SHORT WAVE LIST

RADIO NEWS

JANUARY
25 Cents

1933

and

Radio Call Book Magazine

and

Technical Review

Erecting an Interference Preventing Antenna

Batteryless Auto Radio

New Class B Amplifier

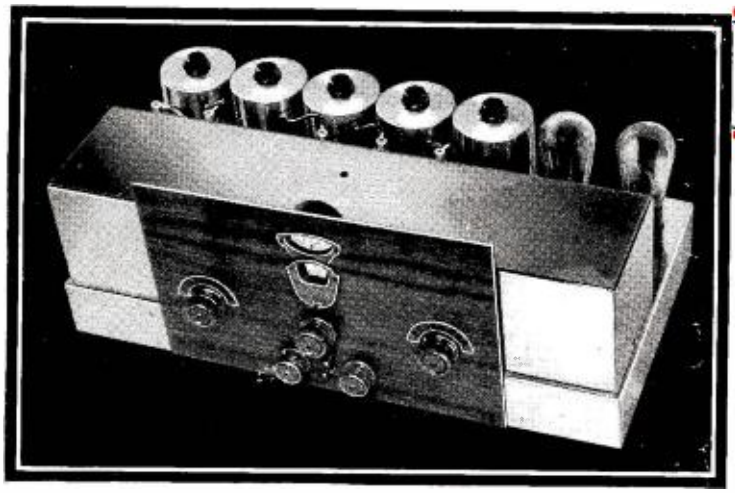
Mathematics in Radio

Experimenting with Photocells

Super Power

guarantees–

To You Every Bit of Performance Possible Under Prevailing Atmospheric Conditions



Lincoln De Luxe
All Wave Superheterodyne

15 TO 550 METERS

With undistorted amplification made possible thru Lincoln's foresight in development of new triple push pull detector and audio system.

Automatic Volume Control
Signal Indicator
Four High Gain I. F. Stages

SUPER POWER of the New Twelve-Tube Lincoln DeLuxe SW-33, coupled with the new Lincoln developments, guarantees to you real radio reception of unlimited distance.

If you have never tuned the new Lincoln, you have missed the treat of your life.

Just tune to a European station which ordinarily fades completely out at times, and note how the Lincoln new automatic volume control holds the signal at a perfect level.

Watch the signal indicator register the weakest signal, and then tune to the exact center of the carrier wave with absolute precision.

When you wish to tune late at night, open up the sensitivity control wide, with power to reach any distance, and reduce volume control to whisper.

Throw in the 53 to 1 ratio on the dial for ease in tuning high frequencies.

Open up the volume control to the limit and shake the floor with the tremendous amplification, without distortion.

Listen to the heavy bass vibratory notes produced by the use of the push-pull detector followed by two stages of push-pull audio and reproduced in the finest auditorium type speaker we can procure.

Note the high sensitivity provided by four tuned stages of intermediate amplification—just tune in a foreign station—you will want the volume control opened only a few degrees.

Just note what a recent Lincoln owner in Java (a country with extremely bad weather conditions, and mineral deposits, making high noise interference) says about the new Lincoln: "Foreign stations come in very loudly. Paris, Rome, Zeesen, Konigswusterhausen, Chelmsford and a score of other European stations come in clearly; Sydney, Queensland and Melbourne from Australia can be received with great volume; JIAA from Japan is consistently heard, while Pittsburgh and Schenectady have been received. Also on the broadcast band daily reception can be had from several European stations, Japan, Manila and China. I have heard of no other set that can equal your Lincoln."

Owners of the first Lincoln models are still proud of their performance.

BATTERY RECEIVER uses ten (10) two-volt tubes, and can be used in connection with the Air Cell or storage batteries.

Mail the coupon for Laboratory information and price. New York City territory write Valentine G. Hush, Division Drive, Dobbs Ferry, N. Y.

LINCOLN RADIO CORPORATION
Dept. N-1, 329 S. Wood St., Chicago, Ill.
Please send information on ☐ A.C. ☐ D.C. receivers.

Name _____

Address _____

City _____ State _____

Print name and address plainly

LINCOLN
De Luxe Receivers

It's What's *BEHIND* the SCOTT ALL-WAVE 15-550 Deluxe METER that makes it THE WORLD'S FINEST RADIO RECEIVER

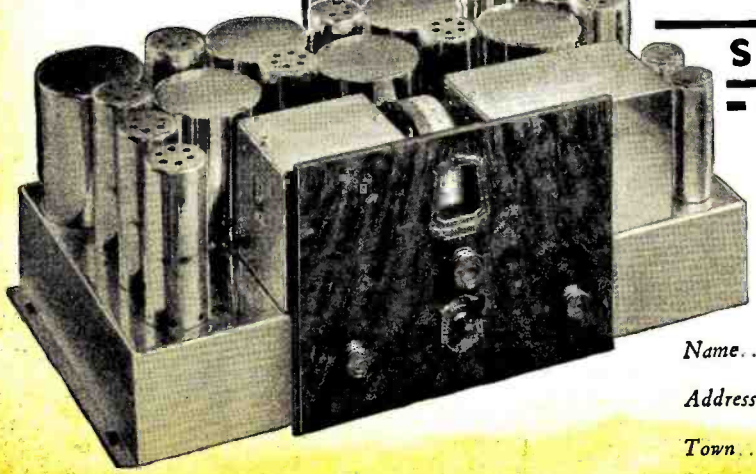
This special SCOTT-designed precision instrument, found in no other laboratory, matches oscillator coils with the antenna with which they are used. So delicate that each coil is matched to its antenna within ⅛ of a single turn of wire.

The SCOTT Research Laboratory is constantly engaged in testing and experimenting to discover new ways and means of assuring SCOTT ALL-WAVE DELUXE owners better reception, finer tone and a higher degree of satisfaction with their sets.

Within a carefully shielded room, from which all outside disturbances are excluded, SCOTT receivers are tested on signals sent within the laboratory from very latest type GR standard frequency generator and a GR audio oscillator.

Here is how resistors in SCOTT receivers are tested, to assure fine tone, fine tuning and super sensitivity. The delicacy of these testing instruments detects variations of ½ of 1% from proper ratings. The SCOTT standard for acceptance demands perfection.

In this electric oven the "climate" is baked out of SCOTT transformers. After every iota of moisture is baked out, the parts are treated so that they will always deliver perfect service in any climate from that of the Arctic to the humid heat of the Tropics.



'Round-the-world reception guarantee . . . unparalleled tone fidelity . . . super-selectivity . . . true single dial control on all reception between 15 and 550 meters . . . no plug-in or tapped coils . . . the whole radio-wise world is talking of the sensational performance of this new SCOTT ALL-WAVE DELUXE!

Perhaps *you've* wondered . . . perhaps *you*, too, have questioned *how* such performance could be secured.

To know, you must look behind the scenes. You must see the infinite care, the accuracy, the micrometer-measured exactness, with which specially trained craftsmen build these receivers in the way that all fine things are built . . . by hand!

Still farther back you'll find super-careful selection of every part that goes into every SCOTT receiver. Tested again and again . . . coils, condensers, transformers—every single part must meet the most rigid specifications by trial on delicate instruments infinitely more revealing than any human judgment.

No mass-production methods here—no slap-bang assembly of "good enough" parts. Every step in the construction of a Scott receiver is one of care and deliberation, taken by an expert.

No wonder the completed receiver is a "world-beater." No wonder more than 19,000 logs of foreign reception on Scott receivers have been sent to us since January 1st, 1932. No wonder Scott receivers have held world's record distance reception honors for more than six years. The whole story of SCOTT laboratory technique in radio receiver construction is a fascinating one. You should have it, to know how fine things are made. And the more you learn, the more you will marvel that such quality can be had at such moderate cost. Send for the whole story NOW!

Get our newly published brochures, "The Creation of a Masterpiece," and "PROOF of Consistent Foreign Reception." They will tell you what *real* radio performance is . . . and PROVE that you get it from a SCOTT ALL-WAVE DELUXE.

E. H. SCOTT RADIO LABORATORIES, INC.
4450 Ravenswood Ave., Dept. N-13, Chicago, Illinois

SEND THIS COUPON FOR PROOF

E. H. SCOTT RADIO LABORATORIES, INC.,
4450 Ravenswood Ave., Dept. N-13 Chicago, Ill.

Send me your two new brochures that tell how and why SCOTT ALL-WAVE DELUXE Receivers out-perform all others. This is not to obligate me in any respect.

Name.....

Address.....

Town..... *State*.....

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Associate Editor

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Ass't Tech. Editor

RADIO NEWS

Howard S. Pearse
Associate Editor

Samuel Kaufman
Broadcast Editor

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Art Editor

Edited by Laurence M. Cockaday

VOLUME XIV | January, 1933 | NUMBER 7

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RADIO CALL BOOK SECTION

DEPARTMENTS

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222 WEST 39th STREET, NEW YORK CITY, N. Y.

25c a Copy, $2.50 a year, $3.50 in Canada, $3.50 in Foreign Countries. Subscribers are notified that change of address must reach us five weeks in advance of the next day of issue.

LEARN RADIO IN 10 WEEKS!

PAY FOR YOUR TRAINING AFTER YOU GRADUATE

I am making an offer that no other school has dared to do. I'll take you here in my shops and give you this training and you **pay your tuition after you have graduated.** Two months **after you complete** my course you make your first payment, and then you have ten months to complete your payments. There are no strings to this offer. I know a lot of honest fellows haven't got a lot of money these days, but still want to prepare themselves for **a real job** so they **won't have to worry** about hard times or lay offs.

I've got enough confidence in these fellows and in my training to give them the training they need and pay me back after they have their training.

If you who read this advertisement are really interested in your future here is the chance of a life time. Mail the coupon today and I'll give you all the facts.

A scene in the big, busy Radio Shops at Coyne. Here you see fellows working on real Radios—not reading about them from books or lessons. This is THE way to prepare for the big-money field of Radio!

TELEVISION *and* TALKING PICTURES

Television is already here! Soon there'll be a demand for THOUSANDS of TELEVISION EXPERTS! The man who learns Television **now** can have a great future in this great new field. Get in on the **ground-floor** of this amazing new Radio development! Come to COYNE and learn Television on the very latest, newest Television equipment. Talking Picture and Public Address Systems offer opportunities to the Trained Radio Man. Here is a great new Radio field just beginning to grow! Prepare NOW for these wonderful opportunities! Learn Radio Sound Work at Coyne on actual **Talking Picture** and **Sound Reproduction** equipment.

PREPARE NOW and be ready for Radio's many opportunities

Forget pay-cuts—lay-offs—unemployment! Don't be tied down to an untrained man's future. You NEED TRAINING IN A FAST-GROWING MONEY-MAKING TRADE. Here's your chance of a lifetime to get it! Hundreds of opportunities now open in Radio. My sensational offer, explained below, makes it possible for you to START AT ONCE!

The right way to learn Radio is the **Coyne way**—not by books, but by actual, practical work on actual Radio, Television and Sound equipment. Here at Coyne you'll service and operate scores of modern Radio receivers, huge Broadcasting equipment, late type Television apparatus, Talking Picture machines, Code transmitters and receivers, etc. In 10 weeks you can step into a REAL JOB, leading to a salary of $50 a week and UP!

ALL PRACTICAL WORK At COYNE in Chicago

ALL ACTUAL, PRACTICAL WORK. You build radio sets, install and service them. You actually **operate** great Broadcasting equipment. You construct Television Receiving Sets and **actually transmit your own Television programs over our modern Television equipment.** You work on **real** Talking Picture machines and Sound equipment. You learn Wireless Operating on actual Code Practice apparatus. We don't waste time on useless theory. We give you the **practical training** you'll need—**in 10 short, pleasant weeks.**

MANY EARN WHILE LEARNING

You get Free Employment Service for Life. And don't let lack of money stop you. Many of our students make all or a good part of their living expenses while going to school and if you should need this help just write to me. **Coyne is 33 years old.** Coyne Training is tested—proven beyond all doubt. You can find out everything **absolutely free. Just mail coupon for my big free book!**

H. C. LEWIS, Pres. RADIO DIVISION Founded 1899

COYNE ELECTRICAL SCHOOL

500 S. Paulina St., Dept. 13-8C, Chicago, Ill.

Mail Coupon Today for All the Facts

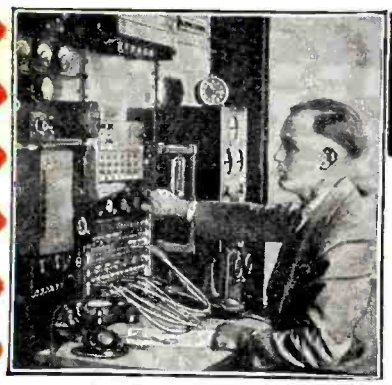
H. C. LEWIS, President
Radio Division, Coyne Electrical School
500 S. Paulina St., Dept. 13-8C, Chicago, Ill.

Dear Mr. Lewis: Send me your big FREE Book; details of your FREE Employment Service; and tell me all about your special offer of allowing me to pay for training on easy monthly terms after graduation.

Name.....

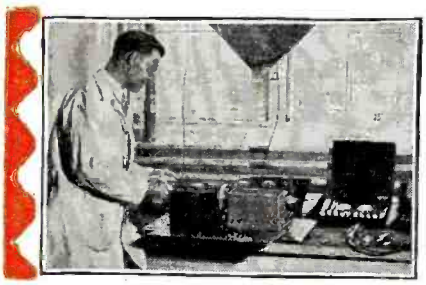
Address.....

City.....*State*.....

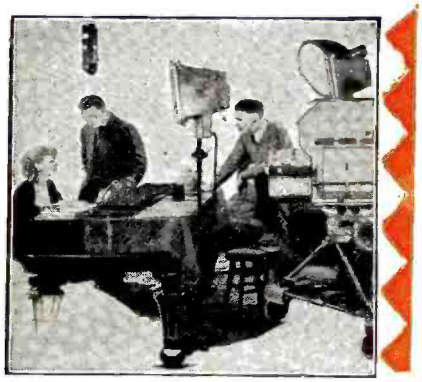


Broadcasting Stations employ trained men continually for jobs paying up to $5,000 a year.

Police Departments are finding Radio a great aid in their work. Many good jobs have been made in this new field.



Spare time set servicing pays many N.R.I. men $200 to $1,000 a year. Full time men make as much as $65, $75, $100 a week.



Talking Movies—an invention made possible by Radio—employs many well trained radio men for jobs paying $75 to $200 a week.

Television—the coming field of many great opportunities—is covered by my course.

I WILL TRAIN YOU AT HOME

Many Make $50 to $100 a Week in Radio -- *the Field With a Future*

My book, "Rich Rewards in Radio," gives you full information on the opportunities in Radio and explains how I can train you quickly to become a Radio Expert through my practical Home Study training. It is free. Clip and mail the coupon NOW. Radio's amazing growth has made hundreds of fine jobs which pay $50, $60, $75, and $100 a week. Many of these jobs may quickly lead to salaries as high as $125, $150, and $200 a week.

Radio—the Field With a Future

Ever so often a new business is started in this country. You have seen how the men and young men who got into the automobile, motion picture, and other industries when they were started had the first chance at the big jobs—the $5,000, $10,000, and $15,000 a year jobs. Radio offers the same chance that made men rich in those businesses. It has already made many men independent and will make many more wealthy in the future. You will be kicking yourself if you pass up this once-in-a-lifetime opportunity for financial independence.

Many Radio Experts Make $50 to $100 a Week

In the short space of a few years 300,000 Radio jobs have been created, and thousands more will be made by its future development. Men with the right training—the kind of training I will give you in the N.R.I. Course—have stepped into Radio at 2 and 3 times their former salaries. Experienced service men as well as beginners praise N.R.I. training for what it has done for them.

Many Make $5, $10, $15 a Week Extra in Spare Time Almost At Once

My Course is world-famous as the one "that pays for itself." The day you enroll I send you material, which you should master quickly for doing 28 Radio jobs common in most every neighborhood. Throughout your Course I will show you how to do other repair and service jobs on the side for extra money. I will not only show you how to do the jobs but how to get them. I'll give you the plans and ideas that have made $200 to $1,000 a year for N.R.I. men in their spare time. G. W. Page, 110 Raleigh Apts., Nashville, Tenn., writes: "I made $935 in my spare time while taking your Course." My book, "Rich Rewards in Radio," gives many letters from students who earned four, five, and six times their tuition fees before they graduated.

Get Ready Now for Jobs Like These

Broadcasting stations use engineers, operators, station managers and pay up to $5,000 a year. Radio manufacturers employ testers, inspectors, foremen, engineers, service men, buyers, and managers for jobs paying up to $6,000 a year. Radio dealers and jobbers (there are over 35,000) employ service men, salesmen, buyers, managers and pay up to $100 a week. Talking pictures pay as much as $75 to $200 a week to men with Radio training. There are hundreds of opportunities for you to have a spare time or full time Radio business of your own—to be your own boss. I'll show you how to start your own business with practically no capital—how to do it on money made in spare time while learning. My book tells you of other opportunities. Be sure to get in at once. Just clip and mail the coupon.

I HAVE STARTED MANY IN RADIO AT 2 AND 3 TIMES

$400 Each Month

"I spent fifteen years as traveling salesman and was making good money but could see the opportunities in Radio. Believe me, I am not sorry, for I have made more money than ever before. I have made more than $400 each month and it really was your course that brought me to this. I can't say too much for N.R.I." J. G. Dahlstead, Radio Station KYA, San Francisco, Cal.

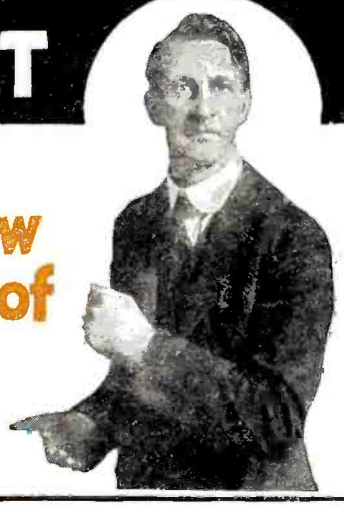
$800 In Spare Time

"Money could not pay for what I got out of your course. I did not know a single thing about Radio before I enrolled, but I have made $800 in my spare time although my work keeps me away from home from 6:00 A.M. to 7:00 P.M. Every word I ever read about your course I have found true." Milton I. Leiby, Jr., Topton, Pa.

Chief Engineer Station WOS

"I have a nice position and am getting a good salary as Chief Engineer of Radio Station WOS. Before entering Radio, my salary was barely $1,000.00 a year. It is now $2,400.00 a year. Before entering Radio, my work was more or less a drudgery—it is now a pleasure. All of this is the result of the N.R.I. training and study. You got me my first important position." H. H. Lance, Radio Station WOS, Jefferson City, Mo.

TO BE A RADIO EXPERT



Act Now --- Mail Coupon Below for Free Book of Facts and Proof

You Learn at Home in your Spare Time to be a Radio Expert

Hold your job. There is no need for you to leave home. I will train you quickly and inexpensively during your spare time. You don't have to be a high school or college graduate. My Course is written in a clear, interesting style that most anyone can grasp. I give you practical experience under my 50-50 method of training—one-half from lesson books and one-half from practical experiments with equipment given without extra charge. This unique and unequalled method has been called one of the greatest developments in correspondence Radio training. N.R.I. pioneered and developed it. It makes learning at home easy, fascinating, practical.

Learn the Secrets of Short Wave, Television, Talking Pictures, Set Servicing, Broadcasting, Etc.

I'll give you more training than you need to get a job—I'll give you your choice, and not charge you extra either, of my Advanced Courses on these subjects—(1) Television, (2) Set Servicing and Merchandising, (3) Sound Pictures and Public Address Systems, (4) Broadcasting, Commercial and Ship Radio Stations, (5) Aircraft Radio. Advanced specialized training like this gives you a decided advantage.

Your Money Back If You are Not Satisfied

I will give you an agreement in writing, legal and binding upon this Institute, to refund every penny of your money upon completing my Course if you are not satisfied with my Lessons and Instruction Service. The resources of the National Radio Institute, Pioneer and World's Largest Home-Study Radio School stands behind this agreement.

Find out what Radio offers. Get my Book

One copy of my valuable 64-page book, "Rich Rewards in Radio," is free to any resident of the U. S. and Canada over 15 years old. It has started hundreds of men and young men on the road to better jobs and a bright future. It has shown hundreds of men who were in blind alley jobs, how to get into easier, more fascinating, better paying work. It tells you where the good Radio jobs are, what they pay, how you can quickly and easily fit yourself to be a Radio Expert. The Coupon will bring you a copy free. Send it at once. Your request does not obligate you in any way. ACT NOW.

J. E. SMITH, President
Dept. 3AR, National Radio Institute
WASHINGTON, D. C.

Sample Lesson Free

I'll send you a Free Lesson to prove that my Radio Course is easy, practical. That's how confident I am that I can train YOU at home in your spare time to become a Radio expert. Only my students could have this book in the past. I KNOW that when you see it, read it, examine it you will be delighted with its clear, simple way of teaching Radio. I KNOW—because I have ALREADY trained thousands of men. Many of them with not even a grammar school education, and no Radio or electrical experience, have become Radio experts and earn two or three times their former pay. Mail the coupon now.

SPECIAL Radio Equipment for Broad Practical Experience *Given Without Extra Charge*

My Course is not all theory. I'll show you how to use my special Radio equipment for conducting experiments and building circuits which illustrate important principles used in such well-known sets as Westinghouse, General Electric, Philco, R. C. A., Victor, Majestic, and others. You work out with your own hands many of the things you read in our lesson books. This 50-50 method of training makes learning at home easy, interesting, fascinating, intensely practical. You learn how sets work, why they work, how to make them work when they are out of order. Training like this shows up in your pay envelope—when you graduate you have had training and experience—you're not simply looking for a job where you can get experience.

With N. R. I. equipment you learn to build and thoroughly understand set testing equipment—you can use N. R. I. equipment in your spare time service work for extra money.

Clip and mail NOW for FREE INFORMATION

J. E. SMITH, President
National Radio Institute, Dept. 3AR,
Washington, D. C.

Dear Mr. Smith: I want to take advantage of your Special Offer. Send me your Sample Lesson and your book "Rich Rewards in Radio," which points out the opportunities for spare time and full time jobs in Radio and your famous 50-50 method of training men to become Radio Experts through home study. I understand this request does not obligate me.

Name.....

Address.....

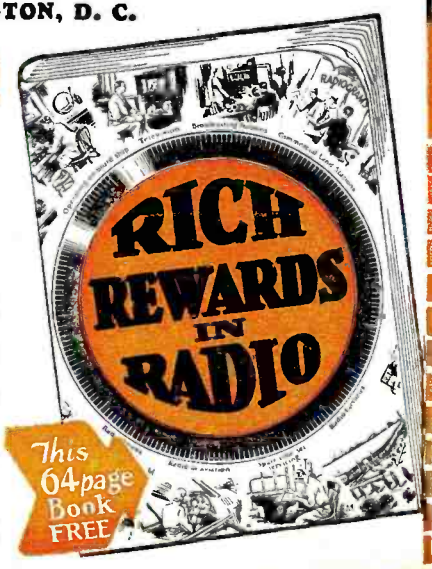
City.....State.....

