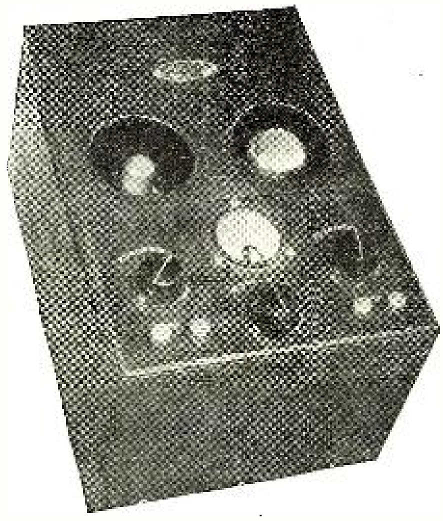


Fig. 6B

of audio amplification, bringing the energy level up to a value equal to a phonograph pick-up. Simplicity of design has been carefully worked out so that only three controls are necessary. One for regulating the voltage, regardless of the fluctuations on the 110-volt, 60-cycle supply line from which the unit is operated. The second control regulates the amount of current that is passed through the microphone, making it possible for the control operator to adjust the pick-up microphone to any degree of sensitivity. The third control is so that any adjustment of volume can be realized from the amplifier, regardless of the sensitivity adjustment.

Fig. 6C

Suitable for the new high quality, large volume amplifier, is the Amplion Giant Dynamic Unit (Fig. 6C). Its distinct and unique features lie in the fact that a double sound chamber is employed, so that both the low and high frequencies are produced off the same diaphragm.

* * *

Among the new chassis for the coming season is the Premier Electric Company's (Chicago, Ill.) offering of five a.c. models and one battery model. The model shown in Figs. 7A and 7B employs three stages of tuned radio frequency, detector and first stage of audio, using the 227 heater type tube, a push-pull stage employing the new 245 power tubes. A full-wave 280 rectifier tube is used in the power pack. The chassis is of an all-metal construction, being one hundred per cent. shielded, and the subpanel is formed from two heavy metal panels on which are mounted all

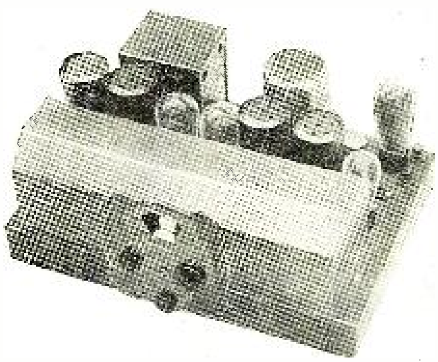


Fig. 7A

associated apparatus, including the two gang condensers which are cradled in a patented mounting, eliminating shipping shocks and jars. The selector control, according to the manufacturer, is single

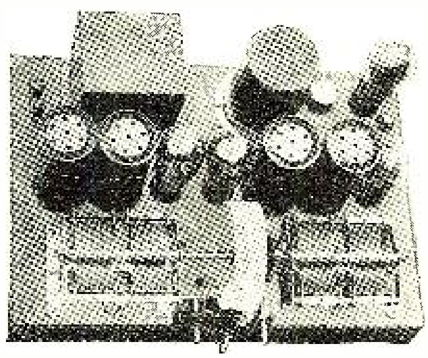


Fig. 7B

control, illuminated, employing a drive with only two working parts, eliminating entirely back-lashing, slipping or jamming. Mershon condenser is used in the "B" eliminator filter circuit.

* * *

Rola Wins Over Lektophone in Court of Appeals

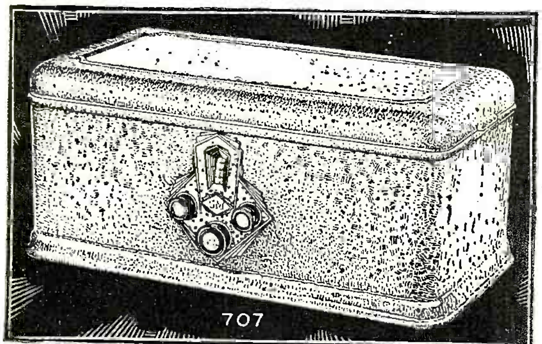
The Circuit Court of Appeals for the ninth circuit has affirmed the decision of the United States District Court for the northern district of California, southern division, which was to the effect that the Rola Company did not infringe the patents of the Lektophone Corporation in the design and construction of their speaker.

In the lower court the Lektophone Corporation of New Jersey sued Rola for infringement on Hopkins' patents No. 1271527 (claims 29 and 30) and No. 1271529 (claims 1 to 8).

In affirming this decision the Circuit Court of Appeals, while not actually declaring the above patents invalid, have interpreted the above claims to be of such limited scope both with respect to dimensions and materials used as to render them of only secondary importance in the art.

SM

New S-M Custom Receiver Designs Shatter All Records

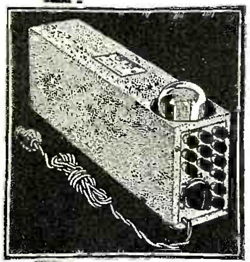


Now the setbuilder can, in truth, have every basic advantage of a receiver built to the latest design from standard parts—and yet, combined with it, all the convenience of factory-built sets, and all the cabinet beauty of the finest furniture.

The 707 Table-Model Shielding Cabinet, shown above, houses either the new 722 Band-Selector Seven or the 735 Round-the-World Six—or its battery-operated counterpart, the 735DC. The 707 is beautifully finished in crystalline brown with gold panel on the removable top. Price is only $7.75. For those who prefer full console cabinets, there are three splendid designs made especially to fit perfectly any of the S-M receivers described in this section. For description of these, see advertisement of I. A. Lund Corporation, page 550.

THEY'RE here—new 1930 designs by S-M which show results far exceeding—no matter how you measure them—the best obtainable last year. That was to be expected—every fan knows that the latest S-M design is always the finest performer to be had in the price class. But this year caps the climax of all S-M engineering history—for the new designs of this year exhibit, in addition to this far better performance, a tremendous new feature: perfect convenience of operation. That includes not only all-electric operation, with built-in power supply, but straight single-dial control—with *no verniers*. By the use of the newly developed series of shielded r. f. coils there is attained a degree of selectivity never before achieved even with multiple controls or verniers. One control now takes care of all tuning, another gives absolute control of volume—and the only other control is an off-on switch!

Smooth Unfailing Power From S-M Units



The setbuilder looking for a power supply that *will not fail* and *will supply smooth current* finds his desires satisfied in S-M power units. Built with that care that makes S-M a stamp of quality wherever found, designed to meet all the requirements of superlative service, S-M units naturally lead the field.

To turn the last stage of your receiver into a power stage using a 210 or 250 tube through the use of an adapter furnished with the wired unit, the 675ABC Power Supply will furnish 425, 135, 90, 22 and variable 22-90 B voltage to receiver, with C voltage, and A power at 1.5 volts, 4 amperes; 2.25 volts, 4 amperes—also 7.5 volts for the power tube filament. Operates from any 105 to 120 volt 50-60 cycle a. c. socket. Tube required: 1—'81. Price, wired, in handsome case 3$\frac{5}{16}$" by 5¼" by 17", less tubes, $37.80. Component parts total $32.97.

Splendidly equipped to handle the new '45 and '24, and '27 and '26 tubes as well, the 669 Unit will supply current to sets having up to 10 tubes. Fixed B voltages of 67, 180, and 220 volts at 100 m. a., C voltages and A power at 1.5 volts, 4 amperes; 2.25 volts, 3 amperes; 2.25 volts, 6 amperes. Handling as it does all modern tubes, the 669 will be your logical choice for power supply. Tube required: 1—'80. Operates from any 105-120 volt 50-60 cycle a. c. light socket. Price, wired, in handsome crackle-finish case 13" by 3½" by 5$\frac{5}{16}$", less tube, $28.30. Component parts total $23.08.

Silver-Marshall, Inc.
6405 West 65th Street, Chicago, U. S. A.

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

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

.... 50c Next 12 issues of The Radiobuilder
.... $1.00 Next 25 issues of The Radiobuilder

S-M DATA SHEETS as follows, at 2c each:

....No. 3. 730, 731, 732 Short-Wave Sets
....No. 4. 255, 256, etc., 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
....No. 8. 710 Sargent-Rayment Seven
....No. 9. 678PD Phonograph-Radio Amplifier
....No. 12. 669 Power Unit
....No. 14. 722 Band-Selector Seven
....No. 15. 735 Round-the-World Six
....No. 16. 712 Tuner (Development from the Sargent-Rayment)
....No. 17. 677 Power Amplifier for use with 712

Name..

Address..

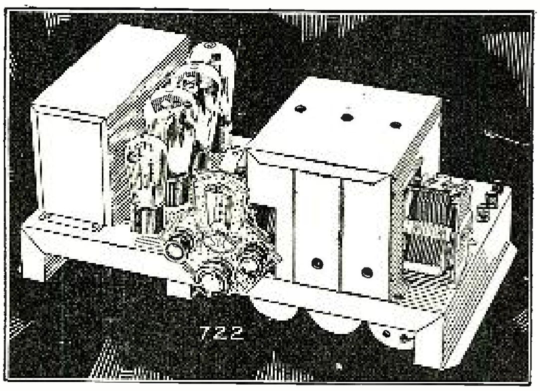
Over 3,000 Authorized S-M Service Stations cover the United States and Canada: Many are profiting handsomely! Write us for the address of the nearest one if you wish a custom-built set: setbuilders write us regarding a franchise in your territory.

"THE RADIOBUILDER" for July gave advance details of the S-M receivers shown on these pages—"THE RADIOBUILDER" has the news on S-M laboratory developments *first*. Hints on operating and building are in every issue—use the coupon!

SILVER-MARSHALL, Inc.

6405 West 65th St., Chicago, U. S. A.

Screen-Grid Power Detection in New S-M Band-Selector Seven



Allied Radio Corporation is proud to present, in conjunction with Silver-Marshall, an all-electric set which, built from standard parts, will far exceed in actual performance any receiver or kit ever before available at any comparable price—and yet which embodies at the same time every important feature of convenience now obtainable in the best factory-built receivers. No engineers in the world know better how to bring out the full potentialities of the marvelous new 224-type a. c. screen-grid tubes than do the S-M laboratories. Into the 722 they have built *three* of these '24 tubes—two in r. f. stages and one as a power detector—*five times as good* in detection as the best heater tubes having no screen grid. There are in all *four tuned circuits* operated by the single illuminated drum dial (with no verniers); the first two form a band selector which delivers into the first r. f. tube only the signal to which the receiver is tuned—its tone purity preserved by a flat-top curve, but with skirts dropping off almost vertically—evidenced by the startling suddenness with which the volume from a strong local station drops off to zero as the tuning dial is turned slightly.

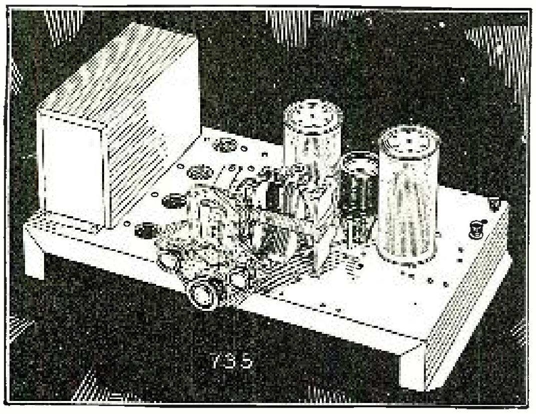
The decidedly higher amplification obtained in the screen-grid power detector makes it possible to use, in the first audio stage, a resistance coupler of extremely uniform frequency characteristic, and this stage, feeding into the push-pull output stage (using two '45 type tubes) provides marvelously perfect tone fidelity.

While the S-M 851 is exactly suited to this receiver, any other high-inductance 90-120 volt d. c. speaker of modern type may be used as well; speaker field excitation is provided from the receiver itself. Tubes required are: 3—'24, 1—'27, 2—'45, 1—'80. Although the ABC power unit is built in and forms an integral part of the S-M 722, the complete assembly measures only 18½ x 9½", and the cost is scarcely higher than that of the famous S-M 720 and 720AC screen-grid sixes of last year which required separate power supply.

Completely wired, less tubes and cabinet, Allied Radio Corporation offers the S-M 722 at $74.75 net to the trade. Our own specially packed parts, following exactly the published list of parts used by Silver-Marshall in building this receiver, total only $52.90 net.

The beautiful S-M 707 table cabinet, in brown and gold crackle-finish, as described in their advertisement on page 546, we heartily recommend at $7.75 net.

The *All-Electric* Short-Wave Receiver



In the 735 "Round-the-World Six", Western Radio Manufacturing Co. and the Silver-Marshall laboratories present *the* superlative short-wave receiver—an *all-electric screen-grid* set covering the bands from 16.6 to 200 meters—and bringing in stations anywhere in that range, in a way that will be a revelation to users of any previously available short-wave receiver.

The *first* a. c. short-wave receiver on the American market, the 735 is easily *first in performance* as well. Newly-designed plug-in coils, a regenerative power detector, a screen-grid r. f. stage, a typically excellent S-M audio amplifier, *built-in* power unit—all these combine with other features to present astounding quality in a remarkably inexpensive and flexible receiver.

The addition of two extra coils (131P and 131Q, costing together only $1.65) cover the broadcast bands, and make the 735 an all-wave receiver. S-M 735—bringing with it all the thrills of short-wave reception—costs, less tubes and cabinet but completely wired, only $64.90. Our own specially packed parts, following exactly the published list of parts used by Silver-Marshall, total only $44.90 net. Tubes required: 1—'24, 2—'27, 2—'45, 1—'80.

735DC, for battery use, price $44.80, less tubes and cabinet. Tubes required 1—'22, 4—'12A. Specially packed parts, $26.80. Either 735 or 735DC fits perfectly the 707 cabinet mentioned above.

Headquarters for the New S-M 712 Tuner and S-M 677 Amplifier

Allied Radio Corporation

Wholesale Radio Distributors

711 West Lake Street Chicago, Ill.

Clip the Coupon for Our New Catalog

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711 W. Lake Street,
Dept. R.N.-12
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Please send at once your new FREE catalog listing S-M parts and kits as well as many other highest-quality radio products.

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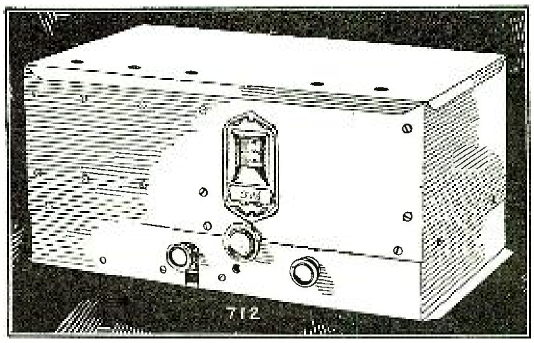
SM

W. C. Braun Co., Official Wholesale Distributors, Offer

Super-Selectivity in The New S-M 712

Better Than The Sargent-Rayment!

Band-Selector, All-Electric, Single-Control



Silver-Marshall engineers, working in the finely equipped new S-M laboratory, tell us that they have produced a tuner even more selective than the amazingly selective Sargent-Rayment 710—one that tests several times as sensitive, and is moreover *all-electric* in operation and strictly *single-control*. New shielded coils, developed by intensive research, are the big factor in the elimination of the stage verniers of the 710.

Uses band-selector tuning between the antenna and the first of the three screen-grid radio frequency stages (a total of five circuits). The 712 not only has selectivity far outclassing anything hitherto obtainable, but the brilliant high notes are marvelously preserved by the band filter in a manner absolutely impossible without it.

Such sensitivity requires far more perfect shielding than ever before necessary, and this has been so perfected that *long distance reception* is possible with only a short indoor antenna—yet when that antenna is removed a dead silence results.

A tuner only, the 712 will feed properly into any power amplifier, but the 677 Amplifier, supplying the only two voltages required by the receiver—180-B and 2½-a. c.—is particularly recommended.

The 712 is supplied ready for use in a metal shielding cabinet 16½ inches wide, 9½ inches deep, and 7⅝ inches high. The symmetrical grouping of controls is placed 9⅛ inches from the left, as the 712 will usually be mounted in a console and center placing is therefore not necessary. Requires one '227 and three '224 type tubes. Component parts total $40.90. Price, as described, wired, in cabinet less tubes, $64.90.