"R"

FORMER PAY

Experienced Radio Man Praises N. R. I. Course

"Before taking your course, I had worked at Radio for over seven years, doing quite a bit of servicing, but I realized that I was in need of better training. From the first lesson on I began to understand points that had had me wondering. I would not take many times the price it has cost me, for the knowledge I have gained. In a period of nine months, I have made at least $3,500." C. J. Stegner, 28 So. Sandusky St., Delaware, Ohio.



The Editor—to *You*

MANY thousands of our readers will be looking to this issue of RADIO NEWS for inspiration during the Christmas holiday and New Year's season, and it is fitting that we should look back over the year 1932 to consider the benefits that radio has brought to us all. Not only has it helped while away idle moments, in entertainment of all aural sorts, but it has contributed considerably to our education. It is true it has made us laugh, but it has also given us drama, has relayed, directly to our ears, first news of important events, has kept us "up" on sports, has told us of exploration in far parts of the world, has brought us lectures and other enlightening talks on all subjects from the latest developments in science, through the gentle art of housekeeping, how to cook, what to buy, how to speak foreign languages and in fact all of the very general information necessary to modern living conditions.

* * *

IT has brought to our ears the details of the greatest political campaign that has ever been waged over the air or through any medium. It has been the medium for arousing our citizenry to the greatest political demonstration ever given at the polls. It has been the prime factor in electing our new President to office for the next four years. It has been established as one of the leading channels for free speech. It has been one of the leading factors of cheer and encouragement in the home during world-wide depression. Now it is with us, helping us to raise ourselves once more to the path of prosperity. It has been of inestimable value in unemployment drives in getting help for those in need. It has stuck with us during our time of trouble and we mean to carry its development forward to make it an even greater boon to humanity in increasingly better times.

* * *

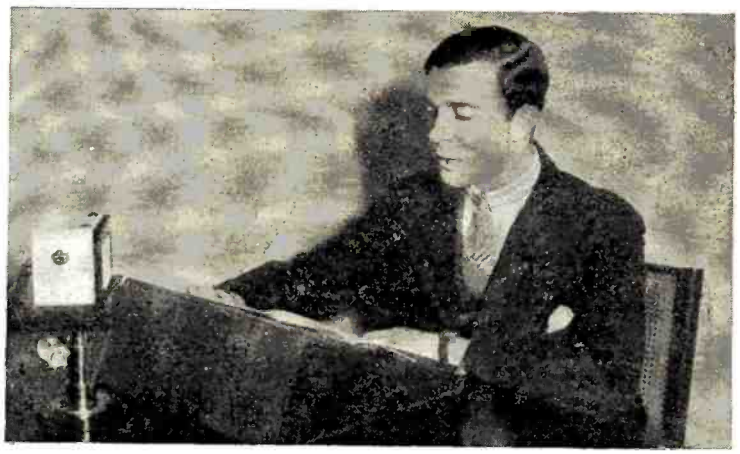
SO MUCH for looking backward. What about the present and the future? In this holiday season, what better gifts could we make to the members of our family, to our growing children, to our friends, than to provide them with a receiving set for their own personal use? What better gift could we offer to a friend than a complete receiver? The present prices of the smaller sets make them admirable gifts for our children—a midget for our son's or daughter's room so that they may listen in to a particular broadcast that does not interest other members of the family. The editor has four such receivers in his own home and on many occasions they are all working at the same time behind closed doors; especially has this been true during the recent political campaign, when one member of the family wanted to listen to one event that did not interest others, etc.

* * *

OR it is quite possible that some of our readers might like to *build* a receiver for a friend or a relative, with less financial expense. In this issue will be found full constructional details for a set that is economical to build and that will give excellent reception results. It is called the "Economy Eight" and, as the name implies, this receiver employs eight tubes in an improved circuit design.

* * *

OR again, an excellent gift might be a complete set of tubes, an auto radio set; these will be found well represented in this issue. Another admirable Christmas gift would be a year's subscription to RADIO NEWS. It might be given to a friend interested in radio or to a member of the family following radio as a hobby. It *is* true that *radio is to play an increasingly important part in our lives,* and everyone should know something about its fundamentals.



* * *

AND now looking toward the future, what has radio in store for us during the coming year? It is predicted that, with the wonderful development in radio tubes, receiving sets offered to the public during 1933 will be more efficient, will reach out to greater distances and will give better tone quality than ever before. New types of circuits, especially in amplification, are making radio receivers more powerful and at the same time simpler to handle and operate. The loudspeaker is coming in for it share of development and radio receivers will have a better chance to show their ability through these improved reproducing devices.

* * *

MAN-MADE static is slowly being conquered and inductive interference is surely bowing before the technical onslaught of the filter experts and the antenna lead-in designers. Fading of radio signals will be a thing of the past in the new sets of 1933, for the new automatic volume-control devices compensate for it without human aid. The new automobile radio receivers work without additional batteries and are easily and quickly installed in all makes of cars. The short-wave and ultra-short-wave fields will be further explored and developed and receivers are now on the market for listening in, at almost any time, to foreign broadcasts which can be received with a volume and clarity more than comparable to local reception of a few years ago. Radio has finally linked the whole world together and signals from the Antipodes are brought to our ears clearly and loudly in approximately one-seventh of a second—about the time it takes for one to blink his eyes.

* * *

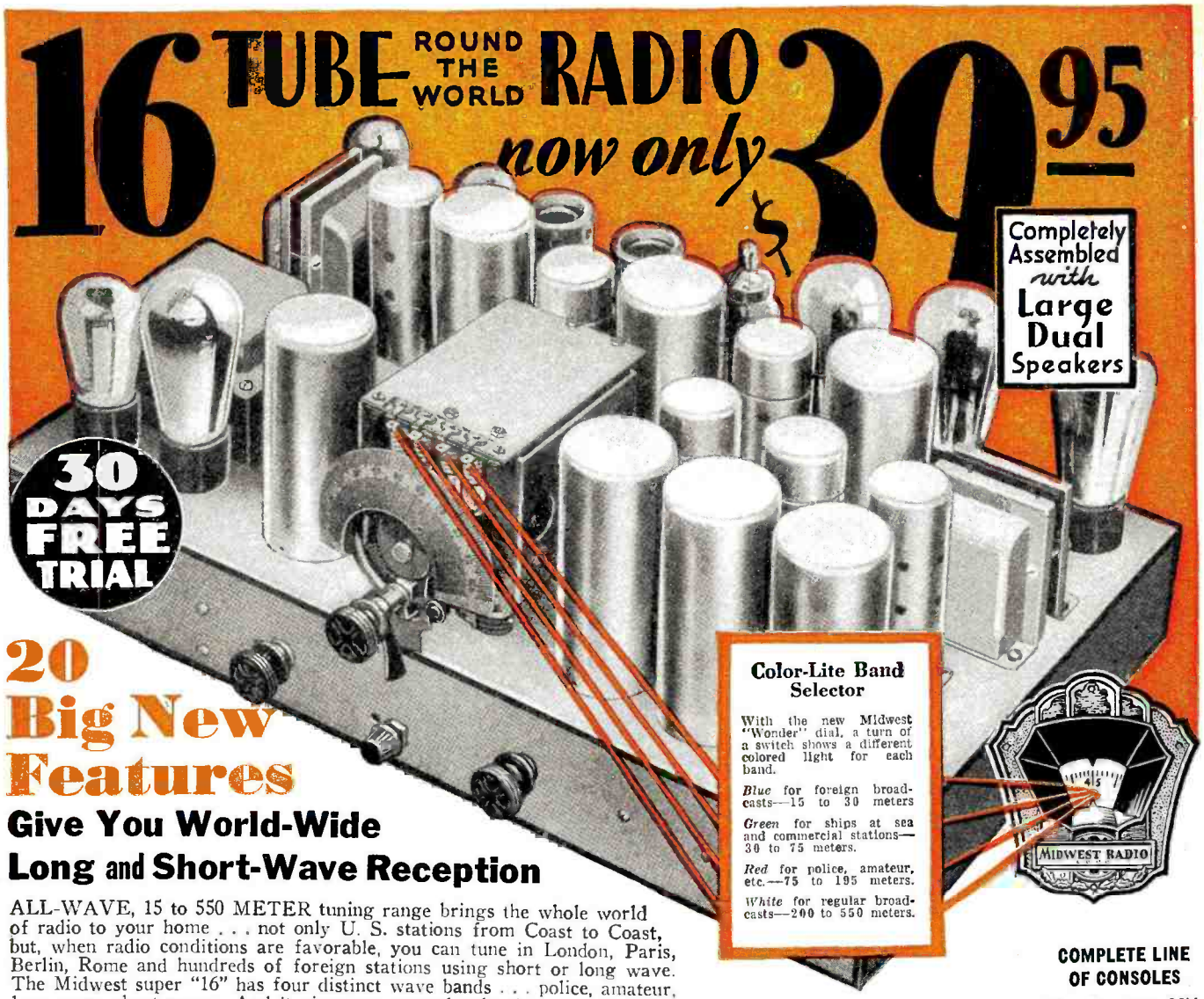
IT is predicted that in 1933 the radio serviceman wil be the backbone of sales and service for the radio industry. He is now looked upon as the radio listener's mentor and guide both in purchasing radio equipment and in keeping it in proper repair. In the coming twelve months it is estimated that he will service, in America, well over two million old sets, replacing tubes, batteries, loudspeakers and other accessories wherever needed. It is estimated that he will be directly responsible for the sale of a million receiving sets and approximately ten million tubes. Service work in general will be of a higher standard and listeners will therefore be able to get good reception of programs at all times. And the broadcasters promise us improved programs, more human interest, more spot news and other worth-while material coming over the air.

* * *

THE photograph on this page, which is provided through the courtesy of the American-Swedish News Exchange, shows a man using the radio to "beg" for clothes and shoes—but not for himself. He is Prince Gustaf Adolf, oldest son of the Crown Prince of Sweden, broadcasting a request to collect these articles of wearing apparel for the benefit of the unemployed.

Hugo Gernsback

16 TUBE ROUND THE WORLD RADIO now only $39.95



20 Big New Features Give You World-Wide Long and Short-Wave Reception

ALL-WAVE, 15 to 550 METER tuning range brings the whole world of radio to your home . . . not only U. S. stations from Coast to Coast, but, when radio conditions are favorable, you can tune in London, Paris, Berlin, Rome and hundreds of foreign stations using short or long wave. The Midwest super "16" has four distinct wave bands . . . police, amateur, long wave, short wave. And it gives you marvelously clear reception . . . better than 7½ KC selectivity. With the wonderful new matched dual speakers, tone control and STAT-OMIT tuning silencer, you will enjoy sensationally clear and smooth radio reception such as you have never before known. And above all you will enjoy absolutely faithful tone reproduction. Thousands of Midwests are giving wonderful satisfaction in every state of the Union and forty-nine foreign countries as well. No radio at any price can give you better reception than this famous Midwest which you buy direct from the factory at a sensationally low price.

TERMS as low as $5 DOWN

4 Sensational Midwest Features

Midwest 1933 ALL-WAVE radios have all the worthwhile improvements and many exclusive Midwest features. Outstanding among the important advantages of these big powerful sets are these:

STAT-OMIT Tuning Silencer

An inter-station silencer or noise suppressor that automatically omits all in-between-station noises, swishing, cracking and frying. This new method gives perfect tuning without Neon lights, visual meters or buttons formerly required.

Class "B" Amplification

Gives absolutely faithful reproduction of all tones and overtones. Enormous reserve power capable of reproducing any instrumental combination of the most powerful orchestra. Handles the full volume of the largest pipes of the grand organ.

Dual Speakers

Two full electrodynamic speakers for complete audible tone range, especially designed for the tremendous power output of the new tubes.

One Chassis—One Dial

Only one chassis for everything, 15 to 550 meters . . . regular broadcasts, police, amateur, ships at sea, commercial stations, foreign shortwave broadcasts. No converter or other auxiliary units used. All bands controlled by one dial.

Read These Letters!

"Am having good results with my 16-tube Midwest. On the short wave I have had most all of the large stations. I get several of the Airport stations and amateur stations aplenty. Had G5SW, LEX, Buenos Aires, VK2ME, VK3ME, Sydney, VE9GW, Bowmanville, Canada, Pointoise, France and Nauen, Germany."
R. P. REYNOLDS.
P. O. Box 1125, Orlando, Fla.

* * *

"The 16-tube radio arrived yesterday, got it going today and to express myself in a few words. What a radio! What a tone! What a surprise! Really, it is more radio than I ever dreamed of seeing incorporated in one chassis. It's wonderful.
L. F. KIMMELL,
7324 Wakefield Ave., Cleveland, Ohio.

COMPLETE LINE OF CONSOLES

The big new Midwest catalog shows gorgeous line of artistic consoles in the new six-leg designs. Mail the coupon now. Get all the facts.

Deal Direct With Factory—SAVE UP TO 50%

Midwest sweeps aside the costly old-fashioned way of selling through jobbers and dealers. You buy direct from the factory. You have 30 days trial in your own home and a positive guarantee of satisfaction or money back. If you wish, you may pay for your Midwest in small monthly sums that you'll scarcely miss. Remember . . . only $10.00 down puts even the biggest and finest Midwest in your home now. Some models as low as $5.00 down.

Don't Buy Any Radio Before You Get Details of This Sensational Value!

Investigate! Mail the coupon. Get the Midwest catalog. Learn the facts about Midwest 12 and 16-tube ALL-WAVE sets—also amazing new Radio Phonograph. Learn about our sensationally low factory prices, easy payment plan and positive guarantee of satisfaction or money back. Get a bigger, better, more powerful, better toned radio—at a positive saving of 30% to 50%. Mail the coupon or write us a postal right NOW!

MIDWEST RADIO CORP.
Dept. 167 (Est. 1920) Cincinnati, O.

RUSH THIS COUPON FOR AMAZING FREE TRIAL OFFER AND BIG BEAUTIFUL CATALOG

Midwest Radio Corp.
Dept. 167
Cincinnati, Ohio.

Without obligation on my part send me your new 1933 catalog, and complete details of your liberal 30-day free trial offer. This is NOT an order.

Name .....
Address .....
Town ..... State .....

USER AGENTS EASY EXTRA MONEY Check here ☐ for details.

Your Favorite Radio Artists—Are They Entertainers or Salesmen?

Everyone knows the great part that radio advertising has played in American broadcasting up to the present time. Under this system the foremost artists of the air are paid by the manufacturers of various products advertised by these programs. The question therefore arises whether or not the artists are true entertainers or merely entertaining salesmen. It seems apparent that their rôle as entertainers must come first in order that they interest their listeners so that their advertising and salesmanship, if any, are to produce results.

Radio News

VOLUME XIV January, 1933 NUMBER 7

THERE'S MONEY IN THE AIR

Just how is radio advertising accomplished and how does it affect radio broadcasting in the United States? Some interesting facts that bear importantly on these questions and their solutions are brought to light for the benefit of our readers by—

Merle S. Cummings

THE growth of broadcast advertising in the United States has been tremendous. Within the brief period of radio's existence the vast amount of time sold on the air and the large incomes derived therefrom have earned for broadcasting a secure footing under the classification of "big business."

This progress was by no means an easy achievement. Station operators and owners had a real job to develop and nurture the new field. There were no precedents to follow. Obstacles arose everywhere. And after the long-sought goal of a profit-making enterprise was achieved, the stations found that in addition to competion amongst themselves, they were looked upon by many news publishers as invaders in the field of advertising. Yet, broadcast advertising soared and, even through the depression years, the gross amount of time sold kept climbing consistently higher.

In broadcast advertising, America has obtained and maintained world leadership. In the few other nations where commercial broadcasting is permitted, radio authorities look to the United States for formulas and rules for making their own broadcasting systems successful.

Yet, despite this achievement in the commercial world, the question has frequently arisen as to whether the broadcasters were neglecting public service, uplift, education, entertainment and general interest in their quest for the sponsor's dollar.

The United States Senate, through a resolution submitted by Senator Couzens, on January 7, 1932, ordered the Federal Radio Commission to make a survey and report to the legislative body on the use of radio facilities for commercial advertising.

The resolution sought information on the feasibility of Government ownership and operation of stations. It sought plans to reduce, limit, control and, perhaps, eliminate the use of radio for advertising. It also sough definite information on the use of radio for educational purposes. In addition, it requested a vast amount of statistical data.

On June 9, 1932, the Federal Radio Commission transmitted its report in accordance with the resolution. The Commission had previously mailed questionnaires to 607 stations and received replies from 583 that could be used for the report.

The report disclosed that actual investments in broadcasting as of December 31, 1931, totalled approximately $48,000,000. During 1931, gross receipts amounted to $77,758,048.79 and gross expenditures

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BROADCAST ADVERTISING IN LATIN AMERICA.
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BROADCAST ADVERTISING IN ASIA, AFRICA, AUSTRALIA AND OCEANIA.
(UNITED STATES BUREAU OF FOREIGN AND DOMESTIC COMMERCE BULLETINS)

RADIO ADVERTISING AND RADIO REGULATION.
DANIEL WHITING (EDITORIAL RESEARCH REPORTS, WASHINGTON, D.C. 1932)

MUSIC'S GOLDEN STREAM FLOODS THE ETHER

The tinkling sounds of money are musical to ordinary ears, but the radio advertiser has a different version; he knows that music—good music—means money in his pocket. Therefore the broadcast studios should be the source of the finest music in the air—if the advertisers' viewpoint is correct

amounted to $77,995,405.68. The latter sum included $20,159,656.07 for talent and programs, $16,884,436.91 for regular employees, $4,725,168.23 for equipment, and $36,226,144.47 for miscellaneous expenditures.

With the exception of forty stations owned directly or indirectly by states or municipalities, all of the stations are privately owned and operated. The stations are divided into four general classes: "local," "low-power regional," "high-power regional" and "clear channel." Of the 607 stations, only 389 are authorized to operate simultaneously at night.

The report divides programs into two classifications—commercial and sustaining. The two types are defined as follows:

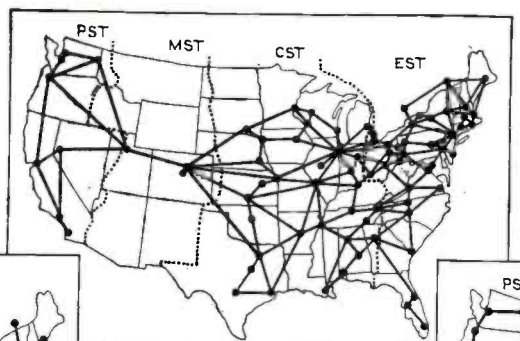
"A commercial program is a program presented by the station for profit. It is sponsored usually by a person or corporation engaged in either the wholesale or retail of merchandise with a view of gaining the good will of listeners and of making direct sales. The program content usually consists of either orchestra, song, drama, symphony, opera or variety, interspersed with sales talks or a description of the commodity advertised."

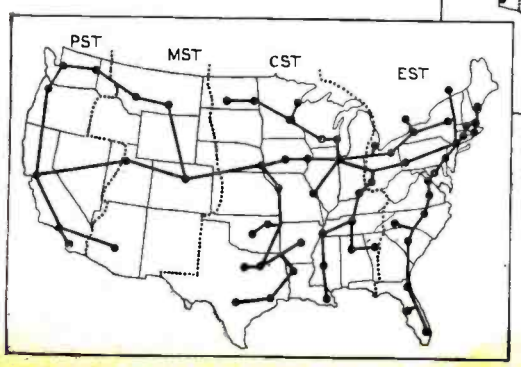
"A sustaining program is a program presented by the station without compensation and at its expense. Its purpose is twofold: (1) It serves as one method whereby the station can qualify under the public interest clause maintained in its license and (2) it serves as a method by which the station seeks to enlarge and hold its audience and thereby increase the value of time available for commercial programs. The program content usually consists of either orchestra, song, drama, symphony, opera, variety, literature, science, politics, news, sport or special events."

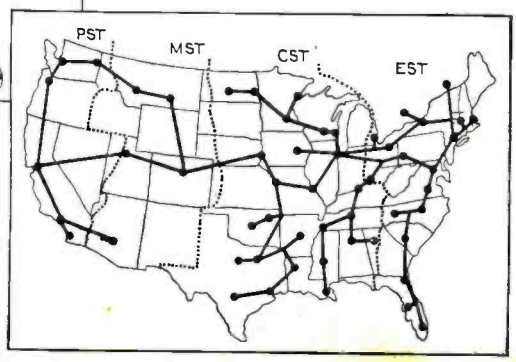
Of the total time used by 582 stations during the survey, 12.52 percent was used to broadcast educational programs of which 80.04 percent were sustaining. Of the total programs on the air over the 582 stations, 36.14 percent were used for commercial programs.

A group of 187 stations was affiliated with companies engaged in chain broadcasting. It is mentioned that, through chain affiliations, stations procure program material of national as well as local interest. This method also brings the best talent of metropolitan centers to local stations. The two largest chains are the National Broadcasting Company and the Columbia Broadcasting System, both maintaining headquarters in New York. Both the NBC and the CBS own, finance, lease or operate several stations in various parts of the country. The remaining stations are affiliated with the networks through special agreement.

The report states that any plan for the elimination of advertising from the air would, if adopted, destroy the present system of broadcasting. The statement is based on the premise that the present system of broadcasting will be retained. It was explained that any plan to reduce, limit and control the use of radio facilities for advertising to a specific amount of time or to a certain percentage of the total time used by the station, must have its inception in new and additional legislation which either fixes and prescribes such limitations or specifically authorizes the Commission to do so under a general







BROADCAST COVERAGE

Above is a map of the Columbia Broadcasting System chain throughout the United States. At left and right, respectively, are the Red and Blue chain networks of the National Broadcasting Company

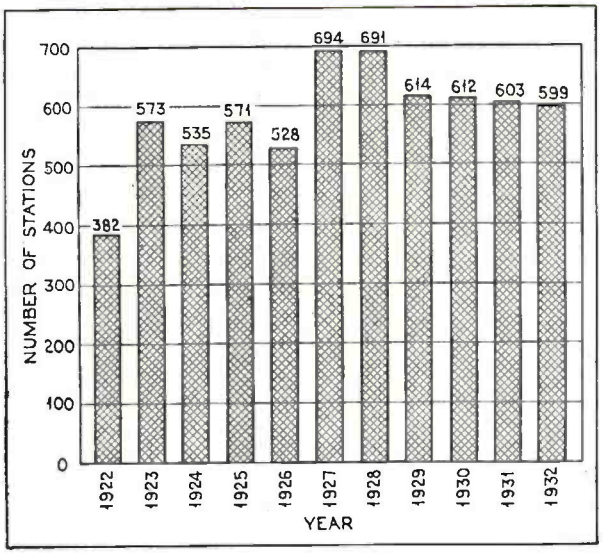
standard prescribed by that legislation. The report explains this point as follows:

"While the Commission may under the existing law refuse to renew a license to broadcast or revoke such license because the character of program material does not comply with the statutory standard of public interest, convenience and necessity, there is at present no other limitation upon the use of radio facilities for commercial advertising."

In order to find whether it would be practicable and satisfactory to permit only the announcement of sponsorship of programs by persons or corporations, the Commission wrote to agencies placing time on the two networks, asking for their opinions on this matter.

The Commission's comment, in part, on this matter follows:

"The American system of broadcasting is predicated upon the use of radio facilities as a medium for local and national advertising. Upon this use depends the quantity and quality of commercial and sustaining programs. The competition between advertisers insures the employment of the best talent available and a variety in kind of commercial programs. The commercial programs furnish the principal source of revenue to stations. The quality and character of sustaining programs are dependent upon the revenue received from the sale of time for commercial advertising purposes. The daily newspaper furnishes a parallel: A newspaper can be sold to the subscriber at a cost greatly under the cost of production because it is used as a medium for advertising, and what it contains of a news, educational, literary and entertaining value depends almost entirely upon the revenue received from the sale of space for advertising purposes. Similarly, a radio broadcast station can present sustaining programs that are of great educational value and rich in entertainment only in a degree measured by the revenue derived from the sale of time for purposes of commercial advertising."



BROADCASTING STATIONS IN THE U. S.

This chart prepared by the Federal Radio Commission shows the varying numbers of broadcasting stations from 1922 to 1932, inclusive

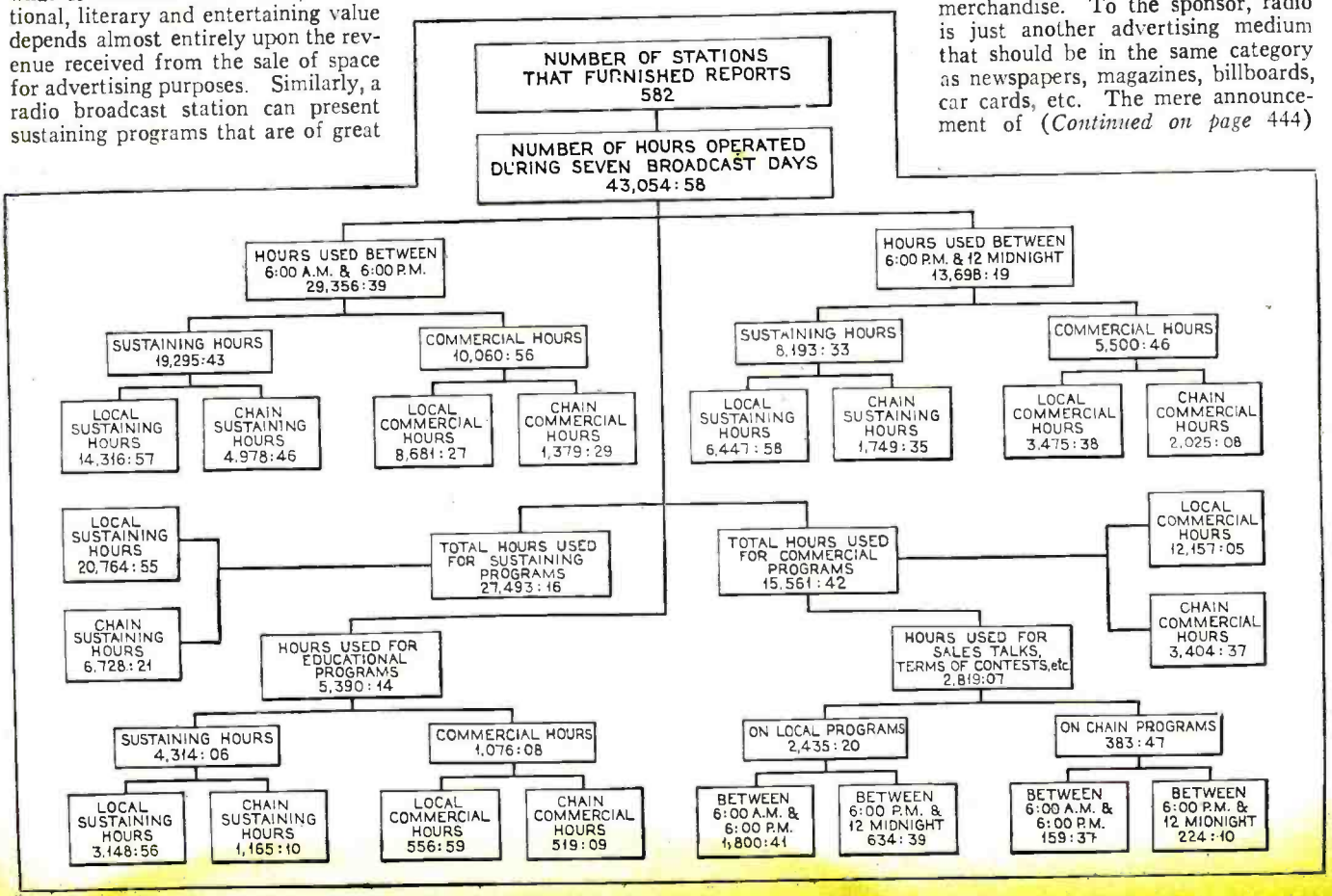
This comparison with newspapers is not readily relished by publishers who cannot see a fair basis for such comparison. Firstly, a newspaper is published entirely at private expense. The ink, the paper, the mechanical plant and all circulation facilities must be handled privately, entirely financed by the publisher and not infringing on publicly owned rights or property anywhere. The radio station, on the other hand, produces programs at its own (or sponsor's) expense and broadcasts into the publicly owned and government-controlled atmosphere. The stations' only expense is "getting the program out." The station must make no provision for seeing that the programs are received. The newspaper, however, must be distributed through well-organized channels in order to be successful.

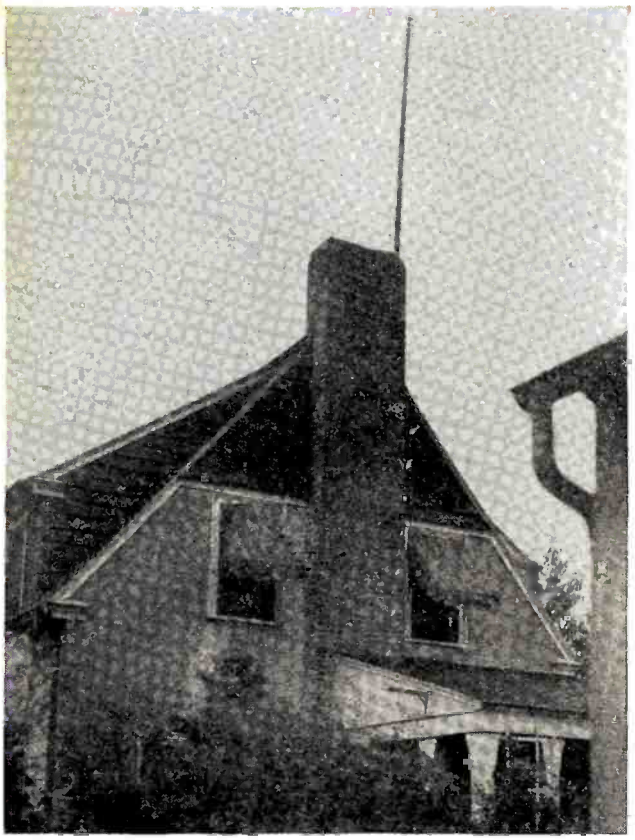
If a reader dislikes a newspaper, he can cease buying it. If a listener dislikes a program or station, he can tune it out. But the unwanted program or station may continue to function on the public channel that may be used for better programs as far as public welfare is concerned.

Of course, the agencies were virtually unanimous in opposing any limiting or curtailing of commercial announcements. Their reasons were based on good business logic and sound common-sense reasoning. It was pointed out that the object of the air advertiser is to sell more merchandise. To the sponsor, radio is just another advertising medium that should be in the same category as newspapers, magazines, billboards, car cards, etc. The mere announcement of (*Continued on page* 444)

HOW THE AIR IS USED

The chart below shows classifications of the uses that the ether is put to hourly, day and night, during a representative week at the height of the season last winter. The chart is based upon reports from 582 broadcasting stations in the United States





A HOME INSTALLATION

Antenna of the "L" type, using a transposed lead-in. The transmission line is carried down to a window where it terminates in a 2-foot twisted pair extending from the window to the receiver

An Effective

FOR REDUCING

The author offers suggestions and discusses their relative to noise-reducing

By Arthur

THOSE who are experienced in short-wave reception have come to appreciate the fact that the short waves have outstanding advantages. So far as DX work is concerned, for instance, reception from all parts of the world is practically an every-day occurrence with any really good short-wave receiver. Also static is less troublesome in these lower ranges. As against these advantages there is one factor which becomes much more important on the short waves than on the broadcast band, and that is found in the greater susceptibility to certain types of noise, and particularly to man-made interference.

In introducing this discussion it is well to call attention to certain thoughts concerning antenna equipment. The ideal antenna is, of course, one which will pick up maximum signal voltage with a minimum of noise and interference. Both the lead-in and the antenna proper require special consideration and treatment if best results are to be obtained. The lead-in serves its purpose best when it is simply a transmission line and is so designed that it is incapable of picking up electrical impulses of any kind. The collection of radio energy should be the function of the antenna proper.

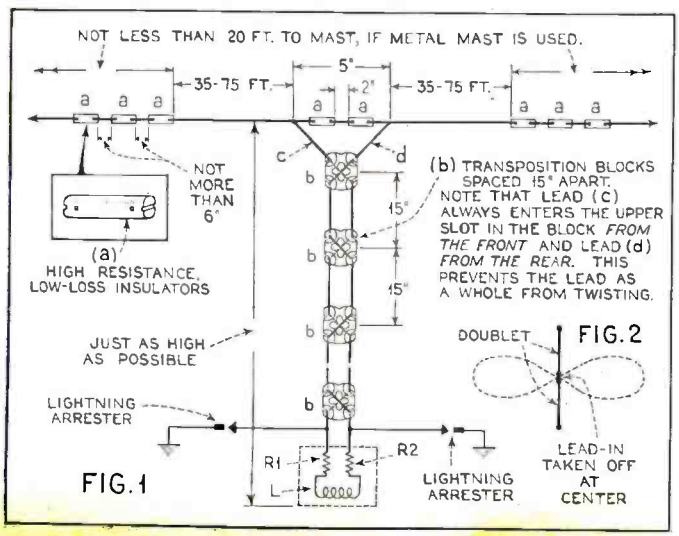
Inasmuch as a great deal of the interfering noise of the "man-made" variety has its point of origin close to the ground, it is desirable to have the entire collector system well up in the air, dispensing with the ground entirely. Thus the doublet type of antenna is one of the recommended types, when connected as shown in Figure 1. The two wires of this arrangement provide the two sides of the collector system, and the whole is therefore much less likely to pick up noise from sources on or near the ground and with limited fields. The conventional L type antenna with a single-wire lead-in and ground connection, on the other hand, has the overhead wire and the ground as the two sides of the collector system. Noises arising in the house, on the roof of which the antenna is erected, therefore constitute the filling for what we might call "an ethereal sandwich." Being directly within the field of the antenna, they are picked up with considerable strength. In addition to this, the single-wire lead-in constitutes part of the collector system and, as it runs directly into the house, naturally tends to pick up noises from the house wiring system, telephones and the like.

Reasoning along these lines, the logic of dispensing with the ground as a part of the antenna system is quite apparent. Also the need for avoiding pick-up by the lead-in is equally obvious. Actually, of course, a two-wire lead-in, whether it be of the parallel or of the transposed varieties, does pick up both signal

* President, Lynch Mfg. Co., Inc.

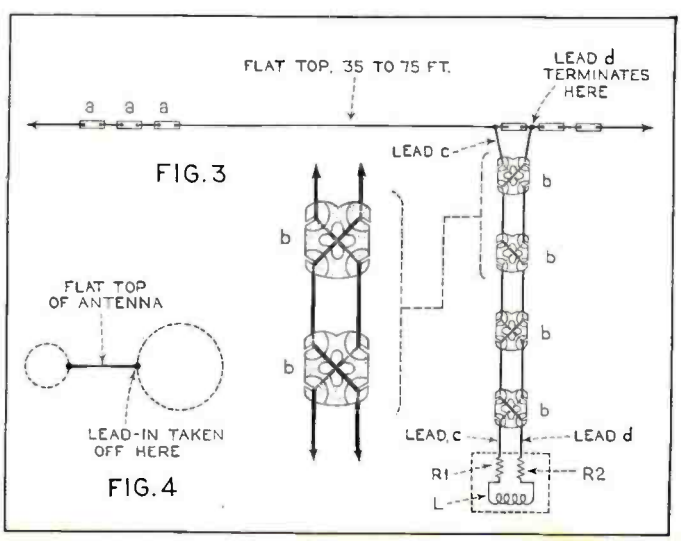
THE HORIZONTAL DOUBLET

Figures 1 and 2. Suggested arrangement is shown in Figure 1. This type of antenna offers directional characteristics as indicated in Figure 2, where the broken lines indicate the approximate shape of the field of greatest pick-up



INVERTED "L" ANTENNA

Figures 3 and 4. The transmission line is identical with that of Figure 1, except that one of the transposed leads is left open at the top end. This type of antenna is in some instances directional, as indicated in Figure 4



S.W. Antenna

INTERFERENCE

on various types of antennas merits. Special attention is given lead-in systems

H. Lynch*

and interference, but the two wires pick these voltages up 180 degrees out of phase. The pick-up from both is impressed across the coupling coil at the receiver, where they partially cancel out, leaving the voltages picked up by the antenna proper to be transferred to the receiver circuits. The advantage of the transposed lead lies in the tendency of local interference to be picked up with equal intensity by the two wires so that the amount of voltage impressed on the coupling coil from each wire will be more nearly equal than would be the case if the two wires were parallel and one was closer to the source of interference than the other. Thus the transposed lead results in more complete cancellation.

These methods of antenna improvement do not constitute a cure-all for noise, and it is well to point out this fact lest readers be misled. Powerful interference noise which has its source some distance from the antenna system will naturally be picked up by the antenna proper just as will the desired signal. But the systems described in this article will in most cases result in material improvement in signal-to-noise ratio, because much of the troublesome noise either has its source within the immediate vicinity of the receiver location or is brought into this vicinity by the electric light or telephone lines and should therefore be greatly attenuated by the systems discussed here.

A study of the various types of antennas which can be erected in congested areas, with the least expense and with the best possible results for the particular service required, leads us to the selection of one of three fundamental types, with possible variations to suit special requirements. Where the space permits, the use of the horizontal doublet, with a transposed transmission line lead, is just about the ideal type.

As shown in Figure 1, this antenna is made of two single wires of equal length, run in a straight line, or 180 degrees apart, separated from each other by suitable insulators and as thoroughly isolated from all surrounding objects as possible. The dimensions and the general instructions for the erection of an antenna of this type are given in the drawing. It is best to figure on permitting the antenna to come no nearer than twenty feet from the roof, or any grounded object over which it must pass, such as barns, trees, tin roofs, etc. If moving the antenna to one side or the other a slight amount will avoid the necessity of having it pass over some object, it is desirable to do so even though this may result in increased length of the lead-in. The doublet will be so much better than the ordinary type of antenna that you will never notice the very slight loss which (*Continued on page* 439)

A DIFFICULT RECEPTION LOCATION

The antenna and transposed lead-in system is located in New York City and is part of the equipment of a commercial short-wave receiving station to which dependable foreign reception is imperative. The antenna is of the horizontal doublet type shown in Figure 1

TRANSMISSION LINE COUPLER

Figure 5. This coupling unit is indicated in schematic form at lower terminals of lead-in, Figure 1. It is intended for insertion in antenna coupling coil of receiver, to be used in place of the regular primary

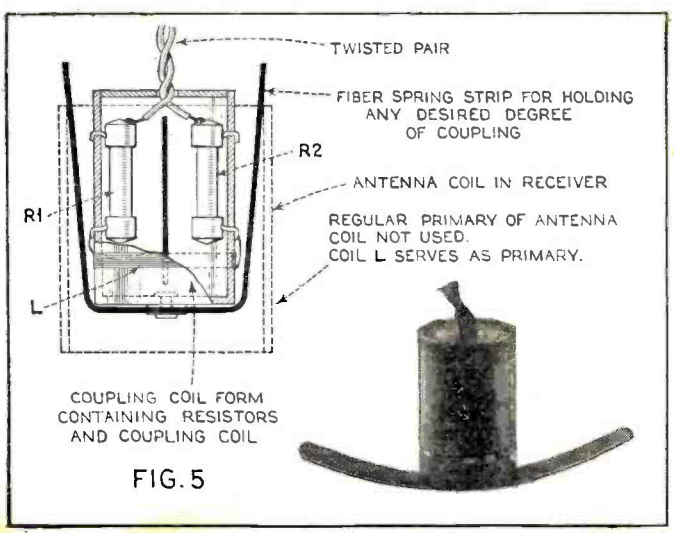
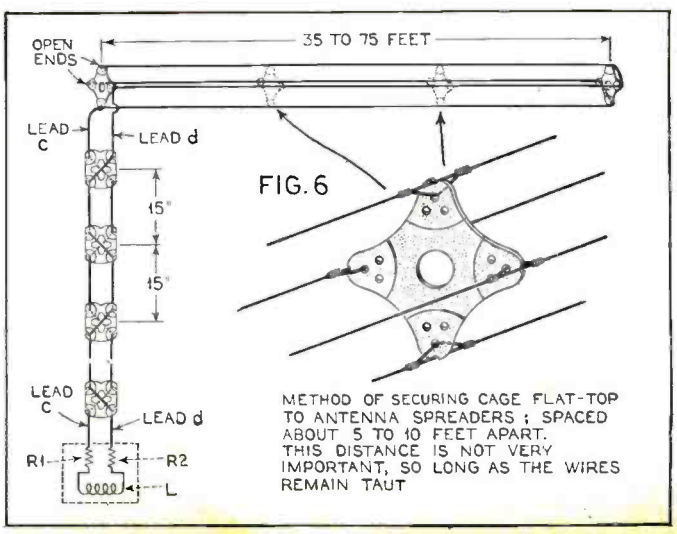
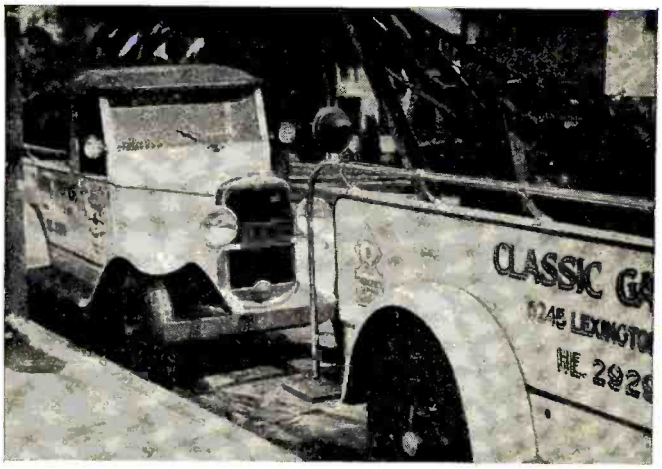


FIG. 5

NON-DIRECTIONAL CAGE ANTENNA

Figure 6. This type of short-wave antenna is said to offer efficiency superior to that of the inverted "L" type, but is not as effective as the doublet of Figure 1. The insert shows one of the insulating spreaders used in 4-wire cage construction





PART OF THE RADIO WRECKER FLEET
Two of the tow-cars in which the author installed short-wave radio receivers to enable them to pick up police wreck reports in order to locate tows

S-W Radio *for* Tow-Cars

A new opportunity for serviceman—installing radio as an adjunct to the garage business. The author's success with this scheme should make excellent sales talk for those interested in selling and installing the equipment

By Robert M. Hyatt

I AM a garage man. And while the wolves of "depression" howl dismally all around me, my business continues to grow steadily. Its amazing growth has been the subject of much talk among our fraternity. How to account for this excellent business when that much lamented and elusive thing is not supposed to exist these days? Simple—radio! Radio on my tow-car, radio in my office.

Undoubtedly I am one of the first—if not the first—to start this new and very satisfying use for radio. Since installing a short-wave set on my first tow-car, several other garages that I know of have equipped their cars. The owners are unanimous in their praise of the efficiency of such equipment.

How has my radio tow-car helped me increase my business? Listen. I will first tell you of my start in the garage business, and how radio saved the day for me. For six years I had worked in garages, the last two in the capacity of service manager. 1930 was a bad year, as I know all will agree. No business; men's wages being lowered steadily. The complaints of dissatisfied customers invariably fell upon me. I was pretty tired of the same old thing.

I suppose it's because I have always been conscientious and particular about the kind of work I turn out, that was building up the reputation I now enjoy. My customers know this and depend upon me solely, and my following of "personal" customers—those that come into the shop demanding that I work on their cars personally—is large.

Feeling certain of the support of all my old customers, I decided to start a garage of my own. I rented a small building near the garage I had just left.

Most of my friends knew of my venture ere it was a reality—and the rest of the city learned of the opening of "Chuck" Hyatt's Garage that night, in the newspapers, handbills and cards.

Two good men comprised my force to begin with. Things went fine for the first three weeks; the place was full—cars owned by friends mainly, with an occasional wreck at night, which we were fortunate in hooking from our many competitors. But work began falling off. We could not depend solely upon the customers of my acquaintance. Of course, new ones turned up, but the first rush was over.

My newspaper advertising held no special inducements; I offered no introductory work at greatly reduced rates, as my competitors had done and were continuing to do. This practice is fast becoming the bane of reliable service and good business in *all* lines. I merely announced my opening.

I have always contended that good work justified reasonable charges. My policy is Keep Your Customers for Future Service, not hook 'em before some one else does, depending on a run of suckers. That won't last. (Radio servicemen, note!)

But business was getting worse. I laid off one man. It began to look like I'd have to let the other one go, when I got the Big Idea that has proved so thoroughly remarkable, that has pulled my ebbing business from certain failure to one of enviable proportions in a few months.

I knew folks were driving just as much then as before this so-called "depression," and they were having just as many—more—wrecks. How to get that wreck business *first* was the problem.

Radio! There's the secret. My place is full of wrecks now. I continue to get them for repair—by radio!

I installed a short-wave set on my old Lincoln tow-car. I knew that a hundred-odd radio-equipped police cars were cruising around here day and night, reporting, among such little things as family quarrels and friendly murders, a lot of automobile wrecks. In this man's town, whichever tow-car reaches the wreck first, gets it—unless the owner of the car has other plans. But how's a garage to find out about these wrecks unless someone calls in to them? There you are; no one had to call in. The police department did all that; I picked it up at my shop.

With my tow-car radio turned on (especially at night), receiving these frequent police broadcasts, I would get news of the wreck before any of the other garages—and be there pronto!

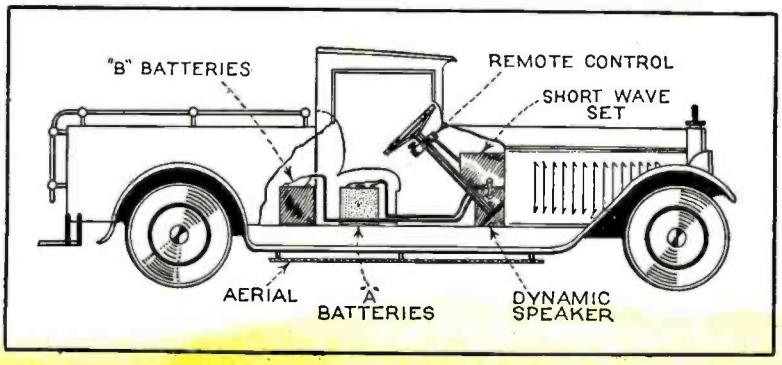
Well, did this stunt work! The first night I got "flashes" of four wrecks, secured tow-in fees on two of them, and the complete repair job on another one. What could be nicer?