Fourteen Points on the 712

1. Band-Selector Tuning
2. All-Electric Operation
3. Strictly Single Control—No Verniers
4. Three States Screen-Grid Amplification
5. Many Times as Sensitive as the Sargent-Rayment
6. Selectivity with Simplicity
7. Power Detection
8. Built of Standard Parts
9. Gives the Thrills of Distance
10. Most Complete Shielding Ever Attempted
11. Uses New Shielded S-M Coils
12. Five Tuned Circuits
13. Convenience Plus
14. Built by Silver-Marshall

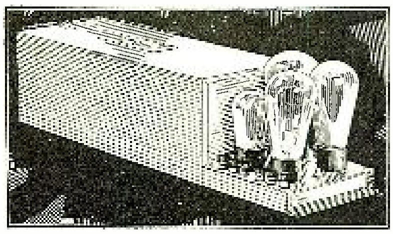
RAPID SERVICE ON ALL S-M PARTS

A complete stock of all receivers and parts illustrated on these pages, together with all parts of the receivers, is on hand ready for *immediate* shipment to fill dealers' requirements anywhere. Our central location and proximity to the S-M factories enables us to render exceptional service. Write on your letterhead or use the coupon below for a free copy of our catalog, and learn about our successful dealer plans.

Official Wholesale Distributors of S-M Products

An Ideal Amplifier For the 712!

That truly superb distortionless amplification, retaining both high and low notes to attain the tone that has helped make S-M famous, is here found better than ever before, and at a cost remarkably small. Particularly adapted to the 712, the S-M 677 is ideal wherever an output of up to 4½ watts, with top-notch tone quality, is required. A special input binding post provides an unusually high ratio, resulting in ideal amplification of phonograph input.



S-M 677 Amplifier

Clough-system audio amplification throughout—the first stage using a 227 tube, and a push-pull second stage using S-M transformers in connection with 245 tubes—gives this 677 Amplifier its powerful undistorted amplification. The power supply, using a 280, provides ample ABC current not only for the amplifier but also 180 volts B and 2½ volts A—sufficient for the S-M 712 or any tuner requiring like voltages. Tubes required: 1-'27, 2-'45, 1-'80. Component parts total $43.40. Price, wired, complete less tubes, $58.50 Net. (Same for 25 cycles $72.50.)

RN-12

W. C. BRAUN CO.
561 W. Randolph St., Chicago.

Dear Sirs: I am not receiving the W. C. Braun Co. Catalog regularly. Please put my name on your mailing list of set-builders and dealers, giving me the prices and information on S-M parts and other merchandise. My letterhead is attached.

Name..

St. & No..

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

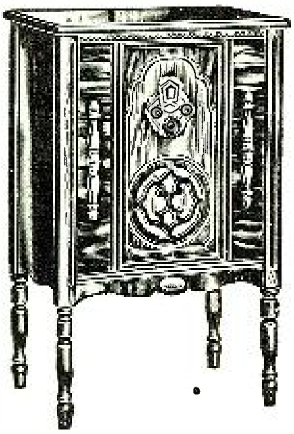
W. C. Braun Company
Pioneers in Radio
561 W. Randolph St.
Chicago
Illinois

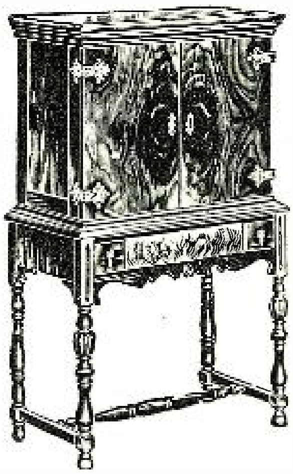
SM

Officially Recommended for S-M Receivers by Silver-Marshall

The Best in Radio—

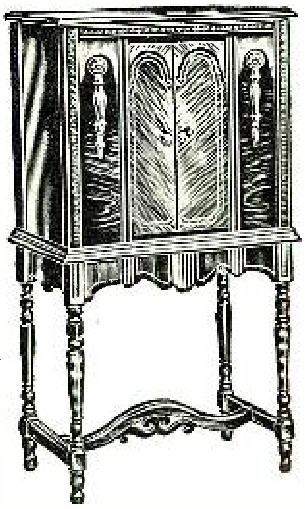
(*Left*)—This beautiful lowboy cabinet is provided with genuine walnut veneer top and side panels, and front side panels of high-lighted, fiddle-back mahogany, all beautifully and harmoniously finished. Overall, 38½″ high, 24½″ wide, and 15½″ deep; set compartment, 9″ by 19½″ by 12½″ deep; speaker compartment, 12″ by 21″ by 12½″ deep. No. 211SM Cabinet, $18, *net*.





The Best in Cabinets—

(*Right*)—Top and sides of genuine walnut plywood, front side panels of walnut with Carpathian elm overlays, and other like overlays on the five-ply "V" matched African walnut sliding doors, contribute to the surpassing beauty of this highboy. Overall 50½″ high, 27½″ wide, and 16½″ deep; speaker compartment, 12″ by 23″ by 13½″ deep; set compartment, 9″ by 23″ by 13½″ deep. No. 217SM Cabinet, price, $30.00 net.



(*Center*)—For combination phonograph and radio use, this walnut cabinet with its butt-walnut full-folding doors is particularly excellent. A sliding drawer for phonograph turntable, pickup, and motor is provided in the speaker compartment, and special provision is made in the lower drawer for the S-M 677 Amplifier. Overall, 54½″ high, 33¾″ wide, and 18″ deep; set compartment, 9″ by 27½″ by 12″ deep; speaker compartment, 12″ by 28½″ by 13″ deep. No. 229SM, price, $56.40 net.

Any of the above cabinets will take the S-M 712 and 677, 735, 722, or 735DC. If your jobber does not handle these special S-M cabinets, write us direct, enclosing 25% deposit if you wish the cabinets shipped C. O. D. (2% off for cash).

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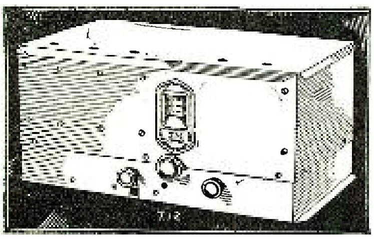
The New S-M 712 Band Selector Tuner



Highest quality—distance, tone, selectivity, and all modern features will be found in this tuner. Gives you results you never before considered possible. Feeds into any audio amplifier, but particularly suited to S-M 677. Get our new catalog and prices and see our complete line of S-M parts and receivers, and our large variety of other high-grade radio materials, as well as the new Screen Grid Receivers.

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Our Stock Number	S-M Number	Name (*Items listed in this section*)	S-M Net Price	Our Net Price
2N-36152	722	BAND-SELECTOR SEVEN (Wired)	$74.75	$73.25
2N-36153	722	Component parts of 722	52.90	51.84
2N-36154	712	TUNER (Wired)	64.90	63.60
2N-36155	712	Component parts of 712	40.90	40.08
2N-36156	735	SHORT-WAVE RECEIVER (Wired)	64.90	63.60
2N-36157	735	Component parts of 735	44.90	44.00
2N-36158	735DC	SHORT-WAVE RECEIVER (Wired, d.c.)	44.80	43.90
2N-36159	735DC	Component parts of 735DC	26.80	26.26
2N-0705	690	AUDITORIUM AMPLIFIER (3 stage)	147.00	144.06
2N-0711	691	AUDITORIUM AMPLIFIER	147.00	144.06
2N-0710	69025	AUDITORIUM AMPLIFIER (25 cycles)	172.00	168.56
2N-0704	679	AUDITORIUM AMPLIFIER (250 tube)	62.50	61.25
2N-0714	677	AUDIO AMPLIFIER (245 pushpull)	58.50	57.33
2N-0716	677	Component parts of 677	43.40	42.53
2N-0715	67725	AUDIO AMPLIFIER (for 25 cycles)	72.50	71.05
2N-07106	678PD	Phono-Radio Amplifier (250 tube)	47.40	46.45
2N-3606	678PD	Component parts of 678PD	39.00	38.22
2N-0103	850	DYNAMIC SPEAKER UNIT (a.c.)	35.10	34.40
2N-0104	851	DYNAMIC SPEAKER UNIT (d.c.)	29.10	28.52
2N-3792	675	ABC Power Unit	37.80	37.04
2N-07108	675	Component parts of 675	32.97	32.31
2N-0709	669	ABC Power Supply for '45 tubes	28.30	27.73
2N-0708	669	Component parts of 669	23.08	22.62

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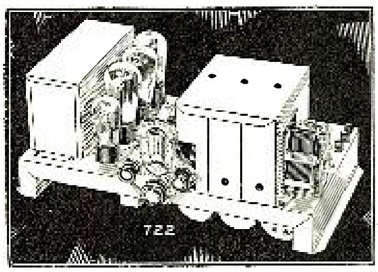

The 712 and the 722 are two of the new S-M receivers of the highest quality—quality that lies in each and every one of their parts, of which the Clough-system audio transformers are a famous example. Prices are remarkably low. Send us your order and get acquainted. Write for our new catalog.

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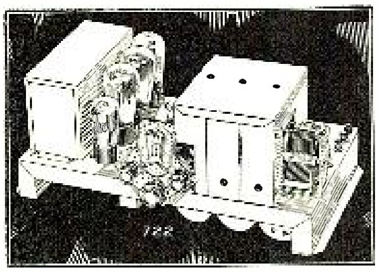
The New S-M 722 Band-Selector Seven

We Handle All S-M Parts



The new S-M 722 Band-Selector Seven, the receiver that is making radio history, is going to make profit and pleasure for you, just as S-M receivers have done in the past. All-electric operation, S-M quality and magnificent engineering design, band-selector tuning, 245 push-pull amplification—this receiver can be expected to be one of the sensations of the year at the low price of $74.75. Component parts total $52.90. Get your order in at once!

Immediate Delivery on S-M 712 and 677

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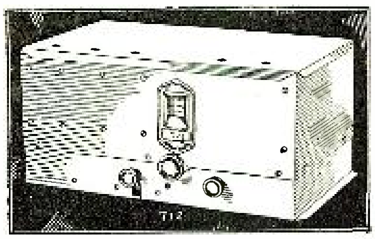
There is a surer index of value than the senses of sight and touch . . . knowledge of the maker's name and for what it stands. Here is the most certain method, except that of actual use, for judging the value of any manufactured goods. Here is the only guarantee against careless workmanship, or the use of shoddy materials.

This is one important reason why it pays to read advertisements and to buy advertised goods. The product that is advertised is worthy of your confidence.

SM Largest Distributors *of* S-M Parts *and* Receivers



On all the S-M receivers and parts described in these pages, as well as on a wealth of other high-grade radio sets and accessories, we are prepared to give immediate, speedy service.

712 Tuner

Far more selective and sensitive even than the Sargent-Rayment 710, the new single-control 712 with band-filter and power detector stands far beyond competition regardless of price. Feeds perfectly into any audio amplifier. Tubes required: 3—'24, 1—'27. Price, only $64.90, less tubes, in shielding cabinet. Component parts total $40.90.

Write for a Catalog

677 Amplifier

Superb push-pull amplification is here available for only $58.50, less tubes. Ideal for the 712. Tubes required: 2—'45, 1—'27, 1—'80. Component parts total $43.40.

Western Radio Manufacturing Co.

The Big, Friendly Radio House

128 West Lake Street Chicago, Ill.

The New Voice of Education

(*Continued from page* 516)

describes his work in the power amplifier installation field as follows:

"Since September, 1926, I had been building up a retail radio business. In December, 1927, the owner of the Northampton Apartment Hotel, a Mr. W. B. Eldred, bought a radio from me for the lobby of his hotel.

"A short time later, Mr. Eldred told me he intended erecting another hotel and wanted a radio in every room. There was no such installation in Chicago at that time, so I took several trips to other cities to look at and study such work, and to gather data.

"In March, 1928, I made him a price, and in July when work began on the building he gave me the contract, which called for one channel, with 92 outlets. This was completed in December, when the building was ready for occupancy.

"Just before completion, Mr. Eldred decided he wanted his guests to have a choice of two programs. Several radio and telephone engineers worked with me to plan out the double channel system theoretically, to eliminate cross-talk, but there was a slight presence of it anyway. It then took three weeks' hard work studying and experimenting from a practical standpoint to absolutely eliminate this cross talk.

"Everything seemed to be satisfactory then, until one guest wanted a great deal of volume and another would want only a little volume. In June of this year we started putting in individual volume controls, which also defied theory and took four weeks to perfect to where they did not affect the rest of the speakers or the tone quality.

"Mr. Eldred and his guests are now satisfied in every respect, and enthusiastic about the results. Mr. Eldred wants my installation on two more contemplated projects, using three channels, and with speaker and switch and volume control in a single wall unit."

Those who read the article of this series which appeared in the last issue (October) will remember the photographs which appeared there showing views of Mr. Baumann's installation at the Lake Lane Hotel.

Unusual Ways in Which Sound Amplification Has Served

Up to this point this series of articles has concerned itself largely with amplifier systems employed in the reproduction of broadcast, phonograph and voice inputs. There are other uses for amplifier equipment not usually thought of. One interesting example, for instance, is found in the recent theatrical production of Eugene O'Neill's play, "Dynamo." In one of the scenes of this show a model of a huge dynamo was on the stage as part of the scenic effect. To lend reality to the production it was desired to make the sound of an operating dynamo emanate from this dummy model. This was accomplished with the utmost success

(*Continued on page* 566)

A Universal Meter

(Continued from page 532)

are connected across the part of the circuit of which it is desired to measure the voltage.

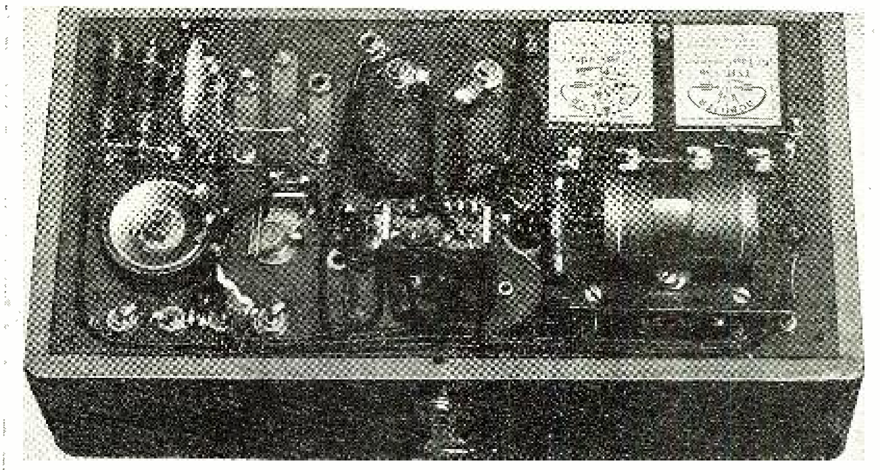
The vacuum tube voltmeter is the most versatile instrument known to the radio art and the experimenter will find many uses for this instrument as he becomes adept in its use. One of its most useful applications, especially to the service man, is the alignment of the tuned circuits of a single control receiver. If an output choke and condenser or output transformer is used in the plate circuit of the last audio tube, the input posts of the vacuum tube voltmeter are connected directly to the loud speaker terminals. If not, a blocking condenser must be used in series with the grid and a grid leak connected across the input posts of the vacuum tube voltmeter.

An oscillator is connected to the antenna and ground posts of the receiver or a local signal tuned in. The volume control is adjusted so that the reading on the meter of the vacuum tube voltmeter is a little above zero. The condensers are now adjusted by means of the trimming condensers or by bending the rotor plates so that the maximum reading is obtained on the vacuum tube voltmeter. The tuned circuits will now be in resonance, as the maximum output is being obtained due to the fact that all of the tuned circuits are in alignment. The trimming condensers should be turned until the reading on the vacuum tube voltmeter rises to the maximum position and starts to drop off. They are then turned back until the maximum point is again found. This is done to assure that the actual resonant point is crossed.

The Frequency Meter

As the input resistance of the vacuum tube voltmeter is very high, it may be used with a coil and condenser combination to give very sharp resonance readings. The coil and condenser are simply connected across the input binding posts of the vacuum tube voltmeter. As there will be the greatest voltage present across the coil at resonance with the exciting circuit, the maximum deflection on the vacuum tube voltmeter will indicate the resonance point. The coil and condenser used with the frequency meter is a General Radio 250 mmfd condenser with six interchangeable coils to cover a frequency range of 30 megacycles to 500 kilocycles. The condenser is mounted in a case of the height and width of the vacuum tube voltmeter and has the binding posts spaced to correspond with the input posts on the vacuum tube voltmeter, thus providing very short connecting leads.