Of course, I didn't get every wreck I went after. Occasionally the owners had their own garages in mind. But I did get the majority of them, which, without my radio, I would have never heard about.

I secured a police permit for my short-wave set. In thus being *first* on nearly all wreck jobs, I met more and more policemen, making

(*Continued on page* 424)

HOW THE INSTALLATION IS MADE
This diagram shows the various essential parts of the equipment and how they are arranged in the tow cars



The GIANT'S VOICE

Describing a novel type of loudspeaker unit that employs a vibrating grating or tongue controlling air impulses produced at high pressures

By Irving J. Saxl, Ph.D.

THREE thousand feet above the landing field cruised the Los Angeles, the pride of the Navy. On the airport a number of men are grouped around some equipment. An engineer speaks. Suddenly his voice, enormously amplified, thunders from the ground up into the air with terrific intensity.

Words and sentences, which have been shouted upwards in the sky with the aid of this special equipment, have been received there three thousand feet above the ground.

At another part of the landing field a radio receiving set is installed, which stays in continuous contact with the transmitter upon the huge airship.

Commander Rosenthal radioed back to the ground station that, in spite of the altitude, the roaring of the motors and the thick blanket of compressed air, caused by the motion of the ship, every man on board heard the message clearly. An enormous distance to talk over—three thousand feet. Handicapped by the roar of the motors of the airship, by air currents and adverse weather conditions, the sound, as such, was able to penetrate this distance and to make an understandable impression. Radio and electro-acoustics have made possible this task, without making first an intricate transformation of the sound into voice currents, modulating it at a radio frequency, transmitting these high-frequency oscillations, receiving them again and demodulating them, amplifying them and finally putting them through a second loudspeaker.

Again the application of the radio principles have made possible an increase of the range of the human voice a thousandfold. Modern engineering thus creates a new method of producing sounds more penetrating than "Stentor's" voice.

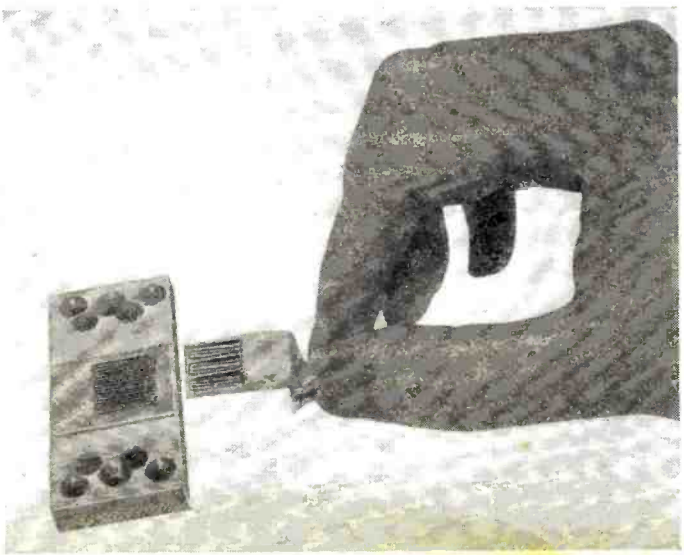
How has this been done?

Use has been made in this new development by Mr. C. F. Dilks, acoustic expert, of an experience which he remembered from an original research in the development of pipe organs he had previously made. By using certain principles of sound patterns useful in the construction of the registers and volume controls of powerful organs to electro-acoustical engineering, it was possible to introduce a new method into the range of loudspeaker design, adding to the classical methods a new possibility and special applications.

The physical principle is not quite new; it has graduated from the biological development laboratories of Mother Nature thousands of years ago. It is now found in the larynx in humans and in other mammals. Again we can learn much in observing the results, crystallized to a highly efficient form and performance, in the hard battle for the survival, results which are shown as well in the pressure-resisting structure of the armor of algae, as in the eye and ear of the mammal —and last but not least, in man's sound organ, the voice box.

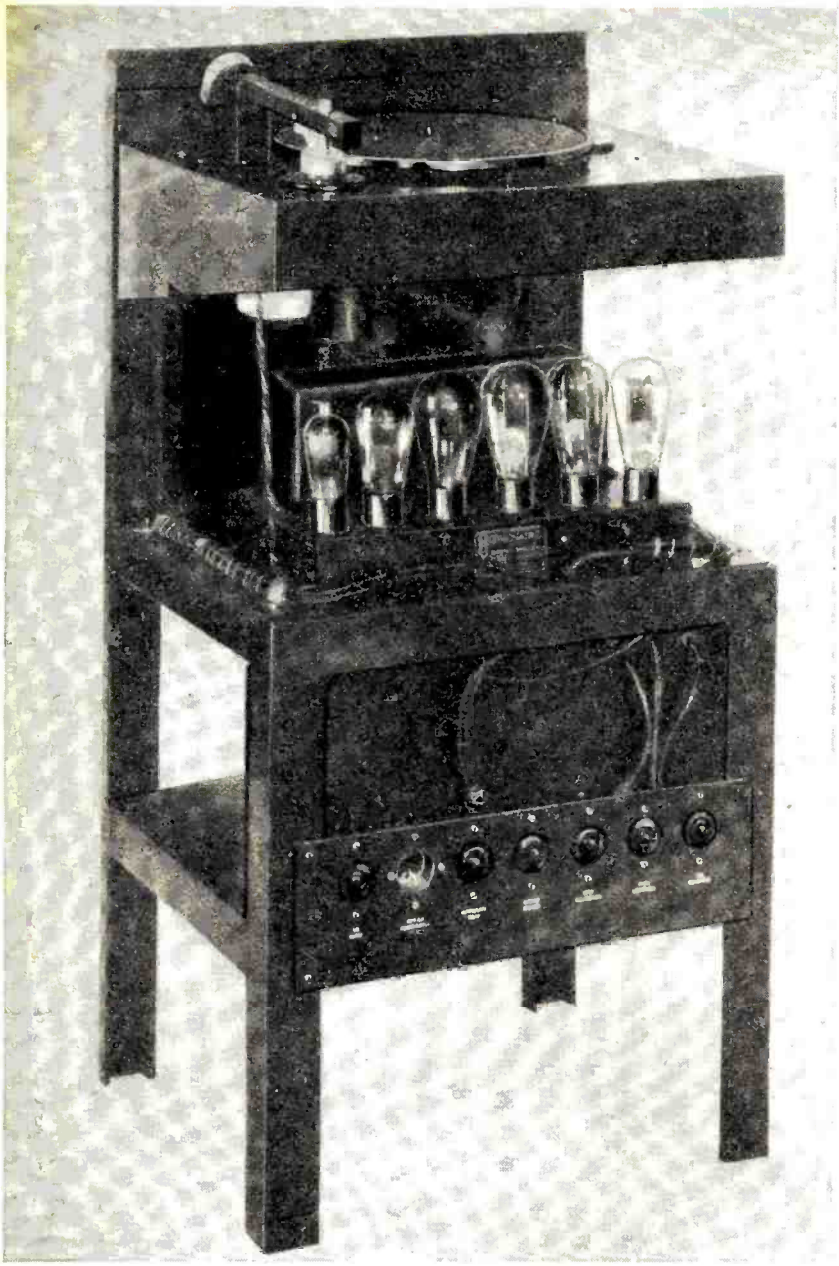
THE ARTIFICIAL LARYNX

Figure 1. At the left is the bridge containing slit openings through which the compressed air is caught. Held in the hand is the tongue with corresponding openings which vibrate back and forth controlling the air stream



The scheme for producing sounds by the human voice box is as follows: Air is compressed in the lungs. In releasing it, it passes the vocal cords in the voice box, putting them into vibrations which can be heard as different sounds, the pattern of which can be modulated in the mouth and the different cavities and resonating members of our system of speech.

This method of producing sound is highly directional and very proficient. If no reflecting objects are found in the neighborhood, the sound travels, in a relatively small angle of radiation, out of our mouth. Vibrating air is blown out and its vibrations pass on to the surrounding medium



SPEECH AMPLIFIER USED

Figure 3. This photograph shows the type -50 push-pull amplifier with the connection panel and phonograph reproducer mounted on the front and top respectively

within a considerable total volume. This tendency of a flow of oscillations in the air is important. The sound of a trumpet, which is also flowing oscillations of air, goes farther than the sound of a violin.

In the violin a layer of air surrounds the vibrating body, takes these vibrations and carries them, elastically, to the joining air molecules. And a very similar action takes place with other vibrating instruments or membranes—as, for instance, used in loudspeakers.

In the new system we are discussing we have an air column which is modulated acoustically and which, due to its large amount and homogeneous consistency with the surrounding air, can easier transport the energy impulses impressed upon it to the outer medium. In addition, as the member which impresses these oscillations upon the flowing air column can be small, the only electromechanically controllable part can be kept small also. Therefore only a small controlling energy is necessary and the oscillations produced are relatively free from inertia or resonance.

The actuating member that controls sound and sound characteristics in this new system can be kept small and light, due to the fact that no big radiating surface is necessary.

Figure 1 shows a picture of this organ—what might be called an artificial larnyx or voice box. As can be seen clearly, it consists of a bridge in which parallel lines are cut. Upon this bridge moves a small tongue with corresponding openings.

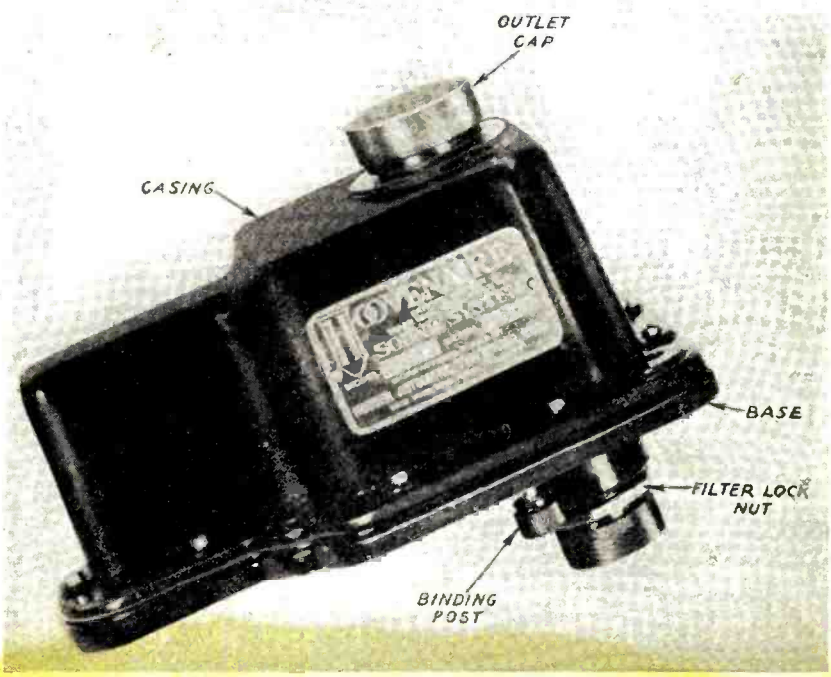
The tongue itself is made of aluminum, which, as it has a specific weight of only 2.7, moves satisfactorily free from inertia—much more freely, certainly, than any one of the big membranes used on conventional types of loudspeakers.

Operating Principle

When the "tongue" moves back and forth, the openings of the bridge and of the tongue ("larynx") move opposite each other, so that it is possible, with relatively very small movements of the tongue, to control a considerable total width of the openings. This device is, therefore, comparable to a valve. As in a valve, a small turn of the handle controls the opening through which a considerable stream of water or steam may flow. This bridge, with its little moving part, is therefore able to control, with very small motions of the tongue, a considerable amount of compressed air flowing through it.

Currents of air passing through this controlling member will be readily stopped or given free way, according to whether the tongue covers the openings of the bridge or uncovers them.

This is done, as shown in Figure 2, by an electromagnet which is fed from the output of a voice amplifier. In this illustration we see, on the left side, a magnet of the permanent type. Moving between the pole-shoes and protruding to the right side, is the

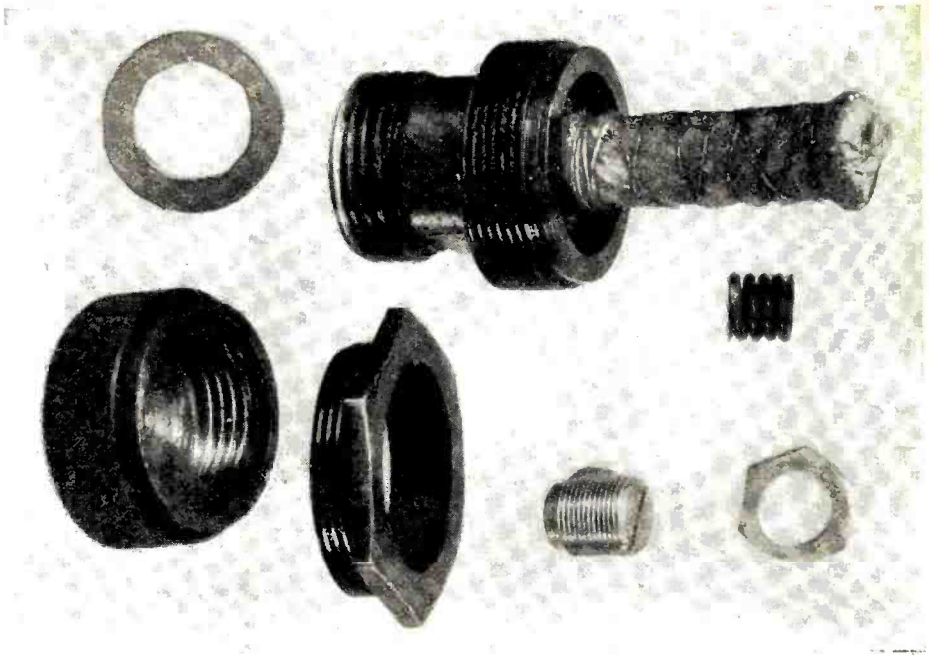


COMPLETE UNIT

Figure 5. Compressed air enters below at the filter connection, while at the top is the outlet nozzle to which is connected the giant horn for projecting the sounds

oscillating "tongue" attached to the bridge.

Standing over the bridge can be seen a tubing nozzle for the compressed air. Through this tubing a stream of air passes, coming from a special compressor. The three stages of this sound system parallel the human speech system. The compressor acts as the lungs. The mechanical larynx sets sound waves into vibration and converts them into audible sound, much as the human larynx does, with the exception that the stimulation comes electrically and not through nerve cells. The horn brings out and resonates the sound as the human mouth does.



AIR FILTER PARTS FOR CLEANING AIR COLUMN

Figure 4. This unit consists of a felt air cleaner inserted in a perforated tube and adjusted to extract impurities in the air in the compressed air stream before they are projected through the bridge and tongue

Input Amplification

As the main amplification is reached mechanically by controlling the currents of compressed air, the electric energy necessary for the control of the tongue can be reduced to a minimum. In the speech-amplifying equipment, only one type –24 tube, one type –45 and two type –50 tubes are used, in addition to a type –81 rectifier tube. This equipment is shown in Figure 3, which gives a complete set-up with which the currents produced by the pick-up of the phonograph, as well as by a microphone, can be amplified and sent through the voice coil of the magnet.

An interesting detail, an air filter, can be seen in Figure 4. It is important, for the efficient working of the unit, that the slits in the bridge and tongue remain constantly unchanged. Now, naturally, if hundreds of cubic feet of air are passed through a small valve, this valve will retain some of the dust and impurities contained in every air. These impurities may clog the openings in the artificial larynx, and this partial closure would affect both the total volume and the quality of the sound. The quality of the sound is influenced because these dust and dirt particles vibrate within the comb of the bridge, thus giving rise to unusual sound vibrations which have no direct relation with the movement of the tongue. And the volume suffers, of course, as less air is permitted to pass if the openings are not perfectly clean.

It was, therefore, an important improvement in this development to put an air filter in the path of the gas stream. This filter simply consists of a perforated tube, over which some interchangeable felt is wound, which tube is inserted in a part of the tubing before the air reaches the vibrating tongue, thus eliminating any impurities of the air.

DETAILS OF UNIT

Figure 2. Illustration shows how bridge is mounted under air tube with tongue actuated by a permanent magnet motor

Multiple Units

For increasing the acoustic power, a number of speaker units of this type can be used, all operating together on one gigantic horn.

Figure 5 shows a close-up of a single reproducer unit. The compressed air enters from the lower part, passing through the filter and the vibrating air valve, which is controlled by the voice currents, and out at the top.

The penetrating power of the voice of this speaker really is remarkable. Experiments have been carried on with twin-motored (*Continued on page* 441)

New Class B Amplifier

COMBINES HIGH POWER AND ECONOMY

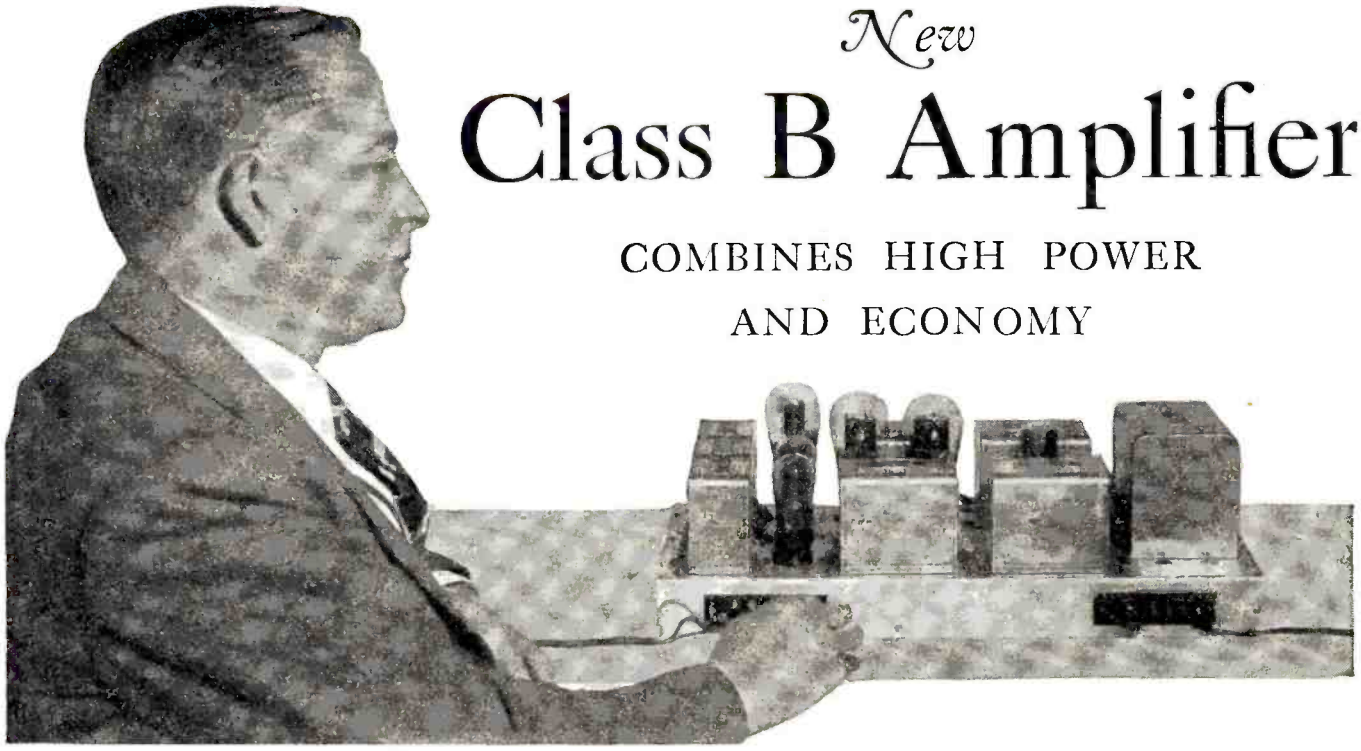


FIGURE 2. A HIGHLY PRACTICAL P. A. SYSTEM

The low tube and operating costs, per unit of output power, mark the Class B amplifier as a distinct forward step in radio progress. This article introduces some of the newest equipment of this type

By S. L. Baraf*

HERETOFORE Class B amplifiers employed such vacuum tubes as the –51, –49, –12D, –04A, –45, –11 and –10 types. The first tube in this list, namely, the –51 type, is said to be capable of delivering up to 3000 watts of power output, and the –10 tube, the last-named, will deliver from 20 to 30 watts of audio power. However, to employ any one of these type tubes in Class B amplification it was necessary to make load curves based on a variation of the grid bias plotted against the resulting plate current to indicate the correct bias to be applied, in order to avoid serious wave-form distortion.

It was further required that the a.c. rectifier plate supply have almost perfect regulation to allow for wide changes in average current (due to variations in signal input), without effecting the applied voltage, otherwise the quality and the power output would suffer appreciably.

With the introduction of the new –46 Class B tube and the –82 mercury-vapor full-wave rectifier, special audio-transformer coupling units were designed and the whole problem of Class B amplification has been greatly simplified, with a decided increase in efficiency and with a real saving in tube cost.

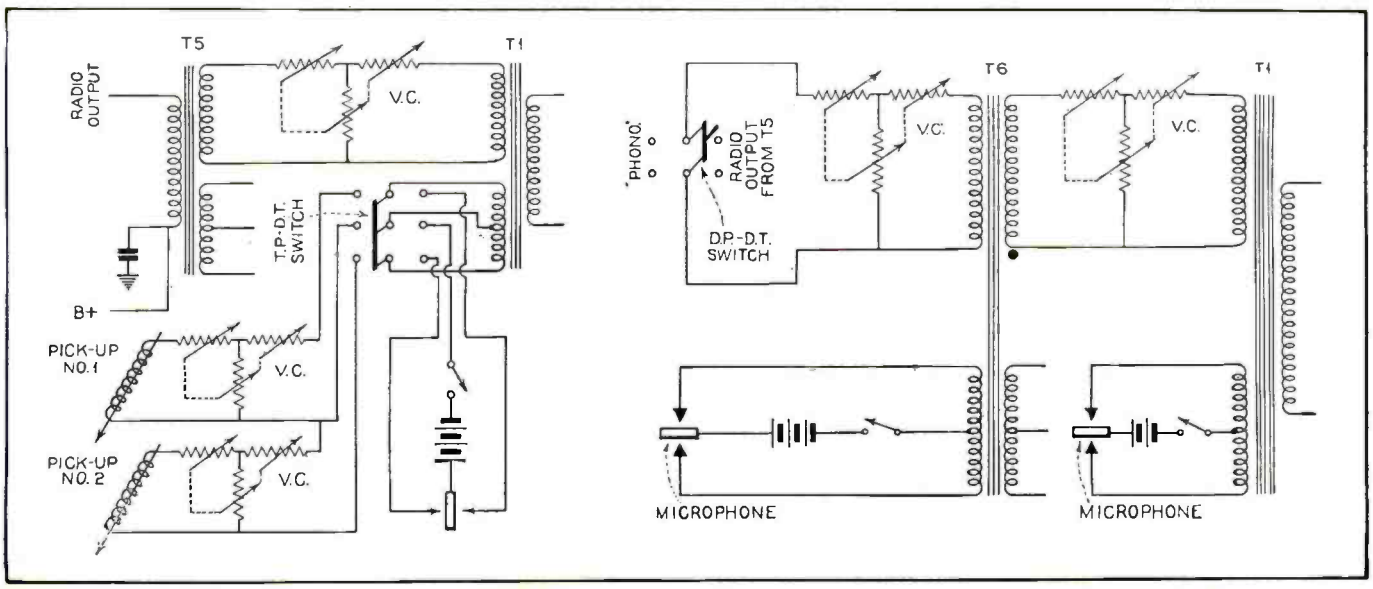
The Class B amplifier described here, which may be constructed by anyone having a fair knowledge of radio building, is a four-stage job using two –56 type tubes, three –46 type and one –82 type rectifier.