Calibration of the frequency meter may be accomplished very easily by tuning an oscillating receiver to zero beat frequency with some transmitting station of known frequency. The frequency meter is then coupled to the receiver by putting the coils in inductive relation or by means of a radio-frequency feed line consisting of a twisted pair of wires about four feet long with a loop of several turns on each end of the twisted pair. The point of maximum response on the vacuum tube voltmeter is the resonant frequency. For greatest accuracy, the coupling to the frequency meter should be loosened to a point where the meter indication is barely



This rear or "inside" view of the Universal Meter gives a clear idea of its construction and assembly

discernible. This method is also very valuable in checking the frequency of a receiver transmitter.

The Tube Tester

The tube tester uses essentially the same circuit as the vacuum tube voltmeter but as the plate current of the tubes will be considerably higher than one milliampere, two external shunts with ranges of 0-10 and 0-100 milliamperes are mounted on General Radio plugs. They fit into General Radio jacks at the points marked 1 and 2 on Fig. 1. The filament and grid voltages used on the tube may be read by means of the push buttons but an external meter is necessary for the plate voltage. The voltmeter jacks on the d. c. side of the switch may be used if the negative B battery is disconnected from the negative A battery whenever the plate voltage is checked.

As the potentiometer gives a variation of 5 volts C bias, a quick check on the mutual conductance of the tube may be had by swinging the potentiometer from the negative to the positive side and noting the change in plate current. The negative C bias should be of such value that the mutual conductance thus obtained will be the mutual conductance of the tube under normal operating conditions. For instance, a 201A tube uses a

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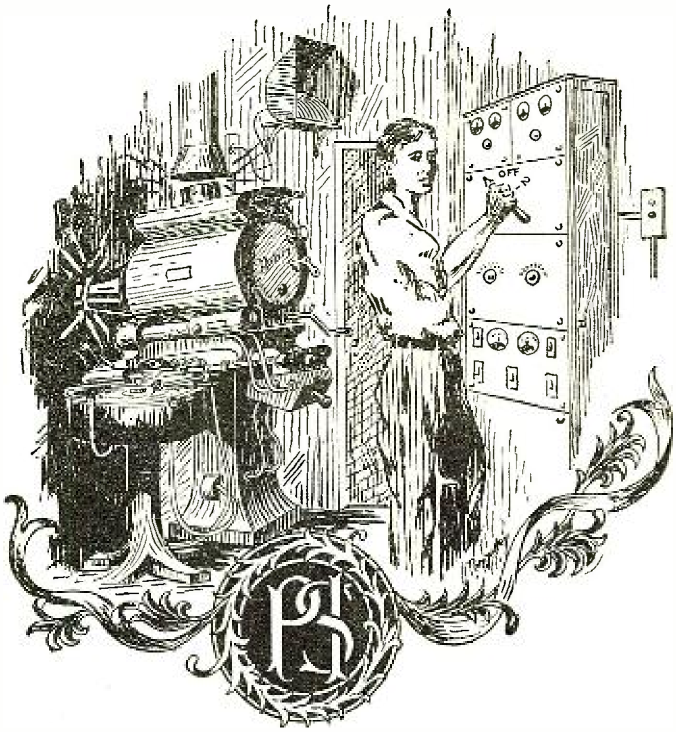

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Our course on Sound Projection which is prepared by the most eminent authorities on Electrical Acoustics will qualify you for a Profession whose place in the engineering world is second to none. All of the available knowledge of the art and the underlying fundamental principles of sound is given to you in an everyday, plain-talk language, as well as two weeks' practical training in the operation, servicing and installation of Sound Equipment.

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In the 20,000 theatres throughout the United States and Canada, which now employ approximately 50,000 projectionists, it is estimated that a very small per cent of this number are qualified to fill the position as Sound operators. Many thouands of new men will have to be taken into this field as fast as the many thousand unwired theatres are wired for sound as the additions of sound doubles the number of operators required. This condition will create many thousands of positions at salaries up to $200.00 per week.

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negative 4½ volt bias and a plate voltage of 90. The negative C battery connected to the tube tester in this case should be 7½ volts. The potentiometer will then give a change of 2½ volts both negative and positive from a value of negative 5 volts, as the point of zero grid is taken from the negative filament and the potentiometer gives a variation of 5 volts from negative to positive filament.

The change in plate current divided by the corresponding change in grid voltage is the mutual conductance of the tube. If a change of five volts grid gave a change in plate current of five milliamperes, the mutual conductance would be .005 ÷ 5 = .001 ohms, or 1,000 micro-ohms mutual conductance.

A very quick check on the amplification factor of a tube may be had by using the tube under actual operating conditions, say 90 volts plate and negative 4½ volts grid, note the plate current and increase the plate voltage to 97½ volts by connecting a 7½ volt C battery in series with it. Now bring the plate current back to its

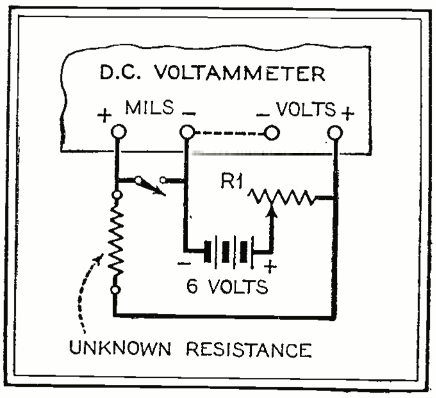


Fig. 6

original value by increasing the negative C bias. The amplification factor of the tube will be the change in plate voltage (7½ volts) divided by the difference between the two C voltages. If the values of plate current and change in C voltages are too small to be read accurately, a larger change in plate voltage, say 22½ volts, can be used, but the smaller the change in voltages used, the more accurate will be the result, as the smaller changes more nearly approximate actual operating conditions such as would be experienced with a signal voltage.

The plate impedance can be found from the figures obtained above by dividing the change in plate voltage (7½ volts) by the difference between the plate currents for the two different plate voltages. If the change in plate current was .001 amperes, the plate impedance of the tube would be 7.5 ÷ .001 which equals 7,500 ohms plate impedance.

The Multi-Range Voltmeter

Credit is due to G. F. Lampkin of the General Radio Company, for the ingenious arrangement of the d. c. shunts and multipliers. The General Radio jack and plug system makes it possible to easily shift from one range to another or to read both the current and voltage in a circuit.

The shunts were constructed by cutting a piece of the proper size of resistance wire, wire from an old fixed resistor will do, to as near the right value as possible. The wire is then either tinned with solder or scraped with a knife until its value agrees with that of a standard meter connected in series with it.

The multipliers for the 100 volt and 1,000 volt ranges are wire wound resistors and will dissipate one watt. The multiplier for the 10 volt range was wound with No. 40 D. S. C. Advance resistance wire to a resistance of slightly over 10,000 ohms and then the wire was removed until its reading checked with that of a standard meter.

The experimenter can usually find a standard meter or meters with which to calibrate his d. c. voltmeter and milliammeter at his radio dealer or at the local high school or college.

This voltmeter can be used any place that a d. c. instrument is required and due to its high internal resistance as a voltmeter (1,000 ohms per volt) it can be used to check the voltages the load current of the unit. The connection of Fig. 6 can be used for checking the output of B power supply units. The variable resistance is adjusted until the desired current is indicated on this milliammeter, the General Radio plug is then shifted to the voltage scale and the single pole switch, S. P. closed. The voltage indicated will be the voltage with the load current just measured.

Another useful application of the system is the use of the voltmeter as an ohmmeter. Resistances above 1,000 ohms can be measured by noting the IR drop in voltage due to the current being taken by the meter flowing through the unknown resistance. The proper voltage for the range to be used is connected to the voltmeter and the voltage noted. The unknown resistance is then connected in series with the voltmeter and the new voltage noted. Designating E1 as the voltage of the battery and E2 as the voltage read through the resistance, the unknown resistance Rx may be found from the equation

$$Rx = \frac{R\ (E1xE2)}{E2}$$

in which R is the resistance of the voltmeter.

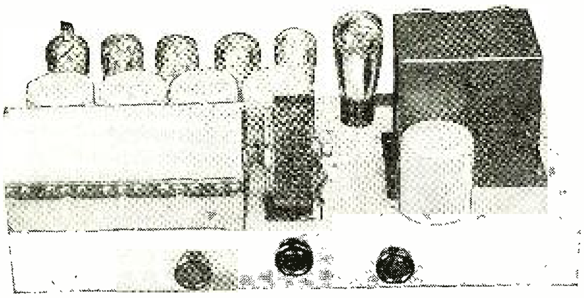
The 0-1-volt range can be used for measuring resistances from 1,000 to 90,000 ohms. The 0-100 volt range can be used for measuring resistances of 10,000 to 900,000 ohms. If the voltage is available, the 0-1,000 volt range can be used for checking resistances up into the megohms.

Radio Industry Needs Service Men

THE radio industry requires thousands of trained radio men to handle its servicing problems. In fact, mass production and volume sales of radio sets have given rise to a serious service problem. Radio sets must be serviced out in the field, and that requires trained men. The large radio manufacturers now have scouts looking for the necessary men in all large centers of the country.

A Familiar Name WORKRITE Since 1909

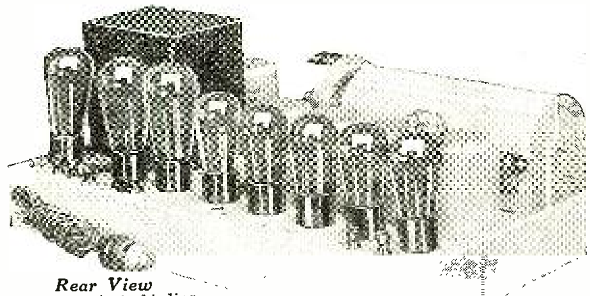
DEALERS! AGENTS!



Front View

An attractive arrangement of especially selected parts showing engineering skill, forethought and experience. Sizes of chassis: 20" long, 10" deep.

Designed by
George W. Walker
LIST PRICE
$89.50



Rear View

Note convenient binding post arrangement: 110-120 A. C. voltage regulator switch; phonograph pick-up jack; speaker pin jack; arrangement for use of either A. C. or D. C. dynamic speaker. Convenient Straight-Line Tube arrangement.

Performance — It Means Everything!

The Name WORK-RITE Is Your Guarantee

20 years of manufacturing experiences, 8 years of which are in Radio, permit the production of this chassis at a price within reach of all. A comparison with other receivers selling at more than double our price will only convince you further of the value each Workrite chassis represents. We doubt whether a better chassis is possible to produce.

Performance was the primary consideration in the design of this chassis by George W. Walker. Costs of material were secondary. All the latest features known to the radio field are incorporated in this unusual receiver.

A RADIO UTILITY AND ENTERTAINER

$16.00 GEORGE W. WALKER **"MULTI-UNIT"** **$16.00**

A Device with a Dozen Uses

Short Wave Receiver — Short Wave Adapter
Regular Broadcast Receiver
Screen Grid Pre-Amplifier — R. F. Oscillator
Extra Stage of R. F. or "Booster"
Radio "Experimental" Unit
Crystal Receiver — Wave Trap — Wave Meter

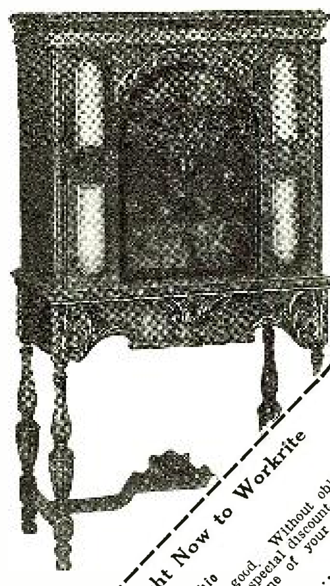
One of the most unusual radio instruments ever devised. Will perform any individual function of a complete receiver, and in addition may be used for calibrating, testing or checking. Makes a wonderful broadcast receiver, short wave receiver or transmitter. Oscillates violently over the entire scale range from 550 meters down to 15. Uses all tubes 199 to 210 and all voltages, A.C., D.C., or rectified. Nothing like it ever placed on the market before.

A WORD TO THE WISE

The inexperienced radio dealers and agents are flocking to purchase cheap and inferior quality receivers—swayed by the many alluring advertisements offering receivers revolutionary in performance at given-away prices. Some manufacturers are striving to substitute parts and accessories entirely unfit for long life and satisfaction—merely to meet this cheap competition.

Nothing will destroy confidence more quickly than a dissatisfied customer. Nothing will destroy the future of Radio and its possibilities more quickly than encouragement to purchase questionable radio merchandise. To avoid replacing receivers to collect payment; to avoid exhausting your profit in free service work; to avoid a loss in keeping cheap merchandise sold—to avoid GRIEF—buy a certified radio chassis. Certified by the trade mark established in 1909—WORKRITE—Cleveland's first radio receiver manufacturer. Pay more for your chassis—a WORKRITE is worth a few extra dollars. Insure yourself a reasonable profit and a satisfied customer. Establish good-will in your business and profit thru future transactions. Remember, the WORKRITE chassis is built to perform—not to a price.

Order a sample. Examine closely the parts used in the WORKRITE chassis; inspect the efforts of skilled workmen; note the fidelity in tonal quality; the selectivity in cutting thru powerful local interference; the ease in tuning far distant stations—then compare this chassis to the highest priced receiver in the market. If it is not all that we claim, return it to our factory—your money will be refunded immediately. You risk nothing.



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Gentlemen: Your plan sounds good. Without obligation to me send complete details and special discount sheets at once for I want to become one of your thousand specially selected sales agents.

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My Address ....
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PRINT NAME AND ADDRESS PLAINLY

The Work-Rite Radio Corp., Cleveland, O.

Performance WORKRITE Means Everything

For resistances under 1,000 ohms, the best method to use is the volt-ammeter connections shown in Fig. 6. The variable resistance is adjusted until some convenient current is obtained. The General Radio plug is transferred to the 0-10 volt range, the single pole switch closed and the reading on the voltmeter noted. The resistance may be found from the Ohms Law equation,

$$R = \frac{E}{I}$$

This article covers but a few of the numerous uses which the experimenter will find for this instrument after he becomes more familiar with its operation and possibilities.

When Camera Meets "Mike"

(*Continued from page 505*)

Close-Up Offers Better "Mike" Placement Possibilities

The great advantage of the picture close-up in speech pick-up is shown in Fig. 2, which is drawn to a scale twice that of Fig. 1. The camera has been moved to within 19 feet of the back wall, and the focal plane is now 15 feet from the lens. The camera height remains at six feet, as before, but it has been tilted forward at a 10-degree angle. The optical triangle with which we must deal, ABC, has an angle at the apex A which is not much less than in the long shot (20 degrees instead of 28), but, as the business of the scene proceeds much nearer the apex, everything is more favorable for sound. (The above photographic figures should not be taken too literally; they are intended only for illustrative purposes.) The camera field includes the heads and torsos of the actors, the upper line being some two feet over their heads (EF). A good pick-up position is available at G, out of range of the camera, fairly close to the direction of speech, and only four feet from the source. The only drawback is that G lies no more than 12 feet from the camera, and if the latter is not well silenced objectionable camera noise may be picked up. This is always a possible difficulty in close-ups, but the camera manufacturers have made notable progress in quieting their machines by judicious substitution of fibre gears engaging with metal ones, and similar measures. Of course in extreme cases the camera and its crew may be put in a sound-proof booth, but this practice interferes so much with effective photography that it is being discouraged in most of the studios. A well-silenced camera is usually safe to within ten feet of the microphone, when the speech level is not too low, and up to this point it may be trucked and manoeuvred to get cinematic effects which nobody who knows anything about picture-making wants to sacrifice.

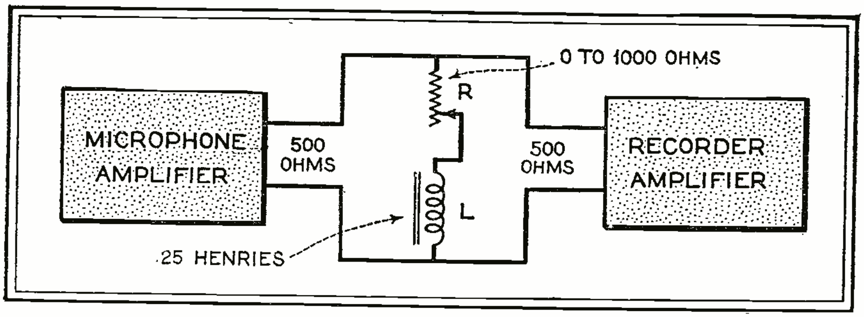


Fig. 3

Of course, just as in Fig. 2 the camera view slides past the microphones just below their location, it is sometimes possible to use the same expedient laterally. If the shot cuts to one side of the actors within a foot or two, a microphone may be placed outside of the camera field, but close to the speakers, who should favor it somewhat in working. Usually a transmitter in this position must be closer to the actors, for a given quality of pick-up, than one overhead, because it is not so easy to center it with reference to a number of persons in the scene.