The schematic diagram of the amplifier in Figure 1 shows the secondary winding of a high-ratio step-up input

*Kenyon Transformer Co., Inc.

UNIVERSAL CIRCUITS

Figure 3. The amplifier shown in Figure 2 is adaptable to any type of input equipment. Various combinations are shown here, the transformer, T1, being the input transformer incorporated in the main amplifier



transformer, T1, connected to a tapered 100,000-ohm potentiometer, R1, which serves as the volume control. The plates of the two –56 type tubes are connected to 250-ohm reactors, L1 and L2, which makes possible a gain of at least three times that of an equivalent resistive load.

The first –46 Class A tube, which is the driver stage, is coupled to a step-down transformer, T2. Since this driver transformer is the critical link in Class B circuits, special care in its design makes possible a high level of energy transfer to the grids of the push-pull –46 tubes without any appreciable distortion. Low-resistance, minimum-loss primary and secondary windings, a primary inductance higher than is required for conditions of maximum undistorted power output, and the choice of a step-down ratio such that whatever grid distortion may occur cancels out the plate circuit distortion of the output stage, are special design factors helping to realize such an accomplishment.

It will be observed that the center-tap on the secondary of this driver transformer T2 is returned to ground. This is entirely in order, as the –46 tubes are connected for Class B operation in this output stage. Biasing resistors or separate bias batteries are not required, as the –46 tube practically operates at zero grid bias.

At this point it might not be out of order to indicate the essential difference between Class A and Class B operation. Class A amplification implies a condition of negative bias, such that plate current flows without grid excitation, the output stage being essentially a reproduction of the input voltage applied. Class B operation implies a condition of positive grid excitation, plate current flowing only when the grid is excited during the positive half of the sine wave delivered by the driver stage.

The outputs of the two –46 tubes in push-pull are connected to the output transformer T3, which is designed to handle the heavy peak current loads from these tubes The 15-ohm output winding on this T3 transformer is tapped at 4 and 8 ohms and is therefore adaptable to numerous arrangements for parallel, series and series-parallel connections to voice coils of dynamic speakers.

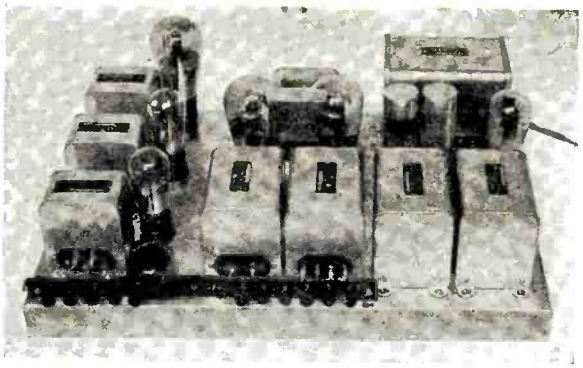
It is at once obvious to the sound installation engineer that two 30-ohm voice coils may be connected in parallel to the 15-ohm winding, four 15-ohm voice coils in paralel to the 4-ohm winding or eight 15-ohm voice coils in a series-parallel arrangement to the 8-ohm winding.

The 500-ohm output winding of this transformer T3 is used when one or more speakers are to be remote from the amplifier. This 500-ohm winding feeds through a twisted pair of leads to a 500-ohm winding on a transformer such as T7, shown in the parts list. There is a 15-ohm output winding on this transformer T7, tapped at 4 and 8 ohms for connections to voice coils of dynamic type reproducers.

The power transformer T4, used with the –82 type mercury-vapor, full-wave rectifier, is purposely designed to have a very low internal resistance. This is imperative, as the power supply must take care of extreme fluctuations of current due to changing input signal levels, without affecting the constant voltage potentials of each audio circuit in the amplifier. To further improve the good regulation inherent in the power transformer, a low-resistance saturated input reactor, L4, is used. This reactor maintains a constant d.c. voltage with widely varying d.c. current loads.

The second choke, L3, has a low d.c. resistance and its function in the current is to smooth out any ripple present in the first section filter. Its inductance is fixed for the normal load taken from a –46 Class B second-section filter. Dry electrolytic type condensers of 8 mfd. capacity are connected across the output of each filter section.

(*Continued on page* 442)



COMMERCIAL VARIATION

Figure 5. This unit differs from that of Figure 2 in that it employs transformer coupling throughout and has a different output coupling arrangement

BOTTOM VIEW OF AMPLIFIER

Figure 4. Showing the wiring of the amplifier pictured in Figure 2, with circuit as shown in Figure 1

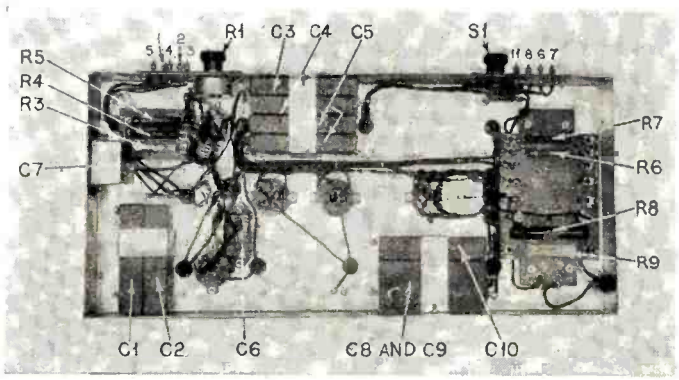
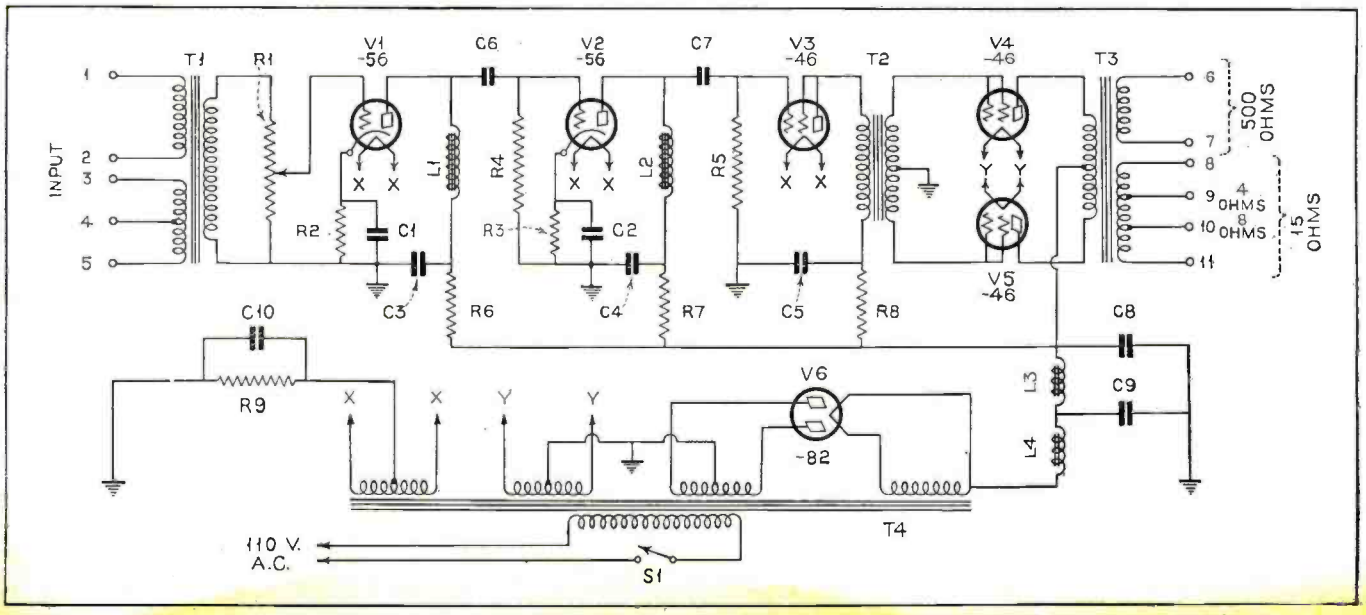
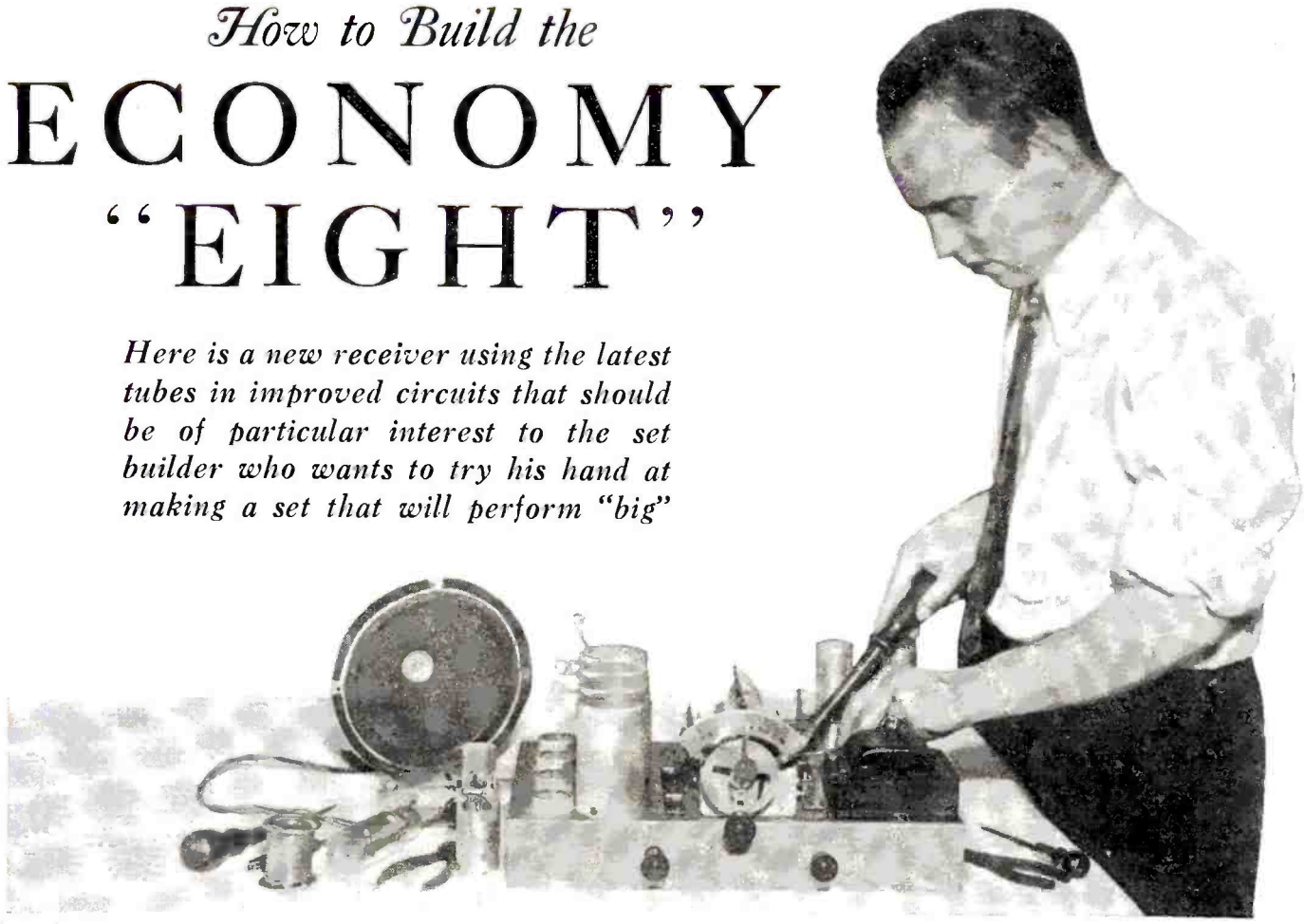


FIGURE 1. THE SCHEMATIC CIRCUIT DIAGRAM



How to Build the ECONOMY "EIGHT"

Here is a new receiver using the latest tubes in improved circuits that should be of particular interest to the set builder who wants to try his hand at making a set that will perform "big"



By Hubert L. Short*

PRESENT conditions have served to emphasize the fact that there has been a constant trend towards simplification in radio design, so that it is now possible to construct an eight-tube a.c. receiver, such as the one described in this article, in less time and with greater ease than was formerly possible in the case of a three-tube battery set.

As to cost, home-built sets are tax free, and, moreover, there has been a radical reduction in the cost of quality radio components. To illustrate this point, the Economy Eight described here can be built for only $13.75.

This receiver has practically everything one would want in a radio set. The three cardinal radio virtues—excellent tone quality, sharp tuning and high sensitivity—are all present.

For example, high radio-frequency amplification and extreme selectivity are absolutely necessary. Unfortunately, these features are sometimes accompanied by modulation distortion and cross-talk unless special precautions are taken. Through the use of the new type –58 variable-mu pentodes in the radio-frequency stages, extreme sensitivity and selectivity are possible and, still, cross-talk and modulation distortion are practically eliminated. This desirable result is accomplished because of the long "cut-off" characteristic of the –58 type tube.

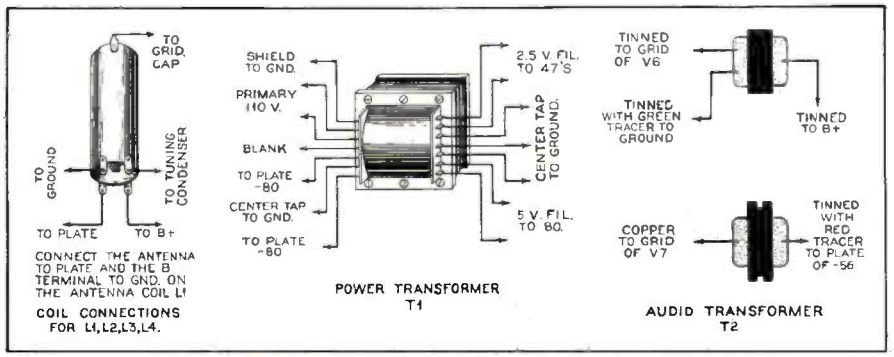
Then again, high selectivity is often accompanied by the cutting of side bands, with consequent impairment of tonal quality. In the Economy Eight, realistic tone quality has been retained, despite the unusually sharp tuning, through careful attention to various factors of circuit design.

An analysis of the circuit of the Economy Eight will give a clearer conception of the many reasons for its unusual superiority. At the present time there are two main circuit classifications—the superheterodyne and the tuned-radio-frequency circuit. Each of these types has its particular advantages and there is no denying the undoubted popularity of the well-designed "superhet." On the other hand, the tuned-radio-frequency circuit has stood the test of time, and through the application of recently developed vacuum tubes, improved r.f. transformers and other new components, it can accomplish almost anything that the superheterodyne can do. Furthermore, it is free from harmonics and image or "double spot" selectivity. Most important of all, from the set builders' standpoint, the tuned-radio-frequency receiver is easier to adjust when completed, since there are no intermediate transformers to "peak," nor other complicated processes to be mastered.

This explains a few reasons why the tuned r.f. circuit was selected for the Economy Eight receiver. There are three tuned r.f. stages, each employing a type –58 tube. The detector stage, utilizing a type –57 tube, is also tuned, so that there are four tuned circuits. A four-gang .00035 mfd. variable condenser is used. In other words, single-dial control is attained merely by turning the full-range vernier dial. For convenience in making adjustments, two of the small trimmer condensers are located on the top deck of

DETAILS OF SOME SPECIAL CONNECTIONS

The drawings below give exact data on some of the important points in wiring for coil and transformer connections

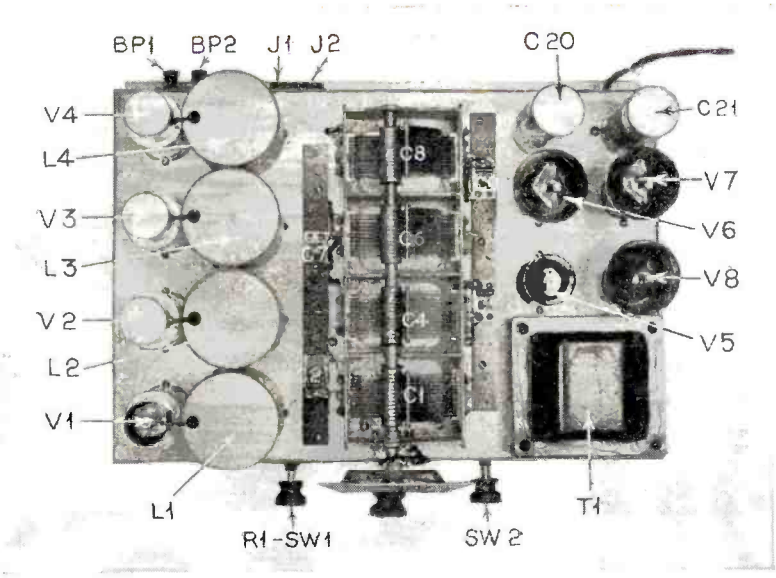


*Engineer, Wholesale Radio Service.

the chassis at the right of the four-gang condenser and the two others are similarly located at the left.

Since the type −57 tube has been designed primarily for use as a biased detector, it functions perfectly in this circuit position. The shield arrangement in the dome is an important feature of this tube, since it permits a decided reduction in the output capacitance. Other advantages are high transconductance and plate resistance and the sharp plate current-grid bias "cut-off" necessary for sensitive detection.

This tube delivers a large audio-frequency output voltage with a relatively small r.f. input signal. In accordance with best modern practice, linear power-detection is used.



TOP VIEW OF THE RECEIVER

Here is shown the placing of the various parts on the sub-base, lettered in accordance with the text and the list of parts

The antenna coupler and the three r.f. transformers are especially designed for use with the new type tubes. They are of low-loss construction and are accurate. Since the four-gang condenser is also extremely precise, very little adjustment of the trimmers is necessary. The four coils are individually shielded by means of cylindrical aluminum shields. The three type −58 r.f. tubes and the type −57 detector tube are also individually shielded. Ventilated tube shields are used, especially designed for the new type tubes.

In addition to adequate shielding, the various portions of the circuit are carefully isolated by suitably by-passed r.f. chokes or resistors. Volume is controlled by means of a tapered Electrad potentiometer connected in series in the cathode circuit of the three r.f. tubes. Minimum bias is maintained on these tubes by means of the voltage drop across the 400-ohm resistor, R2. As shown in the schematic diagram, one end of R1 is connected to the fixed resistor, R2, while the other end is connected to the antenna primary and antenna binding post. The rotable arm of the potentiometer is connected to ground. This method gives smooth, even control of volume from a whisper to the maximum volume obtainable.

Incidentally, the power switch, SW1, is mounted on the volume-control potentiometer as an integral part of that unit, and both are controlled by the same knob. The pin-jacks, J1 and J2, in the grid-return circuit of the detector tube, provide a convenient means of plugging in the pick-up of an electric phonograph or a microphone for home broadcasting or home recording. Obviously, there must be a connection between J1 and J2 when the set is being used for radio reception. This is made externally by means of a short piece of bus-bar wire inserted into the jacks.

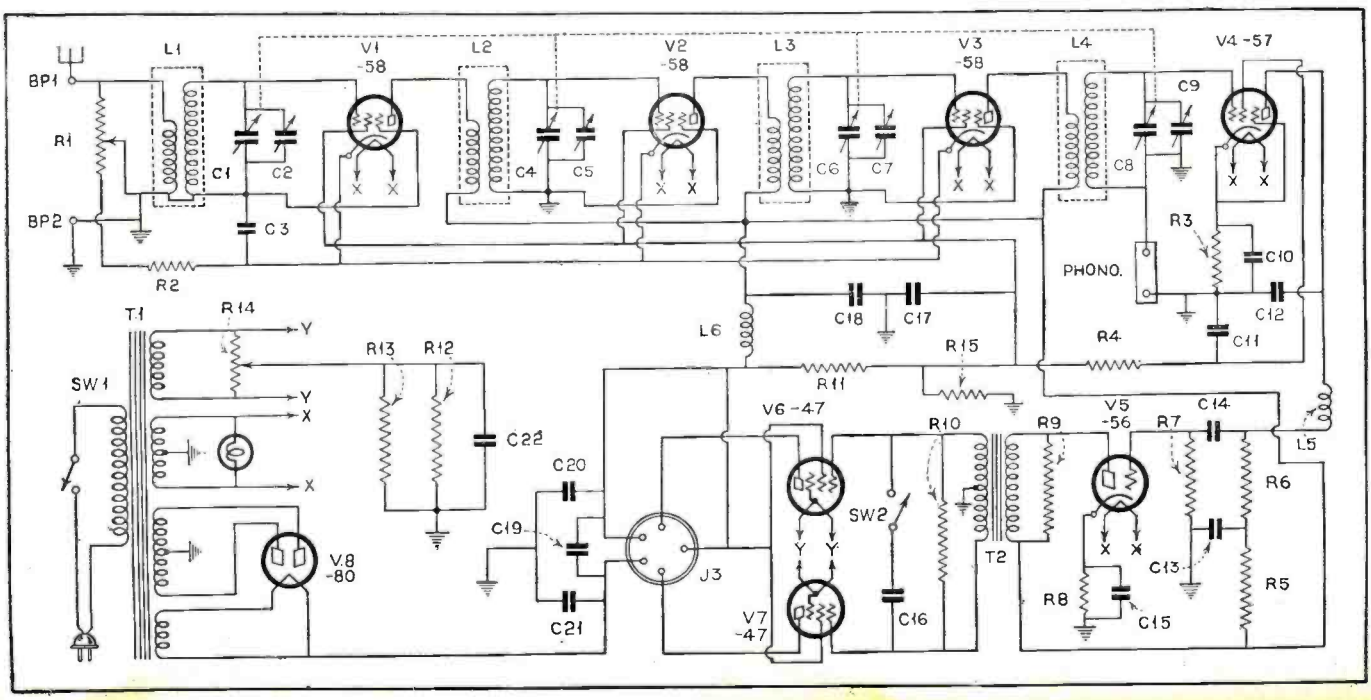
The r.f. choke, L5, in the plate circuit of the detector, by-passed by condenser C12, eliminates nearly all the circulating r.f. currents from the plate circuit, preventing distortion and improving detector action.

In order to attain the finest fidelity possible, the first audio stage is coupled, by resistance coupling, to the type −57 detector. A type −56 tube is employed in the first audio stage. This is a new general-purpose triode, somewhat similar to the old-style type −27 tube but having much lower current consumption. It functions with extra efficiency in a resistance-coupled amplifier.