In the usual picture practice the long shot of Fig. 1 and the close-up of Fig. 2 would be taken simultaneously, the cameras being appropriately placed out of each other's field. They may be three batteries of two cameras each, taking close-up, medium, and long shots respectively, all on one take. This saves time, and gives a wide selection of shots for editing, but it has grave disadvantages from the sound viewpoint. Returning to Fig. 1, assume that the action contains some shouts, the intelligibility of which is not important, followed by sustained dialogue which should be clearly recorded. The director may take his long and close shots simultaneously, with the sound pick-up at G (Fig. 1), which will be satisfactory for the shouts but result in poor reproduction of the dialogue. If it is not feasible to use a prop pick-up (I donate this term to the industry with a graceful flourish, as a fitting name for a microphone concealed in a piece of stage property) it would be a better procedure, from the standpoint of sound, to take the long shot with the 18-foot pick-up for the shouts, and then move the pick-up to G in Fig. 2 before photographing close-up. Most of the directors have already learned that it is better to follow this procedure, even though it takes a little longer.

Sound Engineer's Job Not a Simple One

The skilled sound engineer utilizes a great many expedients, based on common sense and a knowledge of practical acoustics, in carrying on his job. Since the major defect of dialogue pick-up is loss of high-frequency tones, he prefers to work with a slightly tubby loud speaker, simulating the decrease in high-frequency amplitude which is common in theatre reproduction, and avoiding the psychological illusion of good intelligibility which a tinny loud speaker would produce. He avoids closed sets, especially with parallel walls, knowing that flutter echoes prevail in such enclosures and that resonances in them favor the low, boomy notes. At times he places heavy damping in back of the microphone, as in the German broadcast "tent" or in American broadcast practice, but at distance of 10-18 inches, since putting the transmitter close to a cushion or other absorbent is likely, again, to result in loss of the upper frequency range. When possible he picks up with a single transmitter, but if the action requires it he distributes a plurality of microphones and follows the actors with the mixer. Between live sets and dead he will sometimes choose the one and sometimes the other—or, in other cases, take what the scenic director gives him. But he will object strenuously to curved surfaces whose radii intersect in the region of pick-up, because of the difficulties caused by regular reflection in this range. He avoids placing microphones on floors, and in walls, corners, or enclosures, because of the accentuation of low frequencies in such locations. Most microphones respond proportionately to sound pressure, and their size is such that at the higher frequencies a desirable pressure doubling occurs before the diaphragm when the instrument is in free air, whereas when it is near a large surface the low notes are similarly reinforced and the advantage of the high tones is lost. And of course chamber resonances usually favor the lower part of the range, which is desirable in musical pick-up but can be well dispensed with in speech reproduction.

When the exigencies of pick-up compel the resourceful sound expert to place a microphone in such a position—and this applies to prop pick-ups frequently enough to be worth noting—he attempts to simulate a free-air pick-up by resorting to electrical filters. Fig. 3 shows an example of this device. Here the 500-ohm output of a microphone is connected to an amplifier input which matches its impedance. Between the two a 0.24 henry choke, controlled by a resistance in series, has been connected. The coil has a resistance of about 150 ohms at 100 cycles, 1,500 ohms at 1,000 cycles, etc. Obviously any tubbiness in the output of the microphones, caused by unfavorable acoustic conditions in the pick-up, may be remedied, at least partially, by adjusting the resistance to a suitable value. With all the resistance out, practically everything below 100 cycles is eliminated, with considerable effect up to about 600 cycles. With all the resistance in, the effect of the shunt is negligible. Alternatively, the inductance alone, with its internal resistance, may be changed to secure the desired effect.

The sound engineer worth the name does a good many things like that with his inductances, capacities, resistances, and other gadgets. What with these toys, and his job of educating the directors and producers and, equally, being educated himself, he is kept busy. Sometimes he is not only busy, but unhappy. But he isn't bored.

A D.C. Line Receiver

(*Continued from page 502*)

first audio stage does demand filtering, but the current consumption is so reasonable that a very simple filter will suffice. The plate filter consists only of one 30-henry choke and a 2-mfd. condenser. Fig. 1E should be consulted at this point. There is practically no current drain in the plate of the detector because of the high plate resistance of 2 megohms. The current of the other tube is easily handled through a cheap choke designed to carry not over 20 mils. How much better it is to locate the exact source of noise and filter it than to blindly apply a blanket filter on the whole circuit and tolerate needless expense and trouble!

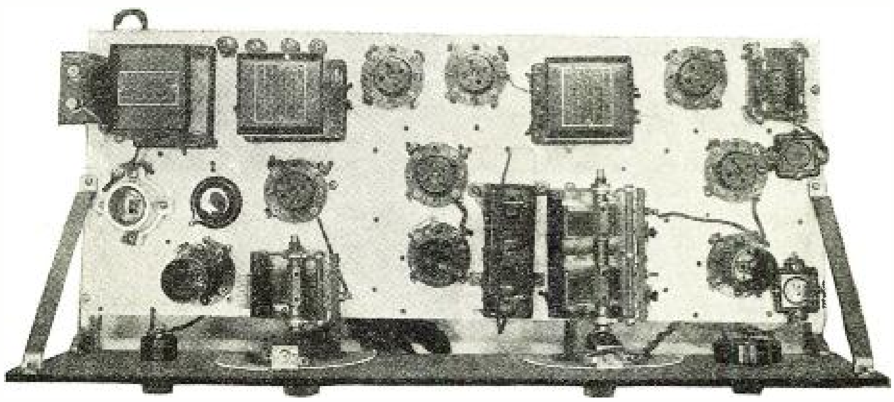
A Few Precautions

There are one or two points which should be thoroughly understood or trouble will be encountered. *The ground on the antenna primary coil should be kept entirely free from any connection to the rest of the set.* Sometimes the d.c. power line is grounded on the negative side and sometimes on the positive side. This is done at the power house and does not interfere with your radio reception under any condition. But, if the ground at the receiver is connected to any other part of the circuit than the antenna primary coil, trouble aplenty will occur. To be brief, there will be fireworks and then more fireworks accompanied by plenty of spot welding. Keep this ground separate, as shown in Fig 1B, and the set will operate with less excitement.

Another point concerning which care must be exercised. *Do not remove any tubes from the sockets without first shutting off the power to the set.* If a tube is removed without cutting off the current, the filament of the other tube in the multiple connection will generally burn out. This is the only possible objection to the whole layout, but care in this respect will obviate any difficulties.

The Complete Circuit

The complete circuit of the receiver, as illustrated in the photographs, is shown in Fig. 2. The photographed receiver has a combined condenser control on the second radio and detector stages. This combined, or double, condenser has a common grounded shaft so that the grid returns, if connected to this shaft, would both have to go to the same place in the overall circuit. Since the grid returns cannot go to the same place because different biases are required, some expediency must be adopted. This is shown in the complete circuit diagram. The secondary of the coil which feeds into the grid of the detector does not connect directly to the rotor of the tuning condenser but returns through a relatively large by-pass condenser. This condenser passes the radio-frequency tuning currents, but prevents any direct current connection. The coil return may thus be taken to any part of the circuit for the proper potential without interfering with the radio-frequency circuits. The complete diagram also shows the option of 50, 60, or 75-watt lamps in the filament circuit. It is best to try out several until the proper potential of five volts is noted across each respective group of filaments. This will



A top view of the receiver

depend on line voltages in each community.

PARTS LIST

Two illuminated dials, No. 1276.
C1 Single compact .00035 mfd. variable condenser, No. 1701.
C2, C3 Double compact .00035 mfd. variable condensers, No. 1702.
C4, C5, C7 Fixed mica condenser, .015 mfd., No. 60.
C6 Fixed mica condenser, .002 mfd., No. 54.
C8 By-pass filter condenser, 2 mfd., No. 9302.
T1 Push-pull input transformer, No. 408.
T2 Push-pull output transformer, No. 409.
L1, L2, L3 Twin coupler plug-in coils, No. 176.*
L4 Choke coil, No. 337.
R1 10-watt rheostat, No. 910.
R2—100,000-watt volumgrad, No. 941.
R3, R4 Pilotohm 2 megohm grid leaks, No. 756.
SW1 Power switch, No. 44.
Nine four-prong solid sockets, Universal, No. 216 (6 for tubes—3 for plug-in coils).
Four binding posts, Antenna, No. 20; Ground, No. 21; loud speaker (L.S. No. 19, L.S. No. 32).
Mounting for resistance coupling, No. 501.
One foundation unit, consisting of brackets, subpanel, front panel, hardware and wire, for Grimes D.C. New Yorker.

*Excepting where specified, the above parts are manufactured by Pilot Radio and Tube Corp.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.
Of RADIO NEWS, published monthly at Jamaica, N. Y., for October 1, 1929.

State of New York, }
County of New York, } ss.

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared Arthur H. Lynch, who, having been duly sworn according to law, deposes and says that he is the Editor of the RADIO NEWS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, EXPERIMENTER PUBLICATIONS, INC., 381 Fourth Avenue, New York, N. Y.; Editor, Arthur H. Lynch, 381 Fourth Avenue, New York, N. Y.; Managing Editor, W. Thomson Lees, 381 Fourth Avenue, New York, N. Y.; Business Manager, H. K. Fly, 381 Fourth Avenue, New York, N. Y.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) EXPERIMENTER PUBLICATIONS, INC., 381 Fourth Avenue, New York, N. Y.; B. A. Mackinnon, 381 Fourth Avenue, New York, N. Y.; H. K. Fly, 381 Fourth Avenue, New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

ARTHUR H. LYNCH, Editor

Sworn to and subscribed before me this 24th day of September, 1929.
(Seal.) Joseph H. Kraus.
Notary Public, City of New York.
(My commission expires March 30, 1931.)

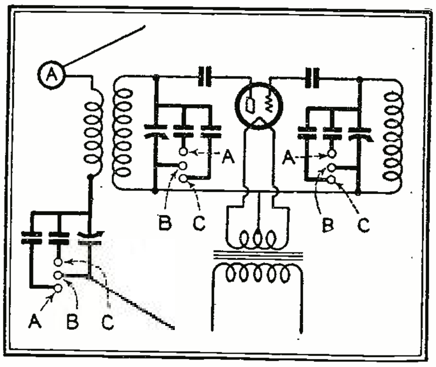
Building a Short-Wave Transmitter

(*Continued from page* 529)

In an oscillator it is possible that ultra-radio frequencies will be produced unless the small chokes, L2, L3, are connected in series with the grids. These parasitic oscillations may cause unnecessary heating and constitute a waste. A 20-turn winding on a ½-inch tube, tapped at the center and connected as in the diagram, Fig. 1, should effectively prevent any such possibility from becoming a reality.

Coupling the Antenna to the Oscillator

It is very important that the proper coupling between the oscillator and antenna be employed. Too little attention is given by the average fan to the coupling used. The method used in obtaining the proper coupling should be simple, so that it can be conveniently done, once



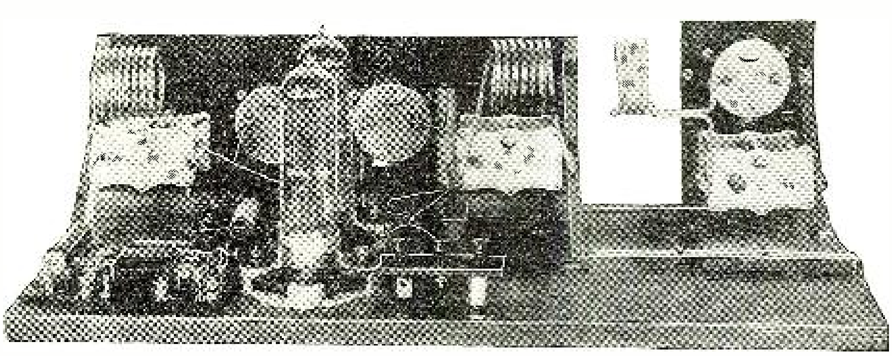
For quickly changing to other predetermined wavelengths, the circuit above is recommended by the author. Shunt condensers do the trick

for all, and the setting noted. If the coupling is too close, two frequencies are radiated and too much space in the spectrum is taken up in the already crowded bands. Use *loose* coupling; one sharp "peak" is then radiated. The proper value of coupling depends upon too many factors to give any general rules, but there is a simple method to tell when the desired result is obtained.

The following procedure would be followed in coupling the oscillator illustrated to its antenna. The antenna panel is first moved along the baseboard until antenna coil and plate coil are about ½ inch apart. The antenna is assumed connected to the antenna panel. With the coils close together, the antenna is tuned to resonance and the maximum antenna current is noted; this is, say, one ampere. Maintaining the antenna at resonance with the oscillator, by means of the antenna-series condenser, the coupling is loosened until the radiation has fallen to about 85% of its initial value, which, for the assumed maximum value of one ampere, would be .85 ampere. The signal is next studied by means of a well-shielded receiver, close at hand, or an ordinary receiver, with reliable operator, at some distance from the transmitter. The antenna condenser is then tuned first to one side of resonance (for example, tuned to a lower frequency than the oscillator) and then to the other, the "note" at each position is noted. If it is found that the note is much better on one side of resonance than on the other, the antenna is tuned to this "best" side and detuned by an amount such that the antenna current is 75% of the maximum reading first noted; this would give an antenna reading of .75 ampere. With a good oscillator and antenna, one can feel assured that with the proper coupling value, the emitted frequency will remain constant.

The method of coupling the plate and antenna coils in this oscillator is novel. The antenna coil, ammeter and series-condenser are all mounted on a small well-braced panel which slides along the baseboard. The panel itself extends somewhat below the top of the baseboard, fitting into a special groove running the length of the set. The main panel also fits into this groove, but is braced inside the set by a lengthwise piece to which it is screwed. Two pieces of strip brass are provided to hold the antenna panel rigidly in place and, in the rear strip, to two set-screws, so that, once the proper coupling is obtained, the screws may be tightened.

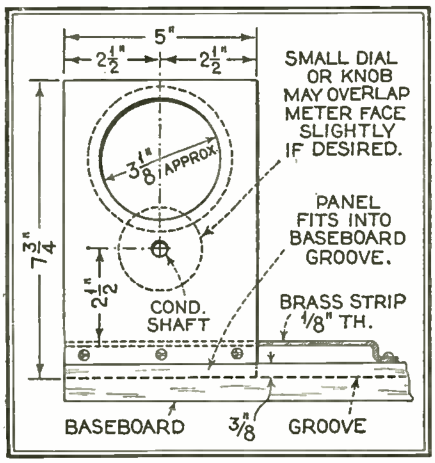
A rear view of the transmitter which clearly indicates how the sliding antenna coil-condenser is mounted



Often the proper adjustment of the coupling will improve the note as much as a whole section of filter. Although a battery or a d.c. generator is the ideal plate supply, well-rectified and filtered a.c. and proper adjustment of the set will give satisfactory results. Every precaution should be taken that the filament and plate voltages remain constant. Keying should be done in the negative plate supply lead to avoid shock in case the hand comes into contact with the key. Surprisingly good keying will result when large filament bypass condensers are used. Often a pair of 1 mfd. high voltage filter condensers, which have become useless for high voltage use, due to insulation breakdown, can be used across the filament leads for this purpose.