Since the output stage employs two power pentodes in push-pull arrangement, an input push-pull audio transformer constitutes the coupling medium between the first audio stage and the output stage. Resistors shunted across the primary and the secondary of this transformer serve to cut out hum and give a more flat characteristic curve, (*Continued on page* 422)

THE COMPLETE SCHEMATIC WIRING DIAGRAM

Here is shown a layout for making connections to all the tubes, parts and accessories used in building the receiver, including the complete power pack which is incorporated. The filaments of the tubes are shown as XX and YY and are carried over to the filament leads similarly marked on the power transformer T1



TWO'S COMPANY; THREE'S A CROWD, BUT

This new microphone picks up the voices of the two performers facing each other and eliminates that of the director of the program standing in back. He can whisper instructions without being heard by the audience

New "Velocity" Microphone

A description of a new microphone of the ribbon type which is actuated by the velocity of the minute air particles set in motion by sound waves

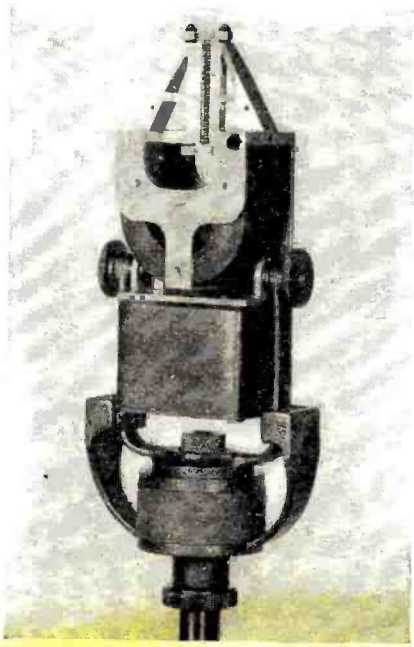
By Frederick Siemens

THE development of a radically new kind of microphone which promises to bring about revolutionary improvements in the quality and technique of radio broadcasting, was announced recently from the laboratories of the RCA Victor Company, at Camden, N. J.

The new microphone, according to the engineers who designed it, reproduces sound with a fidelity never before possible, and, in addition, embodies technical advantages which will solve many pressing studio problems. Unlike existing types of microphones which utilize diaphragms, the new "velocity" microphone utilizes a sensitive ribbon of duralumin, the heart of the mechanism, which vibrates with the minute variations of the air particles set in motion by the sound waves.

Engineers liken the operation of the new "velocity" microphone to a fine mirror which does not add or subtract from the original image, but presents an exact likeness. It responds uniformly to the entire audible range of sound from zero to 14,000 cycles and over, which means that the subtle overtones and shadings which give vitality and life to sound are faithfully reproduced to give the illusion of reality. Accordingly, the new microphone is free from a defect of many existing microphones which tend to either over or under-emphasize certain tones that are in resonance with the vibrating mechanism, producing the artificial whistles and hissing sibilants which acoustical experts in the field of sound have dubbed "sound whiskers."

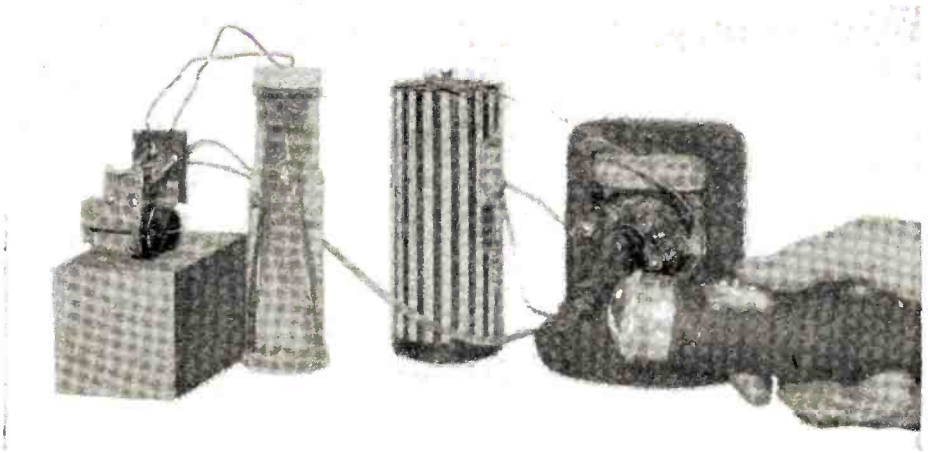
With this new microphone the rattling of a bunch of keys, for instance, a severe acoustical test because of the high frequencies called into play, actually sounds like rattling keys and not like a "string of tin cans rattling on a rocky road." The ring of a telephone bell, too, is retained with all of its lifelike quality, and above all, human voices and the instruments of the orchestra may be clearly identified.



In its application to sound recording, the microphone may be looked to for further marked improvements in the finished product.

Up to the present time all microphones employed a diaphragm which offered a relatively large and impeding surface to the passage of sound waves. Most microphone trouble was laid to the use of a diaphragm. With this in mind, radio engineers of RCA-Victor have produced the new "velocity" microphone, which has been called "the microphone without a diaphragm." The sound waves, instead of being forced to pass around this microphone, actually pass freely through it. All previous types of microphones were actuated by change of pressure on the diaphragm. This new type is actuated by the velocity of the air particles and thus it derives its name.

Another important advantage of the velocity microphone is its positive directional characteristics. In radio and in recording work (*Continued on page* 431)



SIMPLE P.E. CELL EQUIPMENT

Here is shown a complete photo-electric control set-up. The flashlight beam actuates the "pickle-bottle" cell, which in turn operates the small relay at the left, closing or opening the battery supply to the motor

The Pickle Bottle Photo-cell

IS PUT TO WORK

Here the author suggests possible applications for home-made photo-cells, such as the one described by him in the October issue

By M. L. Wendel

Part Two

WHILE many fascinating stunts may be done with a photo-cell, it is also possible to do real chores—step-saving chores, indeed.

The writer knows of a case of an invalid lady who was greatly helped by the application of a photo-cell. It so happened that she was confined to her wheel-chair, and yet it was necessary to unlock her door. Before she was equipped with the arrangement about to be described, it was necessary that she run her chair over to the door, which, when she had many callers, exhausted her and was strictly against the doctor's orders.

First the door was equipped with a magnetic lock, and a small but rugged relay was connected between the photo-electric cell and the lock, with the lock operated by battery current so that a second heavy current relay would not be necessary. The confined lady then simply flashed her light on the cell when the door-bell was rung.

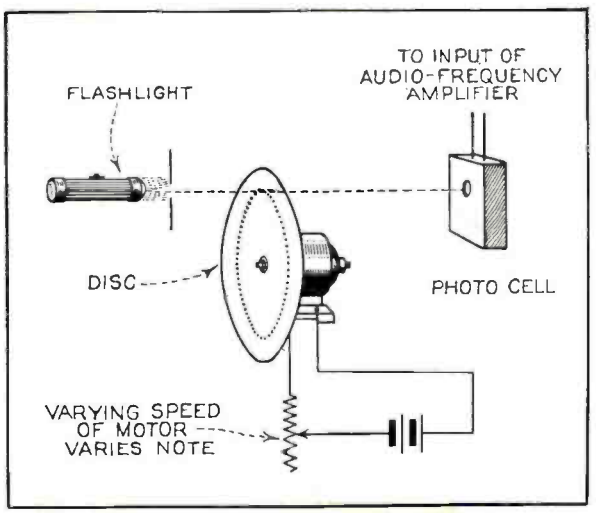
The ingenious experimenter, if he cares to, may easily build an electric lock operated by a battery by using the magnets from an old bell or an old buzzer.

If purely spectacular stunts are required, there are many things that may be done by the use of the simple little pickle-bottle photo-cell described in the October article. If a second relay capable of handling 250 watts is used, the experimenter may amaze his friends by starting a quarter horsepower motor by simply waving his hand. To do this it will be necessary that the heavy current relay be such that, once it closes the circuit, the circuit will stay closed until the relay is "cocked" again. If the contacts of the relay spark too much, it will be found that part of the spark may be absorbed by bridging an old radio condenser of about 4 mfd. capacity across the contacts.

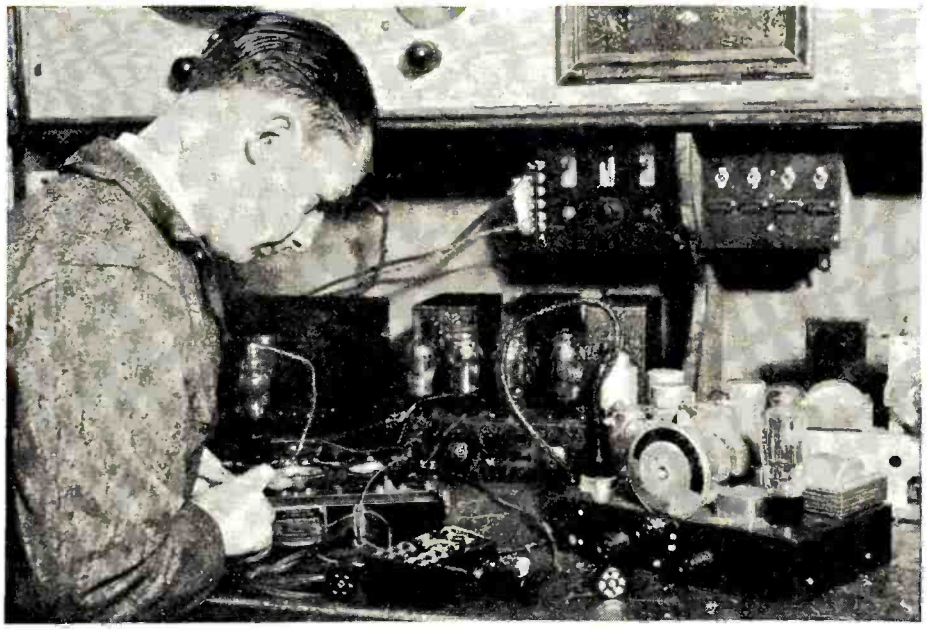
Musical notes of various frequency may be produced by the use of the simple chopper illustrated in Figure 1. If a high-speed motor is used, the builder should be very careful to see that the chopper, which may be of light sheet tin, is securely fastened to the shaft, for it must be remembered that a by-stander might be seriously injured if this should leave the shaft while the motor is traveling at high speed. A rheostat placed in the motor circuits permits the speed of the motor to be varied, thus varying the pitch. If the builder wishes, he may connect the photo-cell output to an ordinary vacuum tube amplifier of the power type and produce a terrific siren.

PHOTO-CELL MUSIC

Figure 1. The holes in the revolving disc permit impulses of light to strike the photo-cell, the output of which is fed into an audio amplifier. The pitch is determined by the number of holes and the speed at which the disc revolves



One of the most practical uses that could be imagined was recently devised by a young chicken farmer who, like many others, took advantage of the fact that chickens may be fooled into a longer day by the use of electric light that may be turned on with an alarm clock. The turning on was easy, but who wanted to rise with the sun and turn the electric lights off? The photo-cell answered the problem nicely. The young farmer simply put a small box outside the coop, placed a home-made photo-cell in it, and now every morning (*Cont'd on page* 447)



How to Construct a

Set Tester Adapter

Many servicemen and experimenters already have set testers that are not suitable for testing the six- and seven-prong tubes and this little adapter will be a boon to them

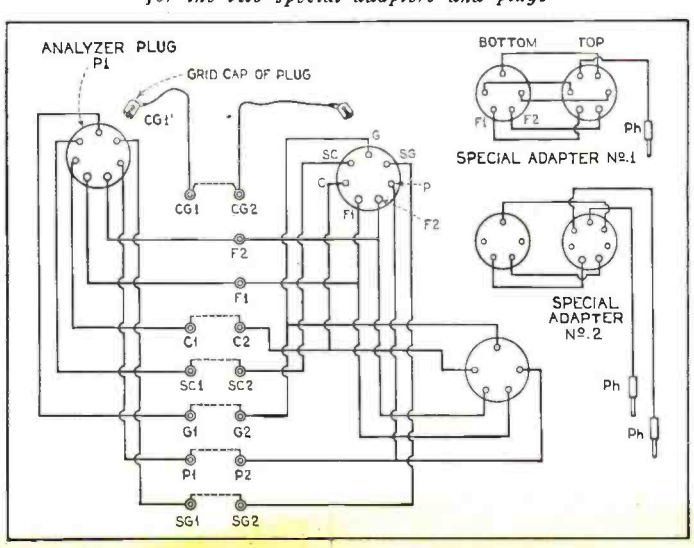
By L. J. Littman*

MOST of this year's radio and television receivers, as well as amplifiers, employ new tubes that have six or seven prongs. The universal adapter herein described makes it possible to test all the characteristics of these new tubes, when used in conjunction with either any present tube tester, set analyzer or just with the aid of any volt- and milliammeter. It is simple in construction and can easily be built by the novice at a ridiculously low cost.

It consists of a small bakelite panel of 2¾ inches by 4½ inches provided with a 7-prong wafer socket, and is screwed down on a bakelite molded case of 2⅞ by 4⅝ by 1½ inches, with a 5-prong socket mounted on its side. A standard wall outlet box, that can be obtained anywhere, can be used therefor. Seven pairs of pin-jacks are mounted on the panel, as indicated in the accompanying illustrations. Two of these jacks, F1 and F2, are connected to the filament circuit, as shown schematically in Figure 1. All pin-jacks with the index "1" are connected to the 7-prong test plug provided therewith. All pin-jacks with the index "2" are connected to the panel socket. Normally small jumpers join all "1" jacks to "2" jacks (except for the filament jacks). Finally the filament, cathode, plate and grid prongs of the 5-prong socket are correspondingly connected to the 7-prong socket.

HOOK-UP FOR THE ADAPTER

Wiring diagram for the adapter, also showing the wiring cables for the two special adapters and plugs

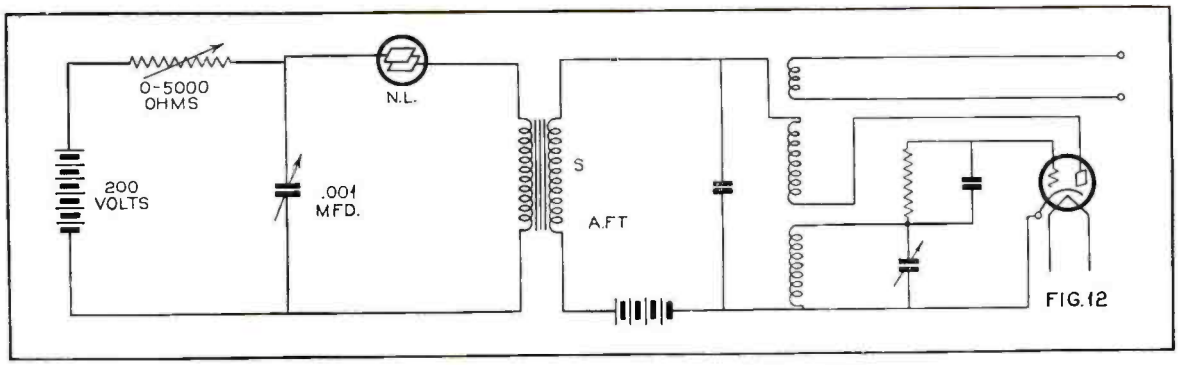


To use the adapter with any tube checker, a 5- to 7-prong adapter is put on the analyzer plug P1, and same is inserted into the 5-prong socket of the tube checker. The grid cap of the latter is put on the plug projection CG' of the same plug. The tube under test is inserted into the panel socket. In the case of a 6-prong tube, a 6 to 7-prong adapter is employed. Suppose you would like to check the new 7-prong type –59 tube, which is expected to replace all type –45, –46 and –47 tubes, and others. (This tube can be used either as a Class A, Class B or as a pentode tube.) To do this it is inserted into the test panel socket, and the pin-jacks P1, SC1, SG1, P2, SG2, SC2 are joined together to check it as a Class A tube. In the case of a Class B tube, the pin-jacks P1, SC1, P2 and SC2 are joined together. To test it as a pentode, the pin-jacks SC1, SC2, C1, C2 are joined. It is absolutely necessary to make all these tests on the new tubes, as, otherwise, "shorted" elements would not be detected when using ordinary adapters, of which a large number would be required. This universal adapter has, further, the advantage of simplifying and clarifying the process of tube checking.

A resistor, R, of .83 ohm and 7.5 watts makes it possible to check the –82 rectifier on the 5-volt filament rectifier winding supplied with all tube testers. It also becomes an easy matter to check a full-wave rectifier tube for both plate

(*Continued on page* 431)

*Chief Engineer, Coast to Coast Radio Corp.



MODULATED RADIO-FREQUENCY OSCILLATOR

The circuit to the right of the a.f. transformer is that of an ordinary r.f. oscillator

Neon Tube Oscillators

This is the second and concluding article on this subject and offers information on the characteristics of neon tube oscillators. It also points out some practical applications

Part Two

[*By* Dale Pollack]

THE wave form produced by the neon tube oscillator is of a unique shape, unattainable with any other simple apparatus, as Figure 5 shows. The upper curve is that of the voltage across the neon tube, while the lower graph shows the corresponding current in the condenser branch of the circuit. That portion of the curves representing t_2 is of much shorter duration, in general, than that of t_1. The peculiar "saw-tooth" wave form has been used to advantage in the measurement of distortion in audio-frequency amplifiers. Reich has shown that, if a current of this type is impressed upon the input of an amplifier and low-frequency discrimination occurs, it will be evidenced by a bending of the positive portion of each saw-tooth. To ascertain if distortion is taking place, it is only necessary to apply an oscilloscope to the output of the amplifier to observe the wave shape of the voltage. Estimates of the amount of distortion present at different frequencies may then easily be made visually. This method is also being used to detect low-frequency distortion in detectors.

The simple circuit shown in the previous article is not the only circuit in which the neon tube will oscillate. A similar action may be obtained by changing the position of the condenser so that, instead of shunting the neon tube, it is placed in parallel with the resistor, as in Figure 7. In this case the previous analysis may be applied in the same manner, except that t_1 is now the length of the period during which the lamp is lighted and t_2 is the period during which the lamp is dark.

The limits in frequency over which the neon tube will oscillate are not as wide as those which may be obtained from a vacuum tube oscillator, although frequencies as high as 95,000 per second and as low as one in 300 seconds have been attained.[9] However, frequencies much higher than 95 kc. may be obtained by the use of oscillator harmonics, as is explained below. The upper limit of the fundamental frequency range is determined to a large extent by the capacity between the electrodes, and, hence, to increase the upper limit, no condenser, other than the inherent capacity between the cathode and anode should be used. External capacity should be minimized in every possible way. The lower frequency limit is indeterminate, but if it is reduced much below 1 cycle per minute, the frequency stability becomes somewhat poor and the lamp operates erratically.

Although the fundamental frequency of a neon tube oscillator cannot conveniently be raised much higher than 50 kilocycles, yet, since the oscillator is very rich in harmonics, as the wave shape would indicate, it may be used to produce oscillations of any reasonable frequency merely by choosing the desired harmonic by means of the proper selector circuit. The wealth of harmonics present in an oscillating neon tube may be demonstrated by operating the lamp in proximity to an unshielded high-frequency oscillator. As the oscillator is tuned, the beat of its harmonics with those of the neon tube will be heard at numerous points over any range that may be selected.

If one of these harmonics is selected and the zero beat position ascertained, it will generally be found that, once the tube has been operating long enough to attain stable operation, the frequency, as represented by one of its hamonics, will be quite constant. If it is found that the stability is not entirely satisfactory, it may often be improved by operating the tube at twice its rated voltage for twenty-four hours before it is used in an oscillator circuit. Even after having been "seasoned" in this manner, a neon tube should be operated for five or ten minutes in the oscillating condition to enable it to reach its normal operating temperature, if stability is an important

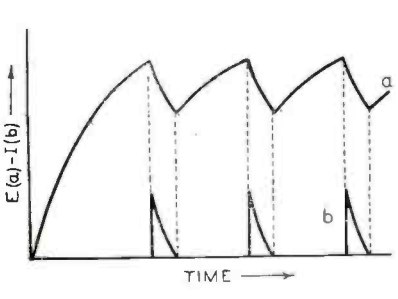


FIG. 5

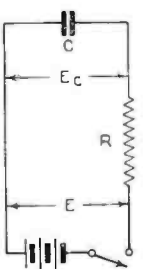


FIG. 6

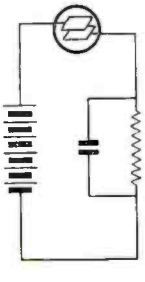


FIG. 7

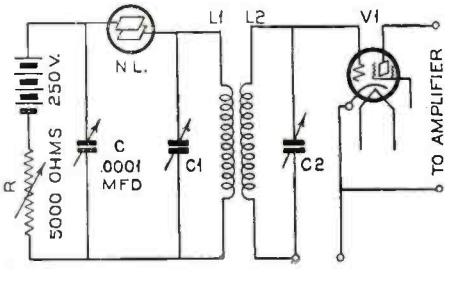


FIG. 8

consideration. Observation of one of the oscillator harmonics by the beat method will enable any drift to be observed. A properly designed neon oscillator may even be used to control the frequency of a short-wave transmitter. A circuit for this purpose is shown in Figure 8. This field is a fruitful one for experiment.

A number of various types of neon lamps are available commercially, all of which are suitable for use as oscillators. The small tubes manufactured for use as indicating lamps are extremely cheap and are adaptable to this service. The effect caused by inequalities in the distance of the anode from corresponding points on the cathode, which has been referred to previously, can be observed in almost all lamps of this type. As the series resistor is varied, the spot of light on the cathode at which the oscillatory action is taking place will be found to move from place to place on the cathode as the applied voltage changes. Each time the spot jumps there is a corresponding sudden change in the oscillation frequency.

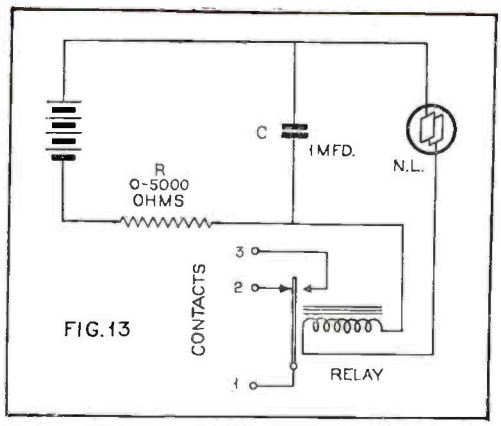


FIG. 13

CIRCUIT INTERRUPTER

With the constants given, the relay will be actuated approximately three times per second. A relay with a resistance of at least 1000 ohms should be used

Neon tubes of this type are convenient to use because of their low critical voltages, their only defect being the shifting of cathode glow mentioned. However, if frequency variations are obtained by means of the condenser rather than with the resistor, the effect will be negligible.

Neon lamps intended for television are often not much more satisfactory in this respect, and, in fact, the only lamp which has been found entirely free from this effect is the one described previously, consisting simply of two wires sealed in a tube of neon. In a tube of this sort all points on each electrode are mutually equidistant and there is no possibility for any of the disturbing variations to occur.

Audio-Frequency Oscillators

Most commercial lamps contain current-limiting resistors in their bases, so that if any accurate measurements of their properties are to be made, these resistances must be removed. In removing one of these resistances, care should be taken not to fracture the gas seal, which is very often placed in the lamp base.

A vacuum tube oscillator of the type shown in Figure 9 may be used as a source of audio-frequency current only when the frequency of oscillation is fixed. If it is desired to vary the oscillation frequency, it is necessary to make large changes in the values of the inductances and capacities, changes which are not feasible with ordinary apparatus, especially if single-dial control of frequency is desired. It has been customary, therefore, to beat two high-frequency oscillators together and to use the resultant as the desired audio frequency. When this method is used, small changes in the oscillator circuit constants of one of the oscillators will produce large changes in the audio-frequency beat, and hence this type of oscillator is adapted to single-dial control. The beat oscillator is almost universally used wherever a variable audio-frequency source is required, but satisfactory beat oscillators are somewhat difficult to design, and for this reason they are expensive pieces of apparatus; and, in addition, the number of tubes which must be used is large.

The neon tube oscillator affords a convenient source of audio current that may be substituted for the beat oscillator in a number of applications, and, in fact, in any position where it is not essential that the output be sinusoidal. It has been pointed out previously that this non-sinuosity may even be utilized to advantage. A circuit for a neon tube audio oscillator and amplifier suitable for most purposes is given in Figure 10. Figure 11 is the frequency-capacity characteristic of such an oscillator. The frequency should be varied by changing the position of the condenser, rather than that of the resistance, or inequalities in the distances between the anode and cathode will be manifested in sudden jumps from one frequency to another. After setting the resistor at an optimum value, no further attention need be paid to it. An oscillator of this type may be used admirably to modulate a radio-frequency oscillator used in the testing of radio broadcast receivers. Any tendency of the cabinet to resonate at any particular frequency or of the speaker to "blast" can easily be detected, as well as any faults in the audio amplifier itself. The circuit of a modulated radio-frequency oscillator is shown in Figure 12.

Another Application

A method for the measurement of capacities and resistances by means of the neon tube oscillator has been developed by Taylor and Clarkson.[10] The method is one in which known capacities or resistances are substituted for the unknown until the oscillation frequency equals that obtained with the unknown elements. By means of this method the measurement of high resistances may be considerably simplified. Various refinements, including the use of a beating oscillator to determine the frequency before and after substitution are suggested in the papers to which reference is made.

Since it is possible to operate the neon tube oscillator at frequencies of two or three per minute, it is apparent that it may be used to advantage in positions in which a slow interrupter is necessary, as in intermittent advertising signs. A circuit for this purpose is suggested in Figure 13. It is entirely feasible to connect a neon advertising sign directly into the oscillating circuit, making the sign itself the neon element. In this connection it should be noted that the ability of a gas-filled tube to oscillate is not singular with the neon lamp. This property is characteristic of all gas-filled discharge tubes.

[9] Ochwald and Tarrant, Proceedings, Physical Society (London), 36, 262 (1924).

[10] See loc. cit., footnotes 6 and 2.

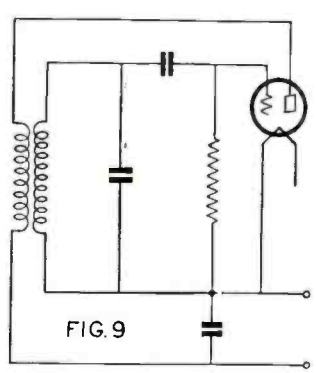


FIG. 9

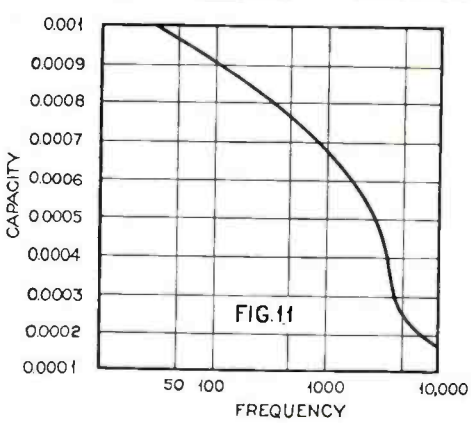


FIG. 11

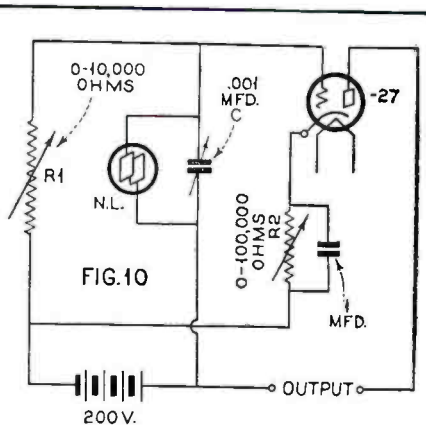


FIG. 10

Radio Call Book Section

Conducted by S. Gordon Taylor *and* John M. Borst

Consolidated Short-Wave Station List

(*Continued from the December issue*)

By Wavelength, Frequency, Call, Location and Time

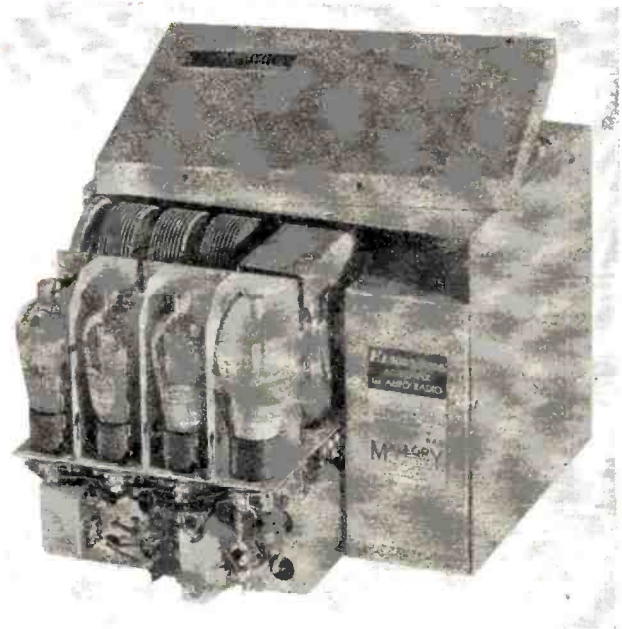
Wavelength Meters	Frequency Kc	Call Letters	Location	Service and Schedule
24.81	12,090	.....	Tokio, Japan	Phone., 5-8 A.M.
24.89	12,045	NSS	Annapolis, Md.	9:55 P.M. (time signal)
25.00	12,000	PZG	Saigon, Indo-China	2-2:05 P.M. (time signal)
25.01	11,993	PK6KZ	Makassar, Celebes	Broadcast
25.10	11,950	KKQ	Bolinas, Calif.	Testing, irregular
25.20	11,905	.....	Paris, France	Broadcast; 1-3 P.M., daily, 10:30 A.M.-1:30 P.M.
25.22	11,895	VE9DN	Montreal, Can.	Broadcast
25.24	11,880	W9XF	Downers Grove, Chicago, Ill.	Broadcast
25.25	11,880	W8XK	Saxonburg, Pa.	Broadcast; 3-9 P.M., daily
25.27	11,870	W8XK	Saxonburg, Pa.	Broadcast
25.27	11,870	VUC	Calcutta, India	Broadcast
25.34	11,840	W2XE	Jamaica, N. Y.	Broadcast 7:30-2 A.M. daily 8 A.M.-midnight Sun.
25.34	11,840	W9XAA	Chicago, Ill.	Relays WCFL; 7-8 A.M., 1-2 P.M., 4-5:30 P.M., 6-7:30 P.M.
25.40	11,810	12RO	Rome, Italy	Broadcast; Sat. 11 A.M.-noon, 4-5 P.M., 10-11 P.M.; Sun, Mon. 11 A.M.-Noon 4-5 P.M.
25.40	11,810	VE9GW	Bowmanville, Ont., Can.	Broadcast; 1-10 P.M. daily.
25.42	11,801	UOR3	Vienna, Austria	Broadcast; 6-9 A.M. Wed., Thur. Exp.
25.42	11,801	W1XAL	Boston, Mass.	Broadcast; irregular
25.47	11,780	VE9DR	Drummondville, Can.	Tests with XAM 1-6 P.M.
25.51	11,760	XDA	Mexico, D. F.	Broadcast; Mon-Fri. 6:45-7:30 A.M., 12:30-6:10 P.M. Sat. 7-8 A.M., 12:30-6:10 P.M.
25.53	11,750	G5SW	Chelmsford, Eng.	Broadcast; daily 6-8 P.M.
25.60	11,720	VE9JR	Winnepeg, Man., Can.	Broadcast
25.62	11,712	HKN	Medellin, Colombia	Broadcast
25.63	11,705		Paris, France	Broadcast
25.64	11,700	YV4BV	Valencia, Venezuela	Testing with Germany. Sometimes broadcast
25.65	11,695	YVQ	Maracay, Venezuela	Phone. to KES 2-8 P.M.
25.68	11,680	KIO	Kauhuku, Hawaii	Exp. 6 P.M. irregular
25.70	11,675	PSZ	Rio de Janeiro, Brazil	Tests with XDA, noon and 6 P.M.
26.00	11,530	XAM	Merida, Yucatan	Phone.
26.02	11,531	CGA	Drummondville, Can.	Phone.
26.10	11,525	GBK	Bodmin, England	Time signal 7 A.M. and 7 P.M.
26.46	11,340	DAN	Norddeich, Germany	Broadcast
27.00	11,111	XFD	Mexico City, Mexico	Tests 3-8 A.M.
27.17	11,000	ZLW	Wellington, N. Z.	Phone to HJY; evenings
27.35	10,975	OCI	Lima, Peru	Phone to Hawaii, irregular
27.68	10,840	KWV	Dixon, Cal.	Phone to VLK, J1AA 9 P.M. and 6 A.M.
27.80	10,800	GBP	Rugby, England	Tests with J1AA and others
27.86	10,770	GBP	Rugby, England	Broadcast
27.94	10,755	CT1BO	Lisbon, Portugal	Phone to Burmuda; daylight
28.10	10,675	WNB	Lawrenceville, N. J.	Tests with HJY; evenings; irregular
28.12	10,670	CEC	Santiago, Chile	Phone. to Holland and France; weekdays from 7 A.M.; sometimes after 9:30 A.M.
28.22	10,630	PLR	Bandoeng, Java	Phone. to LSN; evenings
28.44	10,550	WOK	Lawrence, N. J.	Phone. to GBX 1-7 A.M.
28.50	10,525	VLK-VK2ME	Sydney, Australia	Broadcast
28.52	10,520	VK2FC	Sydney, Australia	Phone to Java and VLK 3-8 A.M.
28.77	10,425	UIG	Medan, Sumatra	Phone.
28.80	10,415	PDK	Kootwijk, Holland	Phone.
28.82	10,410	LSY	Buenos Aires, Argentine	Exp.
28.85	10,400	KEZ	Bolinas, Cal.	Phone.
28.87	10,390	GBX	Rugby, England	Broadcast daily; 8-9 P.M.
28.99	10,350	LSX	Buenos Aires, Argentine	Phone. to OPM 2-4 A.M.; 9-11 A.M.; 3-6 P.M.
29.04	10,330	ORK	Brussels, Belgium	Broadcast; irregular
29.16	10,290	DIQ	Koenigswusterhausen,, Ger.	Tests with W2XBJ; eve.
29.35	10,220	PSH	Rio de Janeiro, Brazil	Press
29.56	10,150	DIS	Nauen, Germany	Phone ORK 9-11 A.M.; 3-6 P.M.
29.59	10,140	OPM	Leopoldville, Belgian Congo	Phone to GAA after 3:30 P.M.
29.84	10,055	SUV	Abu Zabal, Cario, Egypt	Phone to WNB; daylight
29.84	10,055	ZFB	Hamilton, Bermuda	Broadcast
29.97	10,013	CM2LA	Havana, Cuba	Broadcast
30.00	10,000	.....	Belgrade, Yugoslavia	Phone to WLO, 6 P.M.-6 A.M.
30.10	9,964	LSL	Buenos Aires, Argentine	Phone. to WMI; 5-11 P.M.
30.17	9,950	GCU	Rugby, England	Phone to DCI; irreg.; eve.
30.21	9,930	HJY	Bogota, Colombia	Phone to WLO; 6 P.M.-6 A.M.
30.33	9,890	LSN	Buenos Aires, Argentine	Phone.
30.33	9,890	LSA	Buenos Aires, Argentine	Phone to England; eve.
30.40	9,870	WMI	Lawrenceville, N. J.	Phone.
30.40	9,870	WON	Lawrenceville, N. J.	Broadcast; 6:30-8 P.M. and 1-3 P.M.
30.43	9,860	EAQ	Madrid, Spain	Phone to Europe and America
30.61	9,800	LSI	Buenos Aires, Argentine	Phone to Europe and America
30.64	9,790	LSI	Buenos Aires, Argentine	Phone to U. S.; evenings
30.64	9,790	GCW	Rugby, England	Broadcast
30.70	9,772	EAM	Madrid, Spain	Phone. to Java; 4-8 A.M.
30.74	9,760	VLJ	Sydney, Australia	Phone to England; evenings
30.77	9,750	WOF	Lawrenceville, N. J.	Phone 3-4:15 P. M. Tues, Fri.
30.77	9,750	.....	Agen, France	Phone.
30.77	9,750	WNC	Deal, N. J.	Phone.
30.93	9,700	LQA	Buenos Aires, Argentine	Broadcast; daily except Sun.; 9-10 P.M.
31.00	9,672	T14NRH	Heredia, Costa Rica	Broadcast
31.21	9,616	VQ7LO	Nairobi, Kenya, Brit. E. A.	Broadcast; 4-7 P.M. Thu, Fri.
31.25	9,600	CT1AA	Lisbon, Portugal	Phone.
31.25	9,600	LGN	Bergen, Norway	Relays WCAU; daily
31.28	9,590	W3XAU	Byberry, Pa.	Broadcast; mid. Sat. 12-2 A.M.; 4:30-8:30 A.M.; 1:30-3.30 P.M Sun.
31.28	9,590	VK2ME	Sydney, Australia	Broadcast
31.28	9,590	PCJ	Hilversum, Holland	Broadcast
31.32	9,580	VE9DN	Montreal, Canada	Broadcast; 3:30-11:30 P.M.
31.35	9,570	W1XAZ	Springfield, Mass.	Broadcast; 1:45-4:45 P.M. Tuesday; 1:30-8 P.M. Thursday
31.35	9,570	SR1	Poznan, Poland	Broadcast; 2-6:30 P.M. daily
31.38	9,560	DJA	Koenigswusterhausen, Ger.	Broadcast
31.40	9,555	VE9DR	Drummondville, Can.	Broadcast; 5-11 P.M.
31.48	9,530	W2XAF	Schenectady, N. Y.	Broadcast; 2-6:30 P.M. daily
31.51	9,510	OXY	Skamleback, Denmark	Broadcast
31.51	9,520	.....	Tandjong Priok, Batavia, Java	Broadcast; Wed. 5-6:30 A.M.; Sat. 5-7 A.M.
31.55	9,510	VK3ME	Melbourne, Australia	Broadcast; 9-11 A.M. daily
31.58	9,500	HSP2	Bangkok, Siam	Broadcast; between 6-8:30 P.M.
31.58	9,500	PRBA	Rio de Janeiro, Brazil	Exp.; evenings
31.61	9,490	WEF-W2BJ	Rocky Point, N. Y.	Broadcast
31.62	9,488	OXO-OXZ	Copenhagen, Denmark	Phone to Australia; 3-8 A.M.; irreg.
31.63	9,485	PLW	Bandoeng, Java	Broadcast.
31.72	9,460	.....	Buenos Aires, Argentine	Broadcast
31.75	9,450	WES-W2XBJ	Rocky Point, N. Y.	Tests irregular; evenings
31.86	9,415	PLV	Bandoeng, Java	Phone to Australia, Sumatra; 4-8 A.M.
31.88	9,410	PLE	Bandoeng, Java	Broadcast
31.90	9,405	PLV	Bandoeng, Java	Phone.
31.98	9,380	CMAP	Los Andes, Chile	Broadcast
32.00	9,388	CT3AQ	Funchal, Madeira	Broadcast; 4-6:30 P. M. Tues, Thurs; 10:30-noon, Sun.
32.02	9,369	VK3LO	Melbourne, Australia	Broadcast
32.05	9,360	CM2MK	Havana, Cuba	Broadcast
32.10	9,332	CGA	Drummondville, Can.	Phone to GBK; 6 P.M.-6 A.M.
32.22	9,310	GBC	Rugby, England	Phone 2:30-5 P.M. Sun.
32.30	9,300	CNR	Rabat, Morocco	Broadcast; 3-5 P.M. Sun.; irreg. weekdays
32.40	9,250	GBK	Bodmin, England	Phone to CGA; 6 P.M.-6 A.M.
32.50	9,230	FL	Eiffel Tower, Paris, France	Time signal; 4:56 A.M., 4:56 P.M.
32.61	9,200	GBS	Rugby, England	Transatlantic phone
32.72	9,170	WND	Lawrenceville, N. J.	Phone to England; evenings
32.76	9,130	EH9OC	Berne, Switzerland	Broadcast; 3-5:30 P.M.
32.88	9,125	HAT	Szekesvehervar, Hungary	Broadcast
32.93	9,110	SUS	Cairo, Egypt	Phone to England
33.00	9,091	XDA	Mexico City, Mex.	Broadcast
33.00	9,091	SFD	Mexico City, Mex.	Broadcast
33.26	9,020	GCS	Rugby, England	Phone to WND; 6 P.M.-6 A.M.
33.30	9,010	KEJ	Bolinas, Calif.	Tests; irregular
33.50	8,955	TGX	Guatemala City, Guat.	Broadcast; Sat. 10-midnight
33.52	8,950	WEL-W2XBJ	Rocky Point, N. Y.	Exp. irregular; evenings
33.71	8,900	ZLT	Wellington, N. Z.	Phone to VLK; 1-9 A.M.
33.82	8,870	NPO	Cavite (Manila), P. I.	Time signal; 9:55-10 P.M.
34.01	8,820	VK3UZ	Melbourne, Australia	Broadcast
34.68	8,650	VE9BY	London, Canada	Broadcast; 3-4 P.M. Mon.; irregular
35.01	8,570	RW15	Khabarovsk, Silberia	Broadcast
35.05	8,560	WOO	Ocean Gate, N. J.	Phone to ships
35.44	8,470	DAN	Norddeich, Germany	Phone to ships
35.50	8,450	PRAG	Porto Alegre, Brazil	Phone.; 8:30-9 A.M.
36.65	8,185	PSK	Rio de Janeiro, Brazil	Phone. to WOK
36.92	8,125	PLW	Bandoeng, Java	Phone.
37.03	8,100	J1AA	Tokio, Japan	Tests; 5-8 A.M.
37.03	8,100	EATH	Vienna, Austria	Phone.; 5:30-7 P.M. Mon., Thu.

(*Continued Next Month*)

Modern Auto-Radio

OFFERS NEW FEATURES

One of the most recent car radio receivers indicates that auto radio design represents a highly specialized field with requirements and problems all of its own



By M. J. Sheedy*

MOST radio manufacturers, primarily engaged in the production of home receivers, have looked upon auto radio as a sideline. Consequently, it has suffered under the handicap of an industrial stepchild. Circuit design, coils, tubes, condensers, etc., were all borrowed from the realm of home radio and incorporated into the automobile receiver. The fact that they were not really adaptable to this type of service was recognized, but up to the past year or so no concerted effort was made to develop special apparatus to fill this need.

In order to achieve success in any line one must specialize. This rule applies to industry as well as the individual. This theory is responsible for the production of the Motorola models 88 and 61, all-electric receivers as described here. These are the products of an organization whose resources are directed solely to the development of automobile radio. These receivers embody all the knowledge and experience gained in five years of manufacturing automobile receivers.

Simple to Install

In designing the model 88 receiver, the object in view was to produce a receiver that would equal in performance the best of household receivers in its class. In order to arrive at this objective, the natural handicaps under which radio equipment must operate in an automobile must be overcome.

From the dealers and serviceman's point of view, simplicity of installation is of prime importance. The receivers should be so mounted as to be convenient and accessible for service, and in the event of resale of car, removal from same if desired without having the car marred in any way.

Motorola receivers are designed to be mounted on the bulkhead of the car. In the event of heaters or other accessories crowding up the cowl, they may be mounted on the engine side, with perfect immunity to the heat and strong high-tension field encountered under the hood. The simplicity of installation is illustrated by the fact that the writer, who lays no claim to being a mechanic, installed one of these receivers in a Buick automobile in 35 minutes, including a running-board antenna.

The circuit of the model 88 is shown in Figure 1. This receiver has a sensitivity of better than one microvolt per meter. It is an eight-tube superheterodyne using an Elkonode converter for plate supply.

This converter has made possible the all-electric car radio. The heart of this device is the mechanical interrupter. The design of this breaker presented many mechanical problems. When operated in open air, breaker points soon become oxidized and pitted. When in a vacuum, the contact surfaces, while remaining bright and clean, soon became welded together due to lack of means for radiating the generated heat. Suitable alloys have been developed for these contacts which now give satisfactory service.

Built-in Plate Supply

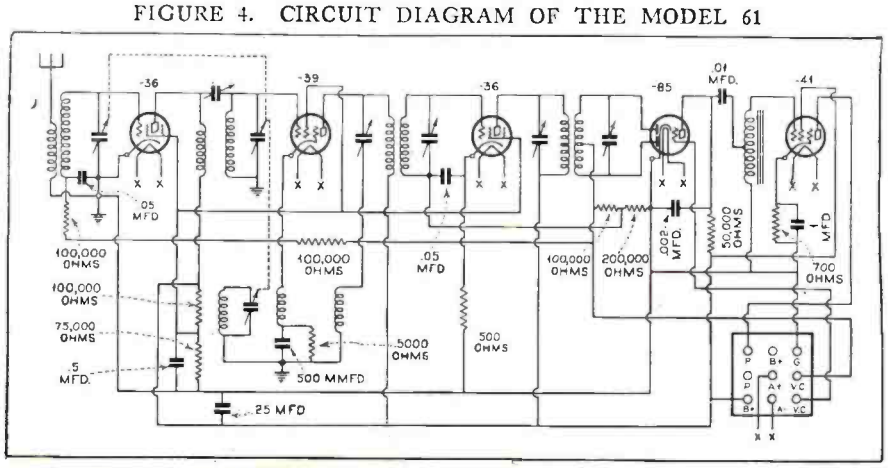
The interrupted primary current is stepped up through a transformer to the proper voltage and then rectified by the BR type tube, which is a half-wave rectifier of the cold cathode gas-filled type. This tube has been designed especially for use in the vibrator type eliminator. Its ability to handle high instantaneous current peaks and its constant internal voltage drop are characteristics which make it particularly suitable for this use, as such eliminators have a very highly peaked a.c. wave form. The absence of a filament is also an advantage in ruggedness and economy. The maximum output of this tube is 50 ma. at 200 volts, which is more than ample, as the set only draws 32 milliamperes.

This current is filtered by condensers and a choke, and the full voltage is fed to the audio amplifier. No voltage divider is used, the necessary voltage drop for the i.f. tube being taken through a filter choke.