Constructional Hints

Some of the practical constructional details are of interest. The tuning condensers are constructed of 43-plate condensers by removing every other plate. The rotors are removed and every other plate in both rotor and stator can be driven out with a small screw-driver in some types of condensers. Before reassembling, the plug-in attachments for the coils are mounted in place, either by soldering or by screws through holes in the rear end-plates. The lock-nuts are

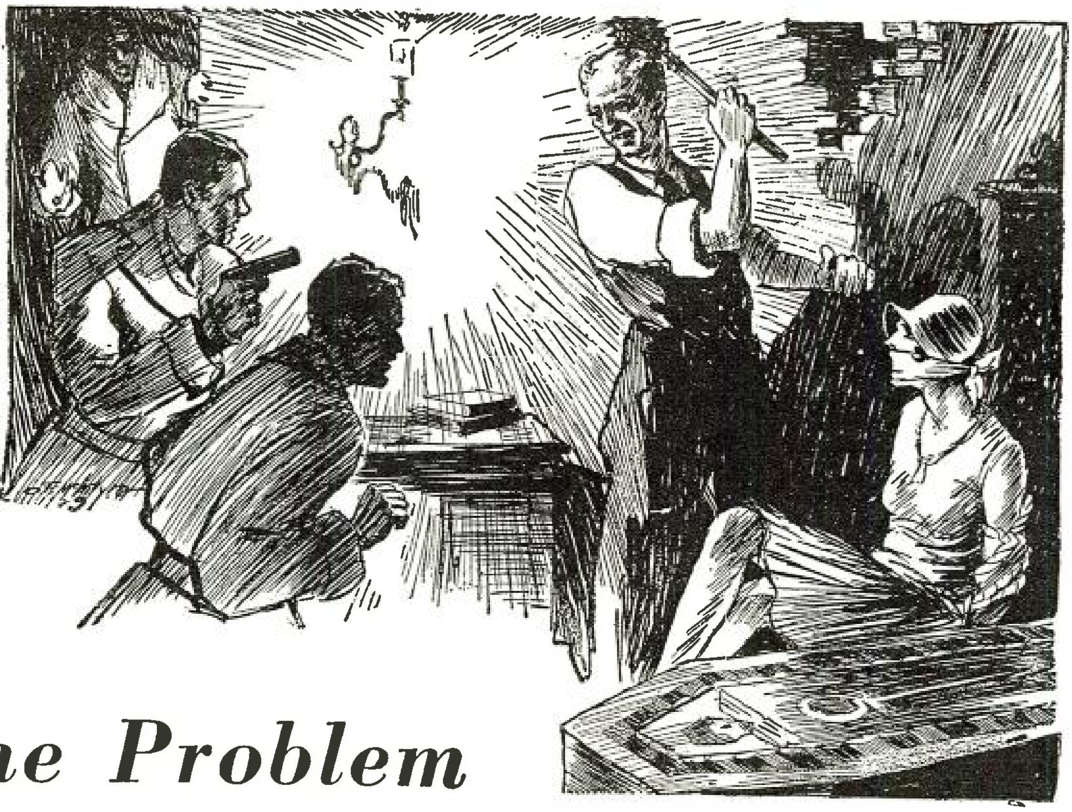


Drilling details and layout dimensions for the antenna coil-condenser panel

readjusted to give the desired dial control.

Coils of the proper number of turns were cut from a long winding, consisting of about 20 ft. of ¼-inch copper tubing wound on a 2-inch wooden cylinder. The end of the tubing is fastened and the other end passes through a hole drilled in the cylinder; by rotating the cylinder the turns are wound tightly in place. The ends of the coils are bent to fit the plug-in attachments and are securely soldered to these. At 40 meters, 8 or 9 turns are used in each tuned circuit. The antenna coil consists of 5 turns from the same winding. A smaller number of turns can be used in the grid coil if desired; this allows a single size of plug-in coil to cover a given range, so that a smaller number of the various sizes need be constructed. All coils are interchangeable in either plate or grid circuits.

The chokes are supported by the heavy wire used in wiring the set. The wire passes through holes in the choke-tubing at the ends of the windings and the choke wire is soldered to these leads.



The Problem of the Twin Mummy Cases..

WHEN the rich and eccentric old Jonas Fielding was cruelly murdered in the secret vault underneath his smart Gramercy Park home, it wasn't a case of simple burglary. It was undoubtedly much more than that!

Why, for instance, did he tell his nephew, Philip Norris, whom he called suddenly on the phone shortly before his death, that he didn't expect to live much longer? Why did he term the simple looking empty Egyptian mummy case his "Treasure of Treasures"? Who were the hidden enemies he feared? Who was the beautiful girl whose portrait hid the entrance to old Fielding's secret vault?

How Would You Solve It?

Those are the questions that ran through Philip Norris' mind when he found himself suspected of the murder. Then Chance stepped in and gave him a clue, for he meets the girl of the portrait face to face, and she flees at sight of him!

What would you do if you were in Philip Norris' place? See if *you* can solve "The Gramercy Park Mystery" before he does.

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The Transmitter Goes to Sea

The outfit has been given the acid test of actual use on board a yacht and in an amateur station and has worked, or been heard, in every continent when used in an amateur station. When used in the yacht, the meters were mounted upside down. All yachts seem to provide plenty of space for everything else but the radio equipment and operator, so it had to be mounted upside down on the ceiling to save space. This required also that the brass strips be made secure to keep the antenna apparatus in place. Some interesting practical results of tests on board a yacht will be given in a later paragraph for those interested or contemplating similar installations.

A transmitter is quite simple to get into operation. The wiring should first be checked; the high-voltage positive lead should be traced through the set to see that it does not touch anything connected directly or indirectly to filament. It is worth while also, for the plate milliammeter's sake, to test the plate condenser with a battery and phones before turning on the power. The antenna is as yet unconnected. First turn up the filaments to rated voltage, then press the key. Turn the grid condenser until the plate current drops to a minimum. The set should oscillate the first time. Measure the frequency with a frequency meter and adjust properly well within the desired amateur band by varying both condensers. If the grid and plate inductances are of the same size and the condensers of the same general construction, both condensers should be set approximately at the same dial-setting. The set is then coupled to the antenna as previously described.

The plate choke in the oscillator can be tested by using a wooden-handle screw-driver. Move the metal end along the choke; much sparking should result at the plate end of the choke, but little, if any, at the other end.

Remote Control Is Popular

Since separate receiving and transmitting antennas give best results, many amateurs operate the transmitter remote control so that the receiving apparatus is away from the immediate vicinity of the transmitter. The relay in the set is used for keying. Connections are as in Fig. 1. Although it is undesirable to extend the high-voltage leads in a powerful set for remote control, thus necessitating a relay, the 110-volt a.c. leads can be extended for turning the set on or off. In some cases it is possible to use a simple pull-chain socket with a long cord, connecting to the supply near the set, for simplified wiring. Some relays require a 20-ohm series resistor when operated on 110 volts d.c. A small storage-battery-operated one is suitable or even a revamped doorbell will serve. The 5 mfd. condenser across the key is to reduce sparking at the contacts, but this may not be found necessary in some cases.

Although the "open" type of construction appeals to visiting radio friends, the set can be placed in a cabinet if desired.

If no cabinet is used, a cloth should be thrown over the outfit when not in use to keep dust from lodging between the condenser plates or other places where it isn't so good.

All wiring is done with No. 10 wire (enameled) to prevent any possible vibration. The r.f. leads to grid and plate should be of the same length between tubes. The panel should consist preferably of ¼-inch stock. Nickeled braces, as in this set, certainly improve the appearance and strengthen the set greatly. These are fastened to the baseboard with two wood screws and to the panel with machine screws and nuts. The antenna condenser is provided with a small knob which overlaps the face of the meter slightly.

When the transmitter is used in a yacht, the antenna capacity changes so that every precaution must be taken so that the antenna has a minimum effect on the oscillation frequency. By adjusting the coupling as previously described, and employing "high-c" oscillator tanks, this is well taken care of. In "salt air" ordinary copper tubing inductances will corrode unless plated. The coils in the oscillator have been silverplated; this is not so very expensive and certainly adds to the appearance of the set. In motor-driven yachts especially, under certain conditions, the coils vibrate considerably, which may be undesirable. However, under other conditions, a slight vibration may be tolerable, as it tends toward a "modulation" on the emitted frequency, which is not so bad at sea. If vibration is severe, the best procedure is to fasten to each coil a piece of bakelite, extending this to the panel and securing it. This does not allow such rapid change of plug-in coils but steadies them. It is often sufficient to tie a piece of bakelite inside each coil with waxed cord.

Outside of the factors mentioned, the set works equally well in an amateur station or on board a yacht—either upside down or right side up. It is a 1930 set.

LIST OF PARTS

2 .0012 mfd. Sangamo fixed condensers—for grid C5.
1 R. C. A. tapped plate blocking condenser—C4 .0006 mfd. C1, C2, C3.
3. .0002 mfd. variable condensers—General Instrument Co.
2 50-watt sockets and tubes.
1 5000-ohm grid resistor—Heavy Duty, Transmitting R1.
1 Filament voltmeter 0/15 a.c. volts, Jewell V.
1 0/300 milliamperes d.c. meter MA.
1 0/3 amp. antenna meter, high frequency, A.
1 Filament transformer, with primary rheostat T. 10 V sec. for 50 watt tubes. 7 V sec. for "210" tubes.
1 Center tapped Bypass Condenser, C6, .002 mfd. each section.
20 ft. 3/16 in. copper tubing for 40-meter band coils, L4, L5, L6.
8 Plug-in attachments, "Ajax," and 2 for each extra coil.
1 Leach relay, keying, model 18, type S-3 (optional).
1 .5 mfd. Polymet fixed condenser (key contacts—optional) C7.
1 200-ohm Resistor (current limiting)—(optional) R2.
1 ft. ½-in. diam. bakelite tubing—for chokes.
60 ft. no. 30 wire for chokes L1, L2, L3, L4.
6 Binding posts, large bakelite.
Panels, baseboard, strip brass, machine screws and nuts.
6 ft. ⅛ by ½ inch brass strip.
1 piece 3/16 by 1½ by 4 inch bakelite—post strip.
1 piece ¼ by 7¼ by 18¾ inch—main panel.
1 piece ¼ by 5 by 7¾ inch bakelite—antenna panel.
1 baseboard ⅞ by 13¾ by 28 inches—main baseboard.
1 baseboard ⅜ by 5 by 8¼ inches—antenna-panel baseboard.

A New Voice in Education

(*Continued from page 552*)

through the use of a small microphone mounted close to a small motor-driven revolving disk backstage. The output of this microphone was highly amplified and fed to a mammoth Amplion speaker mounted within the dummy dynamo.

Another original idea indicating the possibilities of the sound amplifier field is found in one of the advertising efforts of a canned milk company. At an exposition where this company had a display booth a model of a cow was set up and was called "The Talking Cow." Visitors to the exposition could ask the cow questions and would receive an immediate reply, ostensibly from the cow itself. The arrangement used was to mount a concealed microphone inside of the cow's head behind the opening provided by one ear. This microphone was connected through an amplifier to a pair of head phones worn by a man who was concealed some distance away. He in turn was equipped with a microphone which fed into an amplifier, the output of which was connected to a speaker mounted within the cow.

Another unusual use for an amplifier installation was found in a turkish bath, where the proprietor was most conscientious in his desire to have patrons obtain the maximum benefit from his baths. He found that the average patron would not remain in the steam room long enough to obtain the best results, largely due to the monotony of the procedure which does not permit of either conversation or reading. To overcome this monotony a special damp and heat-proof loud speaker was installed with a radio receiver and amplifier located elsewhere.

Any clever advertising scheme, such as that of the talking cow, will find a ready sale among progressive advertising agencies as well as among storekeepers and any others who can capitalize novelty.

A New Band-Pass Tuner Kit

(*Continued from page 520*)

using a single 250 tube output. The use of a push-pull output stage makes it possible to reduce the filtration required at high current and improve the filtration in the low-current section.

A special tap has been provided on the standard 255 input transformer to work out of an 1,800 to 2,000-ohm pick-up. This increases the gain with pick-up input and obviates the necessity of using a separate input transformer and other special circuit arrangements which are necessary with single-stage audio amplifiers.

The combination of the 712 tuner and the 677 or an equivalent amplier make a receiving unit which is virtually limited in its DX possibilities only by the stray level. In Chicago it has received stations from the west coast with an eight-inch antenna. This represented the actual antenna, since without the wire not even local stations could be received.

Parts List for 712 Receiver

The following S.-M. parts:
1 713 pierced metal chasis (with shield partitions).
1 813 escutcheon.
1 313 .00035 mfd. five-gang condenser and dial.
3 121 shielded r.f. coils.
1 122 shielded r.f. coil.
1 124 shielded r.f. coil.
7 275 r.f. chokes.
1 30X selector coupler.
and
4 Potter 30B by-pass condenser blocks.
3 C-R 224 tube sockets.
1 C-R 227 tube socket.
1 Yaxley 10MJP 10,000-ohm potentiometer.
1 Yaxley 840-C condenser block.
1 Durham 10,000-ohm two-watt (green) resistor.
1 Durham 60,000-ohm one-watt (blue) resistor.
2 Polymet .00015 mfd. small moulded condensers.
3 Carter RU-400 400-ohm resistors.
1 H. & H. 1561 on-off switch.
2 walnut 1⅛″ brown wood knobs.
1 walnut 1⅜″ brown wood knob.
8 moulded binding posts.
1 set of hardware and hook-up wire.

Parts List for 677 Amplifier

The following S.-M. parts:
1 677 Case chassis and panel.
1 255R audio transformer.
1 257 push-pull input transformer.
1 337U power transformer.
1 338U filter choke.
1 339U filter choke.
1 4696 1,500 and 800-ohm resistor.
and
1 Potter 673 condenser bank.
2 C-R 245 sockets
1 C-R 280 socket.
1 C-R 227 socket.
1 Carter A. P. 15 hum balance.
1 Durham 2,000-ohm one-watt resistor (white).
1 Durham 3,500-ohm two-watt resistor (brown).
12 moulded binding posts
1 set of hardware and hook-up wire.

Ready For a Short-Wave Chat

(*Continued from page 523*)

communication, and assure ourselves that the signal is clean-cut and steady. We can also observe the effect of different circuit adjustments, different antenna tuning, etc., on the quality and intensity of our signal. The local intensity does not mean very much, however, as so many things enter into the transmission. When using the set for phone on 85 meters we can sit at the desk and talk into the transmitter, hearing our own words in the receiver headphones.

For more accurate frequency measurement we use a wavemeter. The coil is inductively coupled to the oscillator (holding wavemeter near transmitter is sufficient), and the condenser dial is tuned slowly until maximum current is indicated by the bulb, either flashlight or neon. Some of the commercial meters, such as General Radio and Aero, are excellent but a trifle expensive. The circuit, shown in Fig. 2, is simplicity itself, and a meter can be easily built from an old condenser, a flashlight bulb, and two rigidly wound, home-made coils. The flashlight bulb should be of the single cell, 1.2 volt type, as this is a low resistance bulb (.6 ohm cold and 2.4 ohms hot). The tuning with this bulb is much sharper than with a higher resistance bulb, but care must be used not to burn it out.

The home-made meter must be carefully calibrated from a standard one, by holding each in turn close to the receiver coil and noting the dial reading of each when they pull the receiver out of oscillation. As the receiver goes out of oscillation with a click and back again into it with another click, midway between these clicks on the receiver dial indicates the receiver wavelength corresponding to the wavelength at which the wavemeter is set. A curve is made up for the new wavemeter, showing dial settings plotted against wavelength or frequency.

With a calibrated wavemeter at hand, the transmitter can be calibrated in terms of oscillator condenser settings against wavelength. Such curves for the writer's transmitter are shown in Fig. 3. Fortunately enough, the main transmitting wave in each band, 85 and 42 meters, falls on the oscillator setting of 60, but such luck is unusual. While other home transmitters will show curves generally similar, each one should of course be individually calibrated. With this chart on the wall near at hand, the transmitter may be quickly adjusted to any desired wave by changing the oscillator condenser and retuning the antenna circuit. Variation in antenna tuning should not change the oscillator wavelength over 1%.

While the essential information for putting the home transmitter in operation has been indicated here, there are of course other things which space does not permit covering. A valuable source of information on this subject is the "Radio Amateurs' Handbook," published by the American Radio Relay League at Hartford. Conn., and also the articles by R. S. Kruse in *QST* from December, 1926. to March, 1927, entiled "How Our Tube Circuits Work."

Amateur Procedure

After all preliminary testing has been completed, and the operator has assured himself that his transmitter radiates a clean-cut, steady signal within one of the prescribed bands, it is time to "get out of town"—ethereally speaking, of course; with low power and loose antenna coupling no physical move should be necessary. For the average location it is easier to begin with the 80-meter coil, as interference from distant stations is less. In sparsely settled country, however, such as parts of the West, the 40-meter coil offers the best chance of raising someone. The daytime is best for an air début, because the heavy traffic and interference at night tends to crowd out a weak, low-powered signal and the uncertain sending of a beginner. The simplest way to start is to locate with the receiver some other station sending "CQ." Each string of "CQ's" is followed by "de," and the distant station's call repeated two or three times.

When this sequence has been carried through a few times, the distant station sends "AR" or "K" and becomes silent. It is then our turn to switch on the transmitter and start sending his call perhaps five or ten times, followed by "de," and our own call two or three times. Switching on the receiver a moment, we listen to see whether he comes back; if not, we try again. If he does come back, he begins with our call, "de" and his own call, followed by whatever he has to say. In this process we have used the transmitter and receiver switches, but there was no need to touch the receiver tuning.

Using the other method of raising a

TABLE 1

HOME TRANSMITTER PERFORMANCE

Code or Phone	*Wavelength Meters*	*Plate Voltage Volts*	*Osc. Plate Current Mils.*	*Input Watts*	*Antenna Current Amps.*
CODE	85	220	40	9	.20
Mod. choke shorted,	78	220	40	9	.20
mod. plate disconnected	42	220	45	10	.15
PHONE	85	190	33	6	.15
Mod. choke and plate in circuit	Modulator grid bias —22 v.; plate current 40 mils.				

These voltages approximate those of a battery-operated Home Transmitter. Grid leak 5,000 ohms. Oscillator UX210; modulator UX250. Filament voltage 7.5 volts d.c. Antenna —A type—detuned to ⅔ max. current for steady signal.

TABLE 2

Common Q Signals and Abbreviations

QRD	Where bound? Bound . . .
QRG	My frequency? Your freq. . . .
QRI	My tone bad?
QRK	How do you rec. me?
QRM	Interference
QRN	Static
QRQ	Send faster
QRS	Send slower
QRT	Stop sending
QRX	Stand by
QRU	Anything for me? Nothing
QRV	Are you ready? Ready
QSA	Signal readibility 1-5
QSB	My sig. strength vary? Your etc.
QSC	My signals swing out entirely? etc.
QSD	My keying bad? Your etc.
QSO	Can you communicate with?
QSP	Will you relay to?
QST	General call to all stations
QSQ	Send each word once
QSX	Does my frequency vary?
QSZ	Send each word twice
QTA	Cancel my last message
QTC	I have message(s) for you
QTR	What is your time? Time is . . .
C	Yes
N	No
UA	Do you agree?
K (or GA)	Go ahead
Q	Wait
R	Received
RPT (or ?)	Repeat
?WA	Word after
?WB	Word before
?AA	All after
?AB	All before

It will be noted that practically all the Q signals may be used either as a question or as an answer.

station, we send out "CQ" three to five times, signing our own call two or three times. This whole sequence is repeated three times—no more. We then switch on the receiver, and "search" the band for an answering signal in the form of our own call. The tuning control must be moved slowly across the entire band, stopping long enough on each signal to recognize our own call if it is being sent. When we locate someone calling us, we answer him as soon as he stops sending. The standard inquiry call is "three times three," or "CQ" three times and one's call three times, all repeated three times. But as "CQ" catches attention and the call does not, it is usually better to send five "CQ's" and the call twice (three times on the last round). To send "CQ" more than five times running is a step toward becoming that premier nuisance of the amateur bands, the man whose fingers automatically repeat "CQ" *ad infinitum* while his mind is busy elsewhere, or dozing. Others get so tired of listening to his attention signal that they rarely wait for his call.

When contact is established one station usually says something like "GE OM QSA4 PDC hr at Boston, Mass. QRK? QRA?" (good evening, old man, your signals are moderately strong, pure d.c. note here at Boston; how do you receive me?—what is your location?), signing off with a short call. The other station, coming on with a short call, replies with "R" or "R OK" if everything was received perfectly, or "?" or "RPT" if something was missed, and gives the desired information. The chat then continues about anything of interest to the two operators—the weather, the transmitting conditions, the power in use, etc. Most of the "ama-

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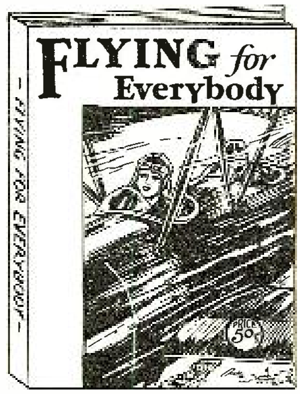

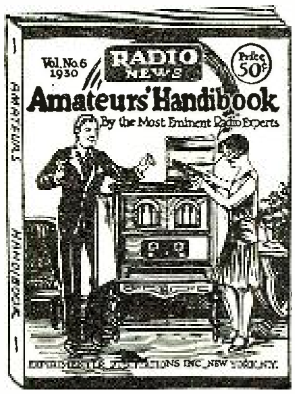

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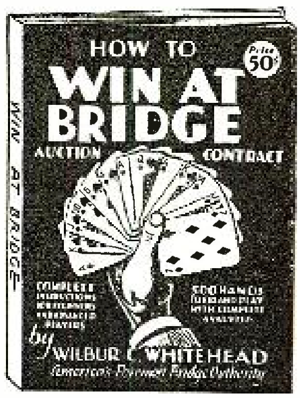

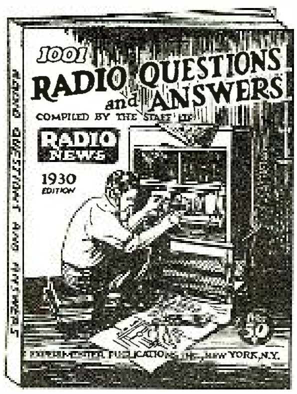

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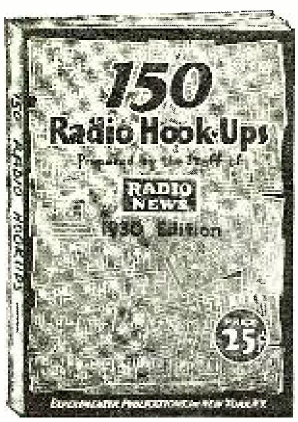

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teur short-hand" as used above is easily guessable, as words are represented by a few of their consonants; and the rest is soon learned by listening to others. Signal strength is rated from a minimum readability of QSA1 to a maximum of QSA5. Some other "Q" signals in common use by commercial stations as well as amateurs are given in Table 2. A special amateur one is "QRAR?—Is your call book address correct?"; and "QRAR—My call book address is correct."

The government call book of American amateurs can be obtained from the Government Printing Office (Washington, D. C.) for twenty-five cents, and private interests publish quarterly an international call book costing a dollar. The signal "VE" is usually sent when beginning a transmission, and "VA" (or SK) is sent when signing off with a particular station. If the station is closing down and will not stand by for others, "CL" should also be sent. When signing off with another amateur it is courteous to send something like "HPE CUAGN VY 73 GB (hope to see you again, very best regards, good-bye)," although lengthy leave-takings can be and often are overdone. "73 GB" should really be sufficient.

With a small transmitter, and particularly with some form of remote control, the receiver may be left on while transmitting unless it is tuned very near the transmitting wave. This permits the use of "break-in," the fastest kind of two-way communication. We call another station, interspersing his call with "BK." As soon as he hears us he comes back. right through our sending, and of course we then stop and listen to him. If we miss any of his sending we simply send "BK," and he begins the word over. The transmitter and receiver switches remain closed; to send we merely press the key, and to receive we merely listen. Like two speakers face to face, either station can interrupt the other. This takes alertness and good operating—hence is more exciting and much faster than regular operation. Unfortunately, the percentage of stations equipped for break-in, and operators familiar with it, is none too great.

Every station should keep a log book. In this appears a more or less complete record of each transmission, including signal strength, static, etc. The notes may extend to the weather, the barometric pressure, or anything else in which the operator is interested. A cheap notebook can be ruled and labelled to the individual taste. The photograph shows a typical page from the W2CX log.

DUE to special testing equipment quite as well as thorough training, the radio service man has attained the dignity of a professional worker, according to J. E. Smith, President of the National Radio Institute. Recently, special testing equipment has been developed whereby the service man can make every conceivable test out in the field. and locate any source of trouble in a radio set. This kind of service is essential to the prosperity of the radio industry which now operates on the principle of mass production, volume sales and satisfied public.

Power Amplification and the 245 Tube

(*Continued from page 521*)

ted are those which are now used in the actual production of a pack for a nationally known radio receiver and that the pack is the result of many months' work and constant revision until the best possible results were obtained.

There is one other point that should be mentioned at the start, and that is that the builder is at perfect liberty to use his own judgment in the substitution of parts as regarding rating and type, as slight changes in parts and ratings, except in such vital points as grid biasing resistors and filament voltages will not appreciably affect the operation.

Referring to Fig. 1, which shows the complete power transformer layout as well as the connection of the filter chokes, filter condensers, the last audio stage, which is push-pull, and dynamic speaker: it will be noted that the plate voltage for the 245 power tubes is taken off directly following the first choke and that from here on the circuit consists of a stage of resistance-capacity type filter. The low voltage end of this may be used to supply voltage for any radio-frequency tubes which it may be desired to operate. It will further be noted that the voltages for the audio-frequency tubes are obtained at the output of the second choke, which is by-passed by the final condenser section.

The connection of the dynamic speaker field to this filter is rather unusual, as it is made through the resistance R13, which is connected to the positive side of the filter following choke AFC2 shown in the sketch. The other end of the speaker field winding is connected through resistor R2 to ground and at the point of connection between speaker field winding and R2 a tap is supplied which may be used to furnish the cathode biasing of any radio-frequency tubes such as 227's or 224's which it may be desirable to use.

The biasing of the push-pull power tubes is accomplished in the usual manner by means of the resistance R12, across which there is a voltage drop. This voltage varies automatically with the plate voltage supplied to the power tubes keeping the bias correct at all times. A connection may be made to the positive end of resistor R12 through another resistor R8 and back to ground at the center point of the high-voltage secondary winding; resistor R8 being supplied with a variable contact which in turn should be connected to the rotating contact of the potentiometer R7 which shunts the filaments of the amplifier tubes. These two variable resistors act to reduce the hum in the speaker.

A single stage of resistance-impedance audio coupling is used preceding the power tubes. This is shown in the upper section of Fig. 1, along with the circuit for the detector tube for the sake of clarity. Where the amplifier is to be used mainly for phonograph work, a pick-up matching impedance may be substituted for the resistance-impedance amplifier, in which case the section of the circuit shown within the dotted line should be omitted. With this impedance-matching unit, a high-grade phonograph pick-up and with good push-pull input and output transformers sufficient volume can be obtained to be properly heard in a small concert hall. An amplifier of the type which has just been considered can be made up to very good advantage on a steel or aluminum base about 10 inches wide by 15 inches long with the dynamic speaker mounted in the center of the pack. Where the speaker is mounted in this manner it would be well in order to prevent vibration to bolt it to the steel base through soft rubber gaskets or else to mount the tubes in cushion type sockets.

The plate voltage supplying the 245 tubes in this pack is 250 volts and the grid bias 50 volts when the a.c. line voltage is about 5% above normal. This means that the output of the first section of the filter is 300 volts, which in turn calls for an a.c. plate voltage from each side of the transformer secondary of about 340 to 350 rms. The rectifier tube filament voltage requires 5 volts at the tube contacts and the 245 filament winding should supply 2½ volts at 3 amperes, whereas the filament voltage for the amplifier tubes should run slightly in excess of 2¼, the current depending upon the number of tubes to be operated from the pack.

The resistance of the choke AFC2 is about 150 to 200 ohms and its inductance about 5 henries, it being wound with No. 31 wire, the cost being much lower than that of the ordinary 30 henry choke—in fact, considerably less than half. The other coils and resistances are specified at the end of this exposition. It will be noted that the filter condensers, which are known as the D-8 Mershon condensers, are grounded to the base of the power pack by means of suitable clamps around the copper cases of the condensers which hold them to the base. Connections are, of course, made to the anodes on top of the condensers which are two in number, as shown.

SUGGESTED PARTS WHICH MAY BE USED

First Stage Audio Resistance-Impedance Unit:

Amertran, National, Ferranti.

Filter Chokes: AFC1 (600 ohms); AFC2 (150 ohms).

Transformer Co. of America, Thordarson, Ferranti, Amertran, National, Dongan, etc.

Electrolytic Filter Condensers (M):

Amrad, Mershon (type D-8).

Resistors:

R1, 31 ohms; R2, 2,500 ohms; R3, 100,000 ohms; R4, 20 ohms (potentiometers; R5, 200,000 ohms; R6, 5,000 ohms (60 mils); R7, 20 ohms (center-tap); R8, 860 ohms (60 mils); R9, 1,500 ohms; R10, 50,000 ohms (variable); R11, 21,000 ohms; R12, 12,500 ohms.

Tobe, Electrad, Frost, Carter, Clarostat, Ward Leonard, Ferranti, Harduck, Hindle.

Dynamic Speaker (field resistance 6,500 ohms approx.):

RCA, Jensen, Valley, Rola, Stevens, Magnavox, TCA, United Reproducers, Metro.

On Short Waves

(*Continued from page* 541)

supplied with a.c. receivers) like a local. 2ME, Sydney, rocks in, while I have also received at different times and good strength 2XAF, ACT, Phillips Station at Bandeong, Java, and a Perlin station conducting a telephone conversation with 2ME.

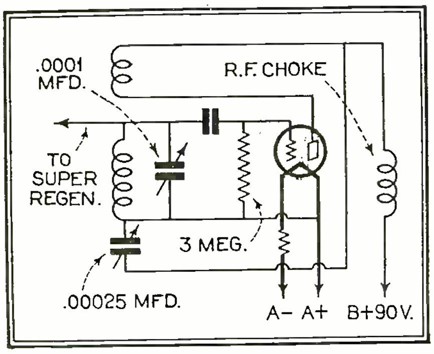


Fig. 2

"These stations have all been received on a broadcast aerial slung four feet above a galvanized roof and in a service station in the heart of Adelaide. The electric train passes our door and we are subjected to all the usual disturbance caused

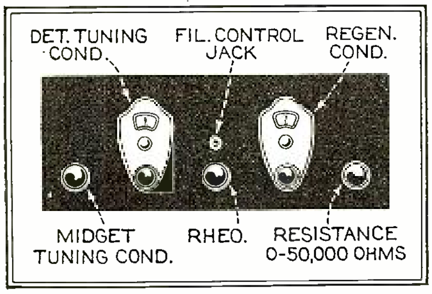


Fig. 3

by flashing lights, motors, etc., and the biggest disadvantage of all is that I cannot get to the receiver when I should like. It's nice being home to get up at any hour and listen, but I can't do this at the service station, and consequently miss all the early morning stations."

The coils used are tube-base and are wound as follows:

Coil No.	*Detector* Grid	Reaction	*Screen-Grid* Plate	Grid
1	1	2	3	3-4
2	2	3	5	5-6
3	3	4	7	7-8

REPORTS from approximately 20 per cent. of the 39,159 radio dealers queried in the April 1, 1929, quarterly survey of stocks in dealers' hands, conducted by the Department of Commerce in coöperation with the Radio Division of the National Electrical Manufacturers Association, showed a volume of business of $25,540,245 for the first quarter of this year, or an indicated total retail sales volume of $132.000.000.

Indicated total retail sales volume figures for the January 1, 1929, and October 1, 1928, quarterly surveys are placed at $186.000,000 and $96,000,000 respectively.

Applying the Band-Pass to Super-Het Design

(Continued from page 527)

cies within two prescribed limits, it is necessary to remove one of the series or shunt elements, which means that the removal of C or L or C1 or L1 in each section will provide a single band filter. The filter system we have selected is shown in Fig. 4 and is based upon two facts. First, that condensers are more easily available than inductances, and second, that since coupling between the coils must be avoided, the filter with but one inductance in each section provides the simplest arrangement.

With respect to the location of the filter, one point is most logical. If the filter precedes the amplifier, whatever voltages are in the amplifier will be passed to the detector. One the other hand, if the filter is located after the amplifier its advantages will be more readily realized. However, it is unsatisfactory for use in the grid circuit of the detector tube because of the high impedance of the circuit and the high impedance requirement of the filter, which means that high values of inductance will be necessary. If, on the other hand, we place the filter as shown, between the last intermediate amplifier tube and the primary winding of the last intermediate-frequency transformer, we accomplish our aim of eliminating the interfering frequencies induced in the amplifier exclusive of the last transformer and at the same time require low values of impedance and low values of inductance. . . . This is the location for our filter.

The circuit shown in Fig. 4 may be represented as a number of series and shunt impedances. These impedances in turn are located between a vacuum tube and the load for that vacuum tube, in the form of a transformer. This means that the filter system functions as an artificial line between the tube and the load for the transfer of energy over a predetermined band of frequency. In order that the maximum energy transfer take place between the tube and the transformer through the filter, the latter must possess a definite value of impedance. This value of impedance is allied with the electrical constants of the elements which comprise the filter, hence must be known before the design is attempted. We are called upon to transfer energy from one impedance, the vacuum tube, to another impedance, the transformer. We therefore have two impedances across the filter, one at each end. If the characteristic impedance of the filter or whatever line is interposed between the two terminating impedances is made equal to the two terminating impedances, maximum energy transformation will ensue. We assume that the transformer employed in the amplifier has been designed for the tubes used on the basis of maximum energy transfer between the tube and the transformer primary. Hence if the plate impedance of the tube is 8,000 ohms, the characteristic impedance of the filter should be 8,000 ohms. However, the series element in the filter is a capacity, which means that the plate voltage for the amplifying tube cannot be passed through the filter. . . . A shunt element will be necessary so as to provide a path for the tube plate current.

Two such paths are available. One is a choke and the other a resistance. The former is preferred if the choke is so arranged that coupling between it and the inductances in the filter will be eliminated. A transformer primary or a plate choke (iron core) rated at about 50 or 100 henrys will be satisfactory. If a choke is used in place of the resistance shown in Fig. 4, the impedance of the filter will be equal to the impedance of the tube. The alternate arrangement is the use of a resistance, as shown. It is logical, of course, that the d.c. voltage drop across the choke will be less than that across the resistance, but since resistances are more economical with respect to price and all coupling is eliminated, the resistance unit is employed in the finished filter.

With respect to the value of this resistance, it is necessary to arrange for maximum energy transfer, which means that the value of the resistance, R, will be equal to the plate impedance of the tube used. Now, in contrast to the choke arrangement, the resistance will have an effect upon the total impedance. The choke would offer a very high impedance, hence exert no influence upon the filter, but the impedance of the resistance is equal to its ohmic value. As is evident, the resistance R is a shunt across the filter and the same is true of the plate resistance, hence the combined impedance across the input of the filter is R in shunt with Rp (the tube plate resistance), and since R = Rp and they are of like value the filter must be designed for the combined impedance of the two; namely, .5 × Rp, because the resultant resistance of two resistances of like value if parallel is R/2 where R is either one of the resistances. Hence we have our third quantity.

We are now ready for the design of the filter. The attenuation secured depends upon the number of sections. The attenuation in one section is multiplied by each section added so that a number of sections provide better results than one section. Three sections as shown constitute a practical and satisfactory arrangement.

The relation between the upper and lower cut-off frequencies is governed by the values of L1C1 and L1C1C. The combination of L1C1 controls the upper cut-off frequency and the combination of L1C1 and C controls the lower cut-off frequency. This relation is shown by Campbell's formula for the constants of a filter wherein the series inductance L is omitted.

$$(1)\qquad L1C1 = \left(\frac{1}{2\,\text{pi} \times F2}\right)^2$$

$$(2)\qquad \frac{C}{C1} = \frac{1}{4} \times \left[\left(\frac{F2}{F1}\right)^2 - 1\right]$$

where F1 is the lower cut-off frequency and F2 is the upper cut-off frequency, and C, C1 and L1 are as shown.

However, these formulæ do not involve the impedance values and it is necessary to employ the following when solving:

$$(3)\quad C = \frac{F1 + F2}{4\,pi \times F1 \times F2 \times Z}$$

$$(4)\quad C1 = \frac{F1}{pi \times F2 \times (F2 - F1) \times Z}$$

$$(5)\quad L1 = \frac{(F2 - F1) \times Z}{4\,pi \times F1 \times F2}$$

where Z is the impedance of the filter.

By employing the reciprocals of the "pi" quantities in each fraction as multipliers it is possible to simplify equations 3, 4 and 5 as follows:

$$(6)\quad C = .0796 \times \frac{S}{P \times Z}$$

$$(7)\quad C1 = .318 \times \frac{R}{D \times Z}$$

$$(8)\quad L1 = .0796 \times \frac{D \times Z}{P}$$

where S is the sum of the upper and lower cut-off frequencies, P is the product of the upper and lower cut-off frequencies and D is their difference.

To simplify matters the writer has tabulated a number of tables showing the electrical constants for C, C1 and L1 for 30, 35, 45, 52, 60, 70, 80, 88, 90, 100, 110, 112 and 115 kilocycles for values of impedance between 5,000 and 20,000 ohms in steps of 1,000 ohms. A typical solution of a problem is as follows: Suppose that we have a superheterodyne employing 199's with 90 volts on the plate. The tube plate impedance is 16,000 ohms under the above conditions. It will be necessary to use a 16,000-ohm resistance so that the filter impedance will be 8,000 ohms. The peak frequency is 115 kilocycles. The filter constants mentioned are all for 10,000-cycle band width, 5,000 cycles each side of the peak. Referring to the table designated "Peak Frequency 115 kc," we follow down the column marked "Filter Impedance" until we reach the 8,000-ohm line. We find that the series capacity C must be .0001737, C1 must be .00366 mfd. and the inductance of L1 must be .482 millihenry. As is evident, the values of capacity have been carried out to one micromicrofarad. Such accuracy is not required. Experience has shown that while 1% accuracy in all values gives excellent results, satisfaction will be obtained with even 5% tolerance.

The following coils provide value of inductance within the minimum and maximum ranges required by the tables:

Type	*Inductance in Millihenrys*
25	.040
35	.075
50	.15
75	.3
100	.6
150	1.3
200	2.3
250	4.5
300	6.5
400	11.
500	20.

With respect to the capacity values, it may be necessary to employ series, parallel and series parallel combinations of a number of units in order to secure the desired value. The method of connection and calculation are shown in Fig. 5. In the event that the capacities in series are of like value, the resultant capacity is equal to the capacity of one in the series divided by the number in the series.

Fig. 6 shows a completed filter. If the coils are of the honeycomb variety, they should be placed at right angles to each other and shielding will be unnecessary, although shielding between the inductance will always help, in which case special precautions will be unnecessary and the coils can be placed parallel to each other. The shields when used should be complete, each a separate can or one can for the entire unit with individual compartments. The following specifications apply for a 10,000-cycle band width filter designed for a 115 kc. "super" employing 201A's with 45 volts on the plate. C is .00014 mfd., C1 is .003 mfd. and L1 is .603 millihenrys. An inductance of .6 millihenry or 600 microhenrys will be found satisfactory. The inductances employed were of the single layer solenoid variety and consisted of 165 turns of No. 30 enameled wire on a 1.5-inch bakelite winding form.

In the event that choke coil feed is employed the choke should not be in the can which houses the first inductance. If the filter proper is shielded, the choke can rest outside of the filter can, or a separate compartment can be provided. This inconvenience is obviated through the use of a resistance, as shown.

The explanation C = 2 × C accompanying the input and output condensers signifies that these values of capacity are equal to twice the normal value of C. The electrical constants quoted for C are applicable wherever C is designated with the exception mentioned.

These Filters are designed for a 10,000 Kilocycle width which is equivalent to 5,000 cycles each side of the peak frequency.

Peak Frequency 45 K.C.

Filter Impedance Z	Condenser C	Condenser C1	Inductance L1
5000 ohms	.000715 mfd.	.00507 mfd.	1.99 mil.hen.
6000	.000596	.00424	2.48
7000	.000511	.00363	2.78
8000	.000447	.00317	3.18
9000	.000393	.00282	3.58
10000	.000358	.00254	3.98
11000	.000325	.00230	4.38
12000	.000298	.00211	4.77
13000	.000275	.00195	5.17
14000	.000256	.001813	5.57
15000	.000238	.001695	5.97
16000	.000224	.00159	6.37
17000	.000210	.001495	6.77
18000	.000199	.00141	7.17
19000	.000188	.001337	7.57
20000	.000179	.00127	7.97

Peak Frequency 60 K.C.

Filter Impedance Z	Condenser C	Condenser C1	Inductance L1
5000 ohms	.000532 mfd.	.00538 mfd.	1.11 mil.hen.
6000	.000443	.00448	1.33
7000	.00038	.00384	1.55
8000	.000332	.00336	1.77
9000	.000296	.00299	1.99
10000	.000266	.00269	2.22
11000	.000242	.00244	2.44
12000	.000222	.00224	2.66
13000	.0002042	.00207	2.88
14000	.00019	.00192	3.11
15000	.0001775	.00179	3.33
16000	.000166	.00168	3.55
17000	.0001565	.00158	3.77
18000	.0001488	.00149	3.99
19000	.00014	.001415	4.22
20000	.000133	.001345	4.44

Peak Frequency 70 K.C.

Filter Impedance Z	Condenser C	Condenser C1	Inductance L1
5000 ohms	.000456 mfd.	.0055 mfd.	.82 mil.hen.
6000	.00038	.00458	.984
7000	.000325	.003928	1.148
8000	.000285	.003437	1.312
9000	.000253	.003055	1.476
10000	.000228	.00275	1.64
11000	.000207	.0025	1.804
12000	.00019	.00229	1.968
13000	.000175	.00211	2.132
14000	.000162	.00196	2.296
15000	.000152	.00183	2.460
16000	.000142	.001718	2.624
17000	.000134	.001617	2.788
18000	.000126	.0015	2.952
19000	.00012	.00144	3.116
20000	.000114	.00137	3.280

Peak Frequency 80 K.C.

Filter Impedance Z	Condenser C	Condenser C1	Inductance L1
5000 ohms	.0004 mfd.	.0056 mfd.	.625mil.hen.
6000	.00033	.0046	.75
7000	.00028	.00401	.875
8000	.00025	.0035	.1
9000	.00022	.0031	1.125
10000	.0002	.00281	1.25
11000	.00018	.0025	1.375
12000	.00016	.0023	1.5
13000	.00015	.00216	1.625
14000	.00014	.002	1.75
15000	.00013	.00187	1.875
16000	.00012	.00175	2.
17000	.000117	.00165	2.125
18000	.000111	.00156	2.25
19000	.000105	.00147	2.375
20000	.0001	.0014	2.5

Peak Frequency 88 K.C.

Filter Impedance Z	Condenser C	Condenser C1	Inductance L1
5000 ohms	.000364 mfd.	.00568 mfd.	.52 mil.hen.
6000	.000306	.00473	.625
7000	.00026	.00405	.727
8000	.000227	.00355	.83
9000	.000202	.00315	.935
10000	.000182	.00284	1.03
11000	.000165	.00258	1.145
12000	.000151	.002365	1.250
13000	.00014	.00218	1.352
14000	.00013	.00203	1.454
15000	.000121	.00189	1.56
16000	.000113	.00177	1.66
17000	.000106	.00167	
18000	.000101	.00158	1.870
19000	.0000957	.001495	
20000	.000091	.00142	2.06

Peak Frequency 90 K.C

Filter Impedance Z	Condenser C	Condenser C1	Inductance L1
5000 ohms	.00035 mfd.	.0057 mfd.	.219mil.hen.
6000	.00029	.00475	.588
7000	.00025	.00407	.868
8000	.000218	.00356	.784
9000	.000194	.00316	.882
10000	.000175	.00285	.98
11000	.000159	.00259	1.078
12000	.000145	.00237	1.176
13000	.000134	.00219	1.274
14000	.000125	.00203	1.372
15000	.000116	.0019	1.47
16000	.000109	.00178	1.568
17000	.0001	.00167	1.666
18000	.000097	.00158	1.764
19000	.000092	.0015	1.862
20000	.000087	.00142	1.96

Peak Frequency 100 K.C.

Filter Impedance Z	Condenser C	Condenser C1	Inductance L1
5000 ohms	.0003 mfd.	.00576 mfd.	.397mil.hen.
6000	.00025	.0048	.474
7000	.00021	.00411	.553
8000	.000187	.0036	.632
9000	.000166	.0032	.711
10000	.00015	.00288	.79
11000	.000136	.00261	.869
12000	.000125	.0024	.948
13000	.000115	.00221	1.027
14000	.000107	.00205	1.106
15000	.0001	.00192	1.185
16000	.000093	.0018	1.264
17000	.000088	.00169	1.343
18000	.000083	.0016	1.422
19000	.000078	.00151	1.501
20000	.000075	.00144	1.580

Peak Frequency 110 K.C.

Filter Impedance Z	Condenser C	Condenser C1	Inductance L1
5000 ohms	.00029 mfd.	.0058 mfd.	.3295mil.hen.
6000	.00024	.0048	.3954
7000	.000206	.0041	.4613
8000	.00018	.0036	.5272
9000	.00016	.0032	.5931
10000	.000145	.0029	.659
11000	.00013	.0026	.7249
12000	.00012	.0024	.7908
13000	.00011	.0022	.8567
14000	.000103	.0020	.9226
15000	.000096	.0019	.9885
16000	.00009	.0018	1.0544
17000	.000085	.0017	1.1203
18000	.00008	.0016	1.1862
19000	.000076	.0015	1.2521
20000	.000072	.00145	1.318

Peak Frequency 115 K.C.

Filter Impedance Z	Condenser C	Condenser C1	Inductance L1
5000 ohms	.000278 mfd.	.00586 mfd.	.3015mil.hen.
6000	.0002315	.00488	.362
7000	.0001985	.00419	.422
8000	.0001737	.00366	.482
9000	.0001545	.00327	.542
10000	.000139	.00293	.603
11000	.000122	.00266	.663
12000	.000116	.00244	.7245
13000	.000107	.00225	.7845
14000	.0000992	.00209	.845
15000	.0000926	.0001955	.905
16000	.0000869	.000183	.965
17000	.000817	.0001725	1.025
18000	.0000772	.001635	1.086
19000	.0000731	.000154	1.145
20000	.0000695	.0001465	1.206

Second Small-Boat Receiver

(*Continued from page* 535)

big brother, described last month. In January RADIO NEWS we are going to sum up our work on receivers suitable for cruisers, giving all the details of tubes, circuits and construction; together with details of a light-weight receiver equally adaptable to use on an automobile or a canoe—actually, provided the canoe will carry a 6-volt storage battery.

The Circuit

In the tuner, four tuned circuits controlled by two two-gang condensers, one dial tuning, are employed. Each tuned circuit (with the exception of the tuning condenser units) is housed in its own shield can. In the first three stages, comprising the three-stage screen-grid radio-frequency amplifier, type 222 screen-grid tubes are employed. The fourth tuned circuit, the detector, is of the regenerative type and employs a 112A tube.

The output of the detector feeds into a 112A first stage of transformer-coupled audio-frequency amplification, which is followed by a second audio stage consisting of a pair of 112A's arranged in push-pull.

Trimmer condensers shunted across the antenna tuning condenser and detector

tuning condenser allow peaking of the circuits to the received signal frequency.

In the first tuned circuit is connected a double-pole double-throw jack switch which can be employed to cut out the first r.f. stage secondary coil and connect in its place the loop.

A milliammeter, placed in series with the tickler coil of the detector circuit, provides a very desirable feature in the operation of the receiver in that it denotes comparative peak signal strength from the station tuned in.

When using the loop to obtain directional reception this meter provides a visual indication of maximum signal strength reception. That is, as the loop is rotated through the plane of the signal's path, the needle of the meter approaches a maximum reading and then with the loop in a direct line with the path of the signal maximum response is obtained. As the loop is further rotated, the reading falls off. Thus, by its use the operator need not rely solely on his ears for an indication of maximum or minimum response from a station with which the tuning circuits of the receiver are in resonance.

Besides being totally shielded by the individual shield cans, the several tuned circuits are completely filtered by the use of chokes and by-pass condensers, both in the plate and screen-grid circuits of the r.f. tubes. Also, each of the tuned stages has its tube shielded by a metallic tube ballast.

This battery-operated receiver has its filaments automatically controlled. In the screen-grid stages, the wire-wound tapped filament resistances function both as a resistance to drop the applied six volts to the 3.3 volts required by the tube's filament and also as a bias resistor supplying the necessary grid bias voltage to the control grids of the screen-grid tubes. In the detector and audio stages, ballast resistors do the trick.

The Junior Radio Guild

(Continued from page 537)

condenser C1 and the regeneration condenser C2; compare their positions with that shown in the accompanying illustration and then by means of the drilling templates which come with the two dials, spot the mounting holes and drill. When this operation is completed, the two condensers may be mounted on the panel. Next, drill four holes along the lower edge of the panel about 1/4 of an inch from the bottom, so that screws may be passed through the holes to fasten the panel to the edge of the baseboard. Then, look at the photograph and determine as accurately as possible the actual position of the socket. When you are sure that you have located its correct position, it may be mounted in place. Then take the coil base and by referring to the photograph make sure that you have it placed in its correct position. Then mount it by means of the wood screws and bushings which accompany it. Finally, mount the binding post terminal strip and radio-frequency choke, amperite, by-pass condenser and the grid leak mounting. In these mounting operations, always refer to the photograph so as to make sure that you have placed the various pieces of apparatus in their correct positions.

Wiring the Converter

Fig. 2 shows how the circuit is to be wired. It is necessary for you to cut strips of wire reaching from one terminal to the other on the various pieces of apparatus which are to be connected together. slip back the insulation from the wire and with a soldering iron and solder make fast the connections. It would be much better for you to attempt to follow the schematic circuit shown in Fig. 1, since while perhaps more difficult than following the picture wiring diagram, it will enable you to understand how circuit connections are made and thus become a valuable asset in your knowledge of radio.

To make the plug for connecting the adapter to the detector socket in your regular broadcast receiver, obtain, if possible. a burnt-out tube, break the glass away from the base and then remove the cement which will be found inside of the base. Unsolder the several wires which connect to the prongs in the base and then connect two fairly long flexible leads (long enough to reach from adapter to broadcast receiver) to the two thicker prongs. Then hold the tube base so that you are looking at the inside of it with the thick filament prongs towards the bottom, and connect a wire to the upper left-hand prong. These flexible leads should be properly insulated and should be about two feet long. Connect these leads to the binding posts as shown in Fig. 1.

Operation

Assuming that the "A" and "B" batteries and antenna and ground are connected to their respective binding posts and the converter plugged into the two-stage audio amplifier of the five-tube receiver, the next thing to do is to turn the filament switch on the broadcast receiver to the "on" position. This will light the filaments of all the tubes and providing that the converter has been wired correctly, stations ought to be received when the dials are rotated.

To tune in a station correctly, follow this procedure:

Turn the right-hand dial on the converter so that the movable plates of condenser C2 are practically all in, or in other words, completely meshed with the stationary plates of that condenser. Then by tapping the finger against the stationary plates of condenser C1, a loud plucking noise ought to be heard in your loud speaker. If this does not happen, then it is possible that the "B" batteries which are connected to the receiver are too low in voltage rating, the tube used in the detector socket of the converter may be an inefficient one, or the connections to the plate coil indicated by "P" and "B plus" on the coil base mount may be reversed. Check the circuit through and see that no mistake in this respect has been made. The plucking noise indicates that the converter tube is oscillating and is in the proper condition for reception. Without touching the dial of condenser C2, rotate slowly the dial of condenser C1. As you approach and tune in to a station, a loud squealing noise will be heard. When, by action of the tuning condenser dial, you reach the maximum squealing noise, turn the dial of condenser C2 so that the rotating plates come out of mesh with the stationary plates until such a point is reached where the squealing stops and the clear undistorted music or speech of the station which is tuned in has been received.

This is a procedure that should be followed in tuning in a station on any point on the tuning dial, and as you become more proficient in the manipulation of both of these dials, you will find that it will not be necessary to advance the regeneration control of condenser C2 so far that it is necessary to have the plates of the condenser completely meshed. Then, too, depending on the tube used, the plate and filament voltage, etc., it may be found that a point may be reached on the dial of C2 which requires no individual adjustment of this control for the various stations which may be tuned in. In other words, a point may be reached which is satisfactory for all stations tuned in and then the only dial which will have to be rotated will be that controlling condenser C1.

PARTS LIST

One panel, 7 x 14 x 3/16 inches.

One baseboard, 9 x 10 x ¾ inches.

Two National dials, type E.

Two Hammarlund midline condensers, .00014 mfd., type ML7 (C1 and C3)

One Benjamin socket, No. 9040.

One amperite, type 1A (R1).

One Hammarlund r.f. choke, type 250 (RFC).

One Parvolt by-pass condenser, .5 mfd., series A (C4).

One Hammarlund equalizer condenser, 70 mfd. (C2).

One Durham grid leak, 5 megohms (R2).

One Durham grid mount (single).

One set Hammarlund short-wave coil kit, type SWT-3.

INDEX TO ADVERTISERS

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Program Pioneers

(*Continued from page* 510)

August meeting which decided on what, at that time, were drastic advances. It was decided to engage a permanent group of vocal artists and a larger instrumental ensemble whose combined talents would permit the building of a more uniform program from week to week.

Armistice Day, 1924, chanced to fall on an Eveready Hour Tuesday.

The thematic type of program had been lying in abeyance since August. This seemed to be an opportunity to put it to the test. We chanced it. Things hummed. Typists had their dinners sent in. We wrote—they copied. Ensign kept phones hot till three buglers started for the studio. Eveready artists stood by for another page of the script on which their lyines and cues were written. Graham McNamee rustled around till he had his hands on that part of Kipling's "Recessional" which he was to read and he, and Max Jacobs with his orchestra, repaired to a studio to study proper balance as stringed instruments played "behind" Mac's reading. McClelland stood by, recalling surroundings "over there" where he had heard this and that song. So did Bill Ensign. Coupled with our own experiences, they were written into the script. When 9 o'clock arrived, there we were by the microphone in Studio A, a full script in each artist's hands, each familiar with his rôle and McNamee starting the ball rolling with the opening of what has been designated as the first thematic program.

The versatility, professional experience, talents, personal interest and loyalty of the Eveready group pulled us through that performance. They were magnificent—that night and a hundred nights after that night.

Rose Bryant, Arnold Morgan, Charlie Harrison, Max Jacobs, Bill Glenn, Ted Webb, Beulah Young, Tom Griselle—their spirit and enthusiasm and McNamee's sympathetic reading of narrative sequences must have carried over the air. For the program was well received.

The Armistice program was followed in December (in fact, on the first anniversary of National Carbon Company's broadcasting career) by a thematic program that became popularly known as the Golden Wedding program. What the Armistice program had done with war songs, this program contrived to do with old-time songs from Stephen Foster's day on to the '90's. A list of songs was made up, and cut in number and length to fit 60 minutes. The final list then was given a background in a blizzard-blown farmhouse where, despite the drifts and zero air, neighbors made their way in sleighs to help John and Mary Bishop celebrate their 50th wedding anniversary.

Tuesdays followed Tuesdays with fiendish speed. Everybody tried to maintain a sense of balance and relative proportion. It was realized that this new form of presentation opened up limitless fields for exploration. It was realized that the earliest thematic programs were poor, crude frameworks in comparison with the finished productions of larger import that were destined to follow.

In the meantime, we bowled along each Tuesday with a thematic experimentation.

That's what it was each week, an adventure, a feeler, a reaching into tomorrow. Some of the things we did taught us an idea was not sound—not good. But without trying, we would not have learned. Other ideas worked out well.

Merian Cooper returns to the States after sharing the trials and privations of a nation or people who migrate semi-annually with all their possessions. Night after night we sit with Cooper, translating the moving picture scenes of this migration into radio form, making Cooper the narrator of his own story and the group embellishing his descriptions with musical scorings.

Arthur Young comes home from Africa, where he has killed a lion with his bow and arrows. He has a story to tell.

Amusing things happened. Provoking things happened. One Tuesday we experimented with a program in which two dogs were supposed to be conversing. We had asked WEAF's program department to secure an animal impersonator for us to imitate the voices of various animals, particularly the barking of dogs. When we reached the studio, sure enough, the impersonator was there, but his impersonations had consisted of crawling into a skin of a lion or the back-end of a horse or the front-end of a cow and then cavorting over Broadway's stages to the great amusement of a visible audience. For an invisible audience, he amounted to just zero.

Every night was an experiment. It would be tiring to record more of them. As we progressed, refinements developed. Microphonics improved. Our knowledge of scoring a script improved, this effort resembling so closely the more recently developed art of scoring sound moving pictures. Our group grew. Harry Gilbert, Nat Shilkret, Betsy Ayres, Ethyl Hayden, Marjorie Nash, Wesley Howard, Jack Kinsey lent of their talent, skill and loyalty, giving of themselves in equal measure as the members older in point of service.

A story of the Eveready Hour from its beginnings would not be complete without tribute to the fortunate fate that made Graham McNamee available to us as announcer. The capacity exacted of him in these thematic programs was much more than that of announcer. He had to impersonate everything from a bo's'un's mate to a voice as impersonalized as a Roman oracle. Frequently our scripts would reach him only a few hours prior to going on the air.

We remember one program when he started us off without having had time to familiarize himself at all with the script. And our background was a fictional championship football game between Eastern and Western elevens. Near the end of the hour, we had written a description of the actual game, play by play. When the program had rolled on to that portion, Graham's eyes grew wide; he gave me a glance that needed no words to interpret its meaning; gritting his teeth, he plunged in. As only he can, the game was described, the only time that Graham McNamee ever read his description from a type-written page.

The Galapagos program (repeated each year since 1925) can be summed up in two words—"Red" Christiansen. Whatever was done by way of dramatizing this yarn, of drawing upon music to make it more graphic, the fact remains that it was "Red" who had suffered those almost unbelievable privations; that it was his story and that it was he who was telling it. Accustomed to the careful and studied enunciation of announcers, listeners found a wholesome novelty in "Red's" slight Danish accent and hearty seaman's manner of speech. It should, in all fairness to "Red," be recorded that he is far from being the illiterate that his Galapagos broadcastings would indicate.

The Showboat program grew out of an idea that we might find unusual radio fare among the books appearing each month under the name of this, that and the other publisher. We had done a program that was built about a book, "Shanghaied Out of Frisco." Its publishers had reported increased sales as a result. In passing, the "Shanghaied" program was another experiment, in that it was the first effort at a serial broadcast. Only half of the story was told. We were criticised pretty severely in listeners' letters for playing such a trick on them. We never serialized anything after that.

There is not much that can be written about this program to differentiate it from many that had preceded it and that have followed it since. We had a studio full of professional people, headed by Lionel Atwill, whose talents and perfect enunciation had served us often previously. The story was carried by him as a narrator, his descriptions being broken frequently by dialogue and occasionally by music. We were confronted by the necessity of portraying hand applause by a large audience. We had found that ten or fifteen people clapping their hands in a studio sounded like ten or fifteen people—when it reached the loud speaker. For many nights, we listened to the applause of large audiences over the radio and finally believed that the sound was most like that of the rustling of heavy manila wrapping paper. Taking several sheets to a studio rehearsal, we experimented and found that the effect was just that of hundreds of people clapping their hands. And Lionel Atwill got more kick out of rustling his paper applause during the broadcast than from any other phase of the hour.

The stage—and the concert field, too—had been loosening the bolts a bit by this time, October, 1926, and theatrical talent had been available to us for some time. Probably 100 actors and actresses were given auditions before the final Showboat cast was selected. Previously, Maida Craigin, Richard Mansfield's leading lady, had done for us what, in our mind, was one of the gems of radio acting, the rôle of Asa in an Eveready presentation of "Peer Gynt." Arvid Paulsen had played the Peer in this production. Others famed for their stage successes had appeared, including John Drew in another radio gem, the last act of "Rosemary"; Francis Wilson in "Rip Van Winkle"; DeWolf Hopper in a hodgepodge including "Casey at the Bat" and many others.

We recall with pleasure Laurette Taylor's radio presentation of "Peg o' My Heart"; casting a prize-fight from the classic atmosphere of Carnegie Hall, featuring Richard Dix and Mary Brian, just as they performed in the picture, "Knockout Riley"; the brilliant success of Pablo Casals, the amusing triumph of Irwin Cobb; the first radio appearance of Moran and Mack.

The season of 1927-1928 was an application of our experience over a period of years; the blending of pretentious continuity programs with programs of light music and guest artists. Francis Wilson, Laurette Taylor and Irvin Cobb, three outstanding successes of the previous season, were put on again between October and December of that year.

The early part of 1928 saw the presentation of glamorous "Trader Horn" himself, Commander Byrd, a repeat program of Galapagos, the London String Quartet, a revival of "Peer Gynt," and many outstanding concerts. The fall of 1928 and the winter of 1929 showed the Eveready Hour to its best advantage, because in that time we saw the development of the continuity form of musical radio drama built to its finest point today, in such programs as "Joan of Arc" and "Tristram."

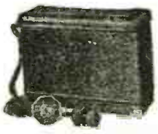
Nineteen-twenty-nine also saw the introduction of original musical comedies on the Eveready Hour. The radio audience probably recalls "The Mayor of Hogan's Alley," "The Small-Timer" and "The Local Boy Makes Good."

Eveready is also proud of the development of a new type of program—musical biographies of great composers, examples of which were the life of Beethoven and the life of Liszt, in dramatic form. Listeners may also recall with pleasure Dr. Roy Chapman Andrews' appearance in 1929, Miss Joan Lowell's program in April, and Commander Ellsberg's thrilling personal narrative of "The Raising of the S-51."

"Under the Gaslight," a revival of one of the famous thrillers of the sixties, full of dark villainy, pompous "asides," haircloth furniture, fainting ladies, what-nots and bustles, was an Eveready hit that served to show the vast progress of the American drama since Gettysburg.

A unique event, tinctured with sorrow to all lovers of fine music, was the Eveready Hour broadcast of the farewell performance of the famous Flonzaley Quartet. This great organization, accustomed to the necessarily small audiences of intimate chamber music halls, had its invisible millions listen the night of May 7, when they sent on the air their last concert before disbanding. Nicholas Longworth, Speaker of the House of Representatives, on behalf of musical America, said farewell to the "peerless four" in a special hook-up from Washington.

WHAT'S NEWS IN RADIO?



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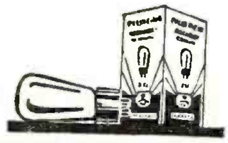

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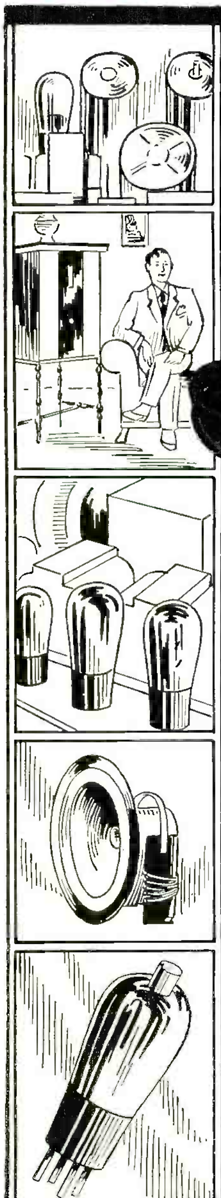

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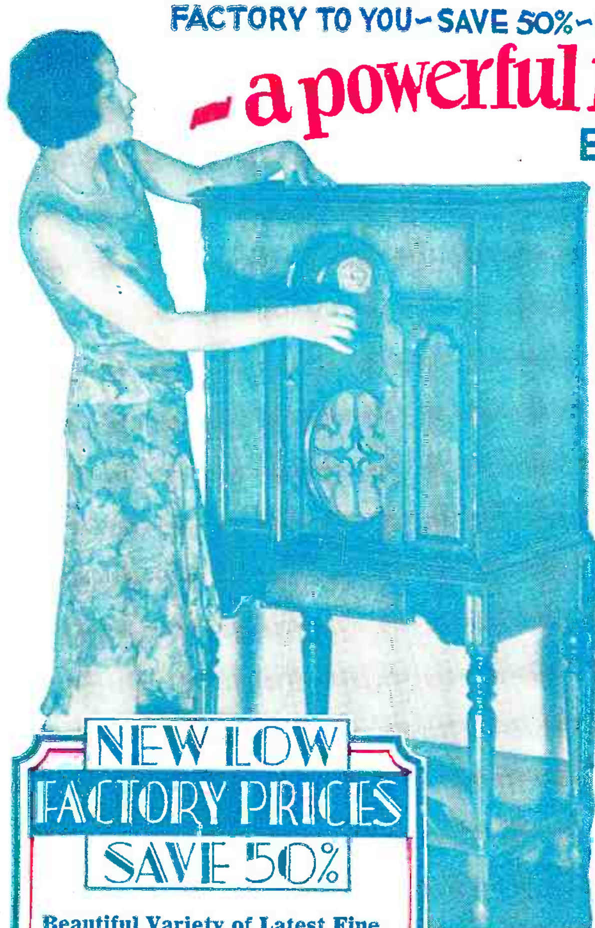

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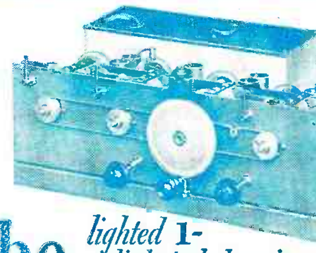

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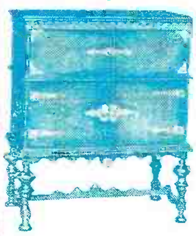
An exquisitely new and fine, genuine walnut desk-type Mastercrest console. Very pretty and a rare bargain. Hinged top.



Spanish Treasure chest design, Mastercrest console. Finest selected grain, solid walnut. Antique wrought hardware. Marvelous value. Hinged top.

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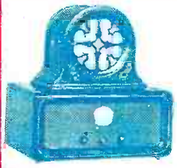

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