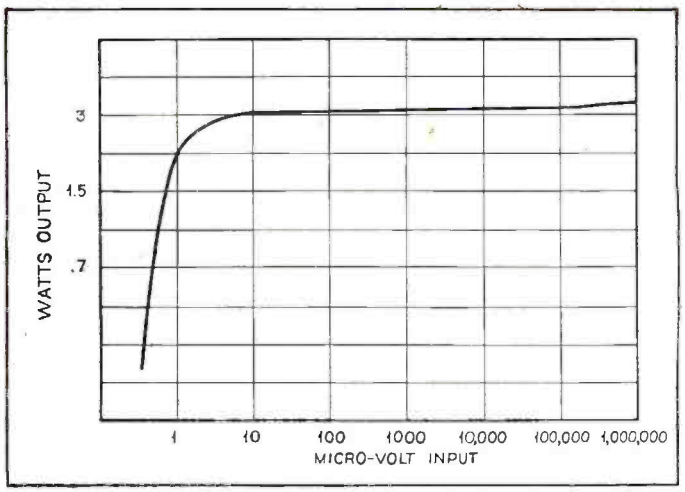
There is a peculiar condition in the operation of these converters that might interest the service man. In order to secure good wave form and efficiency, the balance between input and output is held very close. A slight increase in the resistance of the breaker coil will upset this balance considerably. A low primary voltage will have the same effect.

While these units will operate indefinitely at maximum voltage, their life and efficiency are apt to be impaired if run extensively on a low battery. If the resistance of the breaker coil is raised, the "kick-back" voltage will not readily dissi-

FIGURE 4. CIRCUIT DIAGRAM OF THE MODEL 61

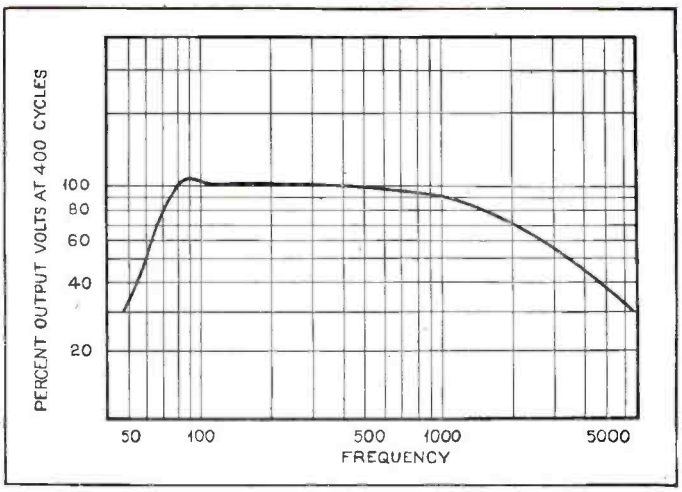


* York Automotive Distributing Co.



THE A.V.C. CHARACTERISTIC

Figure 2. The automatic regulation of output volume is highly effective. The curve shows that all input signal voltages in excess of approximately 6 microvolts will result in substantially the same output volume



AUDIO FREQUENCY RESPONSE

Figure 3. For home receivers this curve would not be particularly satisfactory, but the acoustics of a car body are quite different from those of a living room. This curve is said to meet the requirements of auto installations most satisfactorily

pate through it and will prolong the arc. The possibilities of operating under this condition, however, are rather remote, as the operator, knowing he has a low battery, will generally conserve its energy for starting.

Getting back to the receiver itself, we see that V1 is a -36 type tube, used as an r.f. amplifier. The resonant input circuit is completed through a .05 condenser. This leaves the grid return free to be acted upon by the a.v.c. voltage from the -85 tube.

The output is impedance-coupled to V2, which is a -39 tube, used as a mixer. The cathode circuit of this tube is completed through a small coil L1 in addition to the biasing resistor. The by-pass condenser across this resistor is a fairly low impedance to radio frequencies but a high impedance to intermediate frequencies.

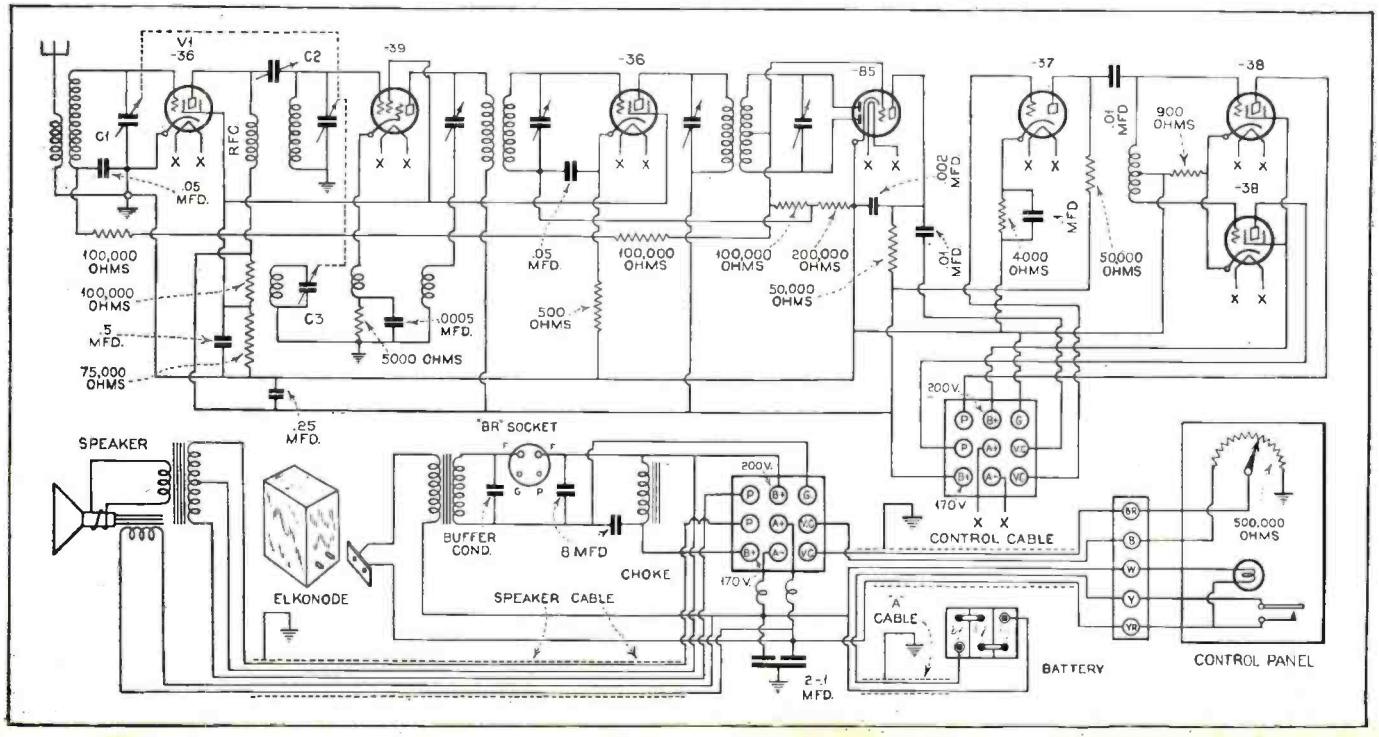
This coil L1 is coupled to the plate circuit. The plate coil L2 is not effective at intermediate frequencies, but offers a high r.f. impedance which causes the tube to oscillate at radio frequencies. The oscillating frequency is controlled by C3, L3, which are closely coupled to L1 and L2. C1, C2 and C3 are variable condensers mounted in a three-gang arrangement. C3 is designed to track with a difference of 175 kc.

The output of V2 is coupled to V3 through an intermediate transformer as shown, L2 offering no appreciable resistance. A -39 tube may be used at V3 if greater sensitivity is desired.

The output of V3 is inductively coupled to the -85 tube. This tube performs three separate functions, namely: a.v.c., full-wave rectifier and first audio amplifier. The i.f. current is fed to the two electrodes which are mounted around the lower part of the cathode. Current flows to one or the other of these collectors according to each half of the cycle. The result is a modulated voltage being built across the two sections of the biasing resistor. This is fed to the grid and the tube functions as a triode amplifier. The high negative potential is filtered through two resistors of 100,000 ohms each and fed to the grid of the r.f. tube, providing automatic control. A slightly lower potential is fed to the grid of the i.f. tube. This completes the a.v.c. circuit. The efficiency of this a.v.c. system is clearly shown in Figure 2. Note its sharp upturn at low input and its constant output over a wide range of signal voltages.

We now come to the audio circuit. Investigation showed that the characteristics of standard audio systems were not suitable for use in an automobile. Body rumble and resonance effects at high speed offset the tonal (*Continued on page* 445)

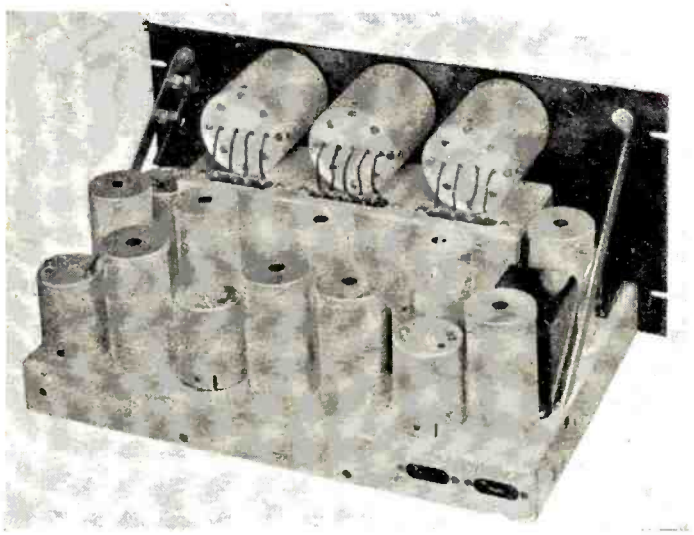
FIGURE 1. THE COMPLETE CIRCUIT DIAGRAM, MODEL 88



NEW SHORT-

This new receiver, while designed tion systems, is equally effective for work and provides for both

By S. Gordon Taylor



THE OVERALL SHIELD REMOVED

Figure 4. All important parts, including tubes, are individually shielded. Note the slots in projecting ends of front panel, to facilitate rack mounting

ONCE again the RADIO NEWS Laboratory finds the opportunity to bring to the attention of "hams" and short-wave enthusiasts receiving equipment which they will find admirably suited to their purposes, although designed primarily for another type of service. Incidentally, it is of interest to note the trend on the parts of certain manufacturers to make available to the radio fan and experimenter equipment produced for commercial station use. It is believed that this is a logical development of merchandising procedure. Not only does it widen the manufacturer's market outlet, but at the same time it provides the more serious experimenter with a wider variety of equipment from which to choose that which best meets his particular requirements.

The receiver to be described in this article is the National "AGS" communication type short-wave receiver. This receiver has an interesting origin. It was developed by the National Company's engineers in collaboration with the U. S. Department of Commerce, this combination working together on the design of equipment for use at the Department of Commerce airport stations throughout the United States. The result of a long period of research and experiment finally took the form of the "AGS" receiver which is now in use at a number of airports, as well as at numerous other commercial stations of various types.

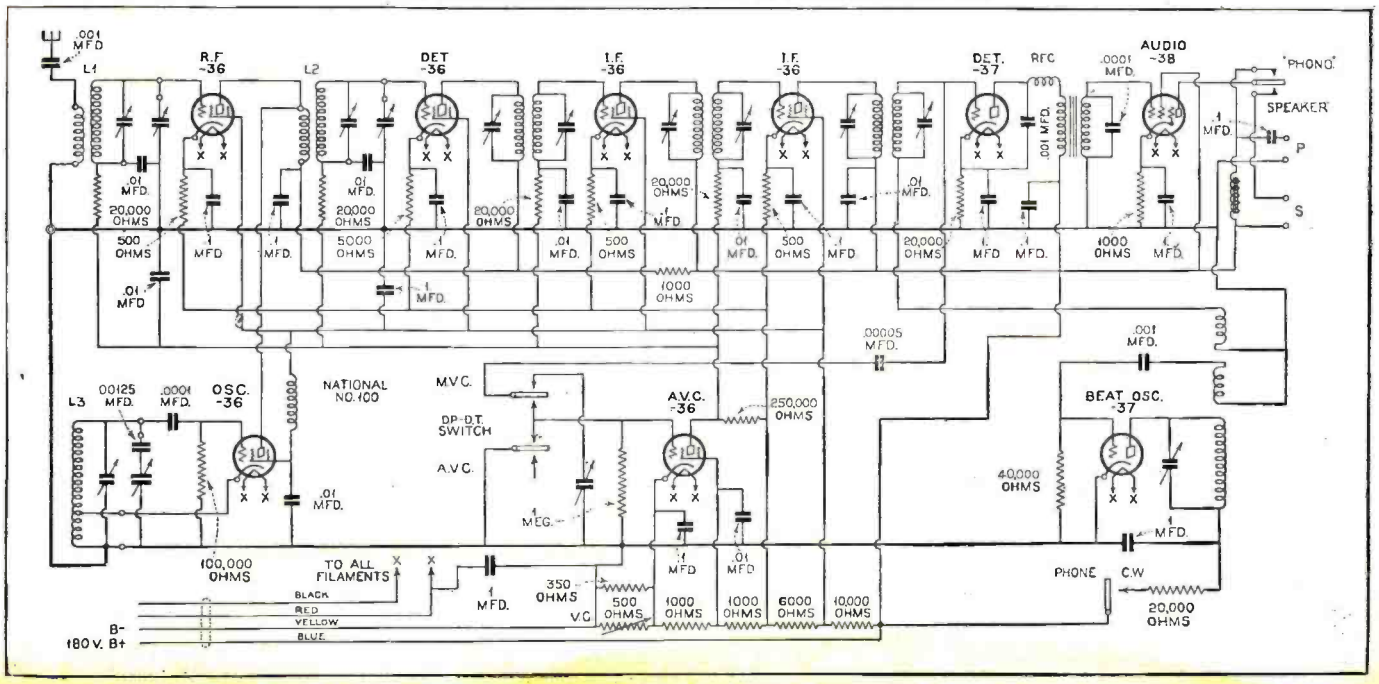
Obviously, the requirements of various types of commercial services have many points in common. It would not be too much to say that all these services have the same basic requirements and that these requirements are likewise common to the experimenter, whether he be a member of the amateur transmitting fraternity or simply a short-wave DX "hobbiest." All require extreme sensitivity, high selectivity, a favorable signal-to-noise ratio and absolute dependability, for instance. Differences in individual requirements have to do largely with the particular wave ranges to be covered and provisions for band-spread tuning in these particular ranges. Requirements may also vary so far as output equipment is concerned. For certain services headphones may be preferred, while loudspeaker reproduction is demanded by others.

A little thought will indicate that if a receiver is designed to fulfill the main basic requirements of good reception, the differing individual requirements can readily be taken care of as more or less incidental. This possibility is exemplified in the receiver under discussion, for instance, in the output system which provides for both headphone and loudspeaker; the different types of plug-in coils which are available, including those for both c.w. and voice reception, etc. More will be written of these individual features later in the article.

Consistent with its design for commercial services primarily, the "AGS" is a rack-mounting unit. But another example of

THE SCHEMATIC CIRCUIT DIAGRAM

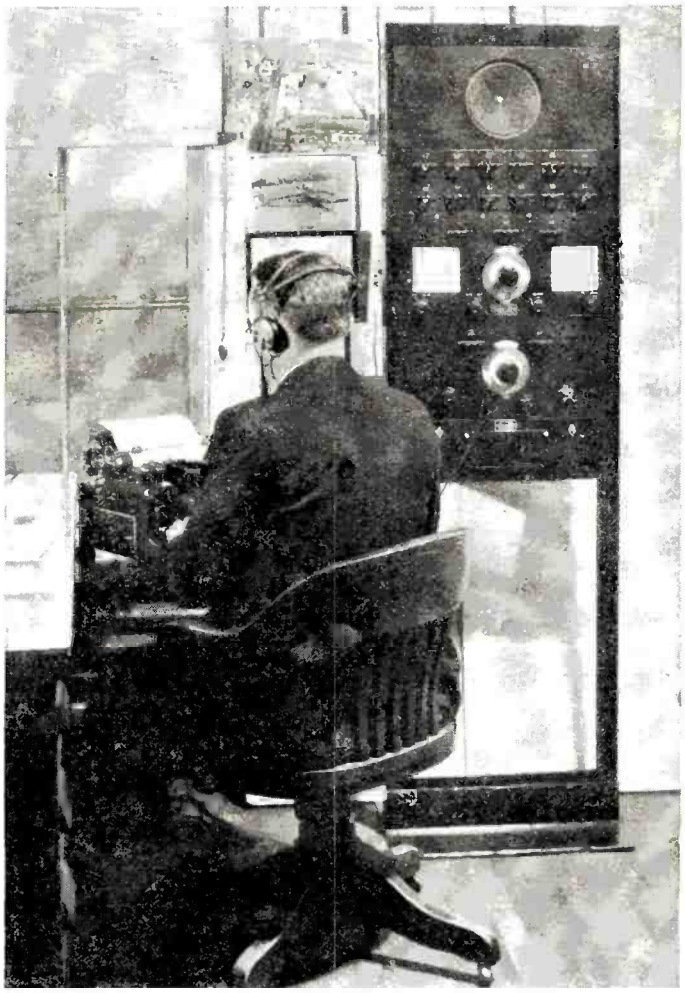
Figure 1. An unusual feature is found in the method of volume control, in that the a.v.c. tube is made use of for both manual and automatic control, as described in the text



WAVE DESIGN

primarily for airport communica- amateur or short-wave broadcast c.w. and 'phone reception

and William C. Dorf



its universal utility is found in the fact that its physical design is such that it can be just as readily used on a desk or table, a method of use which is usually preferred by the amateur or short-wave fan.

The station photograph accompanying this article shows such a rack assembly in actual use and Figure 2 shows the details of equipment mounted on this rack. The top panel includes a dynamic speaker with its own field supply equipment. It is so connected that the speaker or headphones may be used at will by simply flipping the switch on the front of the "AGS" receiver. Immediately below the speaker panel is the spare-coil-holder panel. Provision is made here for a dozen coils and provides a handy means for storing the coils not in use at the moment, keeping them instantly accessible at all times.

Receiver Controls

The third panel is the "AGS" receiver with its single tuning control taking the form of an extremely smooth-working dial with a 270-degree rotation, divided into 150 dial spaces and equipped with a vernier scale which permits accurate reading to 1/10 of one space. That is to say, the condenser setting can be logged to 1/1500 part of its 270-degree swing. Below the tuning dial are four other knobs. The one at the left permits instantaneous switching from voice to c.w. reception. The next is a switch which offers a choice of either automatic or manual volume control. The third knob is the manual volume control and the fourth is the headphone-loudspeaker switch.

The next panel down is the tuned r.f. stand-by receiver. This is entirely independent of the receiver above and permits a watch to be kept on one channel while working another with the regular receiver.

The narrow panel at the bottom is the power supply unit which takes care of both receivers. It is of the double-duty type and is the equivalent of two separate supply units housed in one container for convenience. The separate "on-off" switches for the receivers are located on this panel.

Space is provided on the rack for any further extensions of receiver equipment that may be desired, although there are few purposes that cannot be adequately served by the equipment shown here. Where conditions do not demand such elaborate equipment, that shown in Figure 3 is used. This view was taken in the communications office of one of the larger press services, where the receiver is used to copy press from Europe and South America, day and night. In addition to the receiver, the single type power pack is shown—and the "Baldies." The latter, incidentally, give indications of a romantic past, in the notches that have been cut in the cap of one of them. Unfortunately, the writers overlooked asking the operator for the story and are therefore unable to here record the history for the benefit of posterity.

Calibration Curves on Panel

Figure 3 shows the front-panel view of the "AGS." This panel is of heavy-gauge metal, finished in black crackle lacquer. The four tuning controls have already been discussed. The small metal frame to the left of the tuning control contains the tuning curves for all coils, plotted in dial setting against both wavelength and frequency. This enables the operator to select the approximate dial setting for any desired stations and also indicates what set of coils will bring in any desired frequency range. To the right is a similar frame holding a printed form and transparent writing surface which provides a place for the operator to log the dial settings for given stations or ranges, once they have been tuned in. The record may be removed from the writing surface at any time by a damp cloth, without obliterating the printed form.

Along the top of the receiver are the three plug-in coils constituting one set. To anyone who has worked with plug-in coils the idea of having them accessible from the front panel needs no indorsement. As employed in this receiver, the coils are thoroughly shielded. Referring to the rear view, Figure 4, for a moment, the three individual coil shields may be seen along the top. The metal front panel constitutes part of the shield and tops of the coil forms themselves complete the shielding when the coils are inserted in position. For this purpose the coil-form tops, cast out of metal with the finger-holes integral, fit snugly into the holes in the panel.

To eliminate confusion, each coil mounting hole on the panel is numbered. Each set of coils is designated and marked with a letter, and each coil of a set is numbered to correspond with the numbers on the panel. Thus confusion in inserting coils is eliminated.

Band-Spread Coils

The standard coil equipment consists of five sets of three coils each, or a total of fifteen coils. These five sets are marked A, B, C, D and E and cover a wavelength range from 15 to approximately 185 meters. Other coils are available, including band-spread coils for the amateur bands, air service bands, etc. All coils are of unusually sturdy construction and are incased in bakelite covers to provide complete protection to the windings. The bakelite housing is not in contact with the coil windings and therefore does not introduce losses in the tuned circuits. Contacts are made by means of prongs on the bottoms of the coil forms, which fit into sockets at the base of the shield wells in the panel. These sockets are so

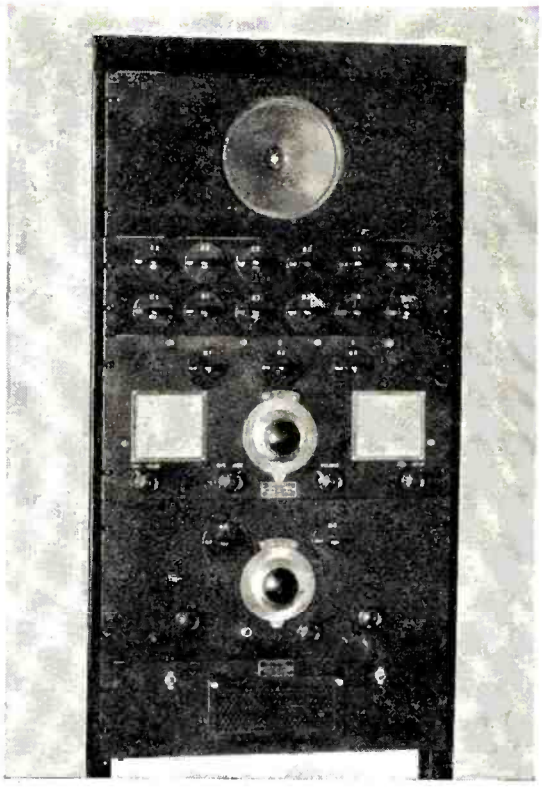
designed that the coils slip into position without any fishing around in an effort to get the right pins to mesh with the right holes.

Turning now to Figure 4, it is evident that a thorough shielding job has been done. In this view the overall shield which also serves as a dust cover has been removed to disclose the individual unit shielding. All tubes and coils are individually shielded. The i.f transformers are inclosed within the low cans, with openings at the top to permit exact line-up of the grid and plate circuits of each stage.

Speaker and Phones

An example of the unusual attention given to every detail of this receiver is found in the fact that a special screw-driver is provided for use in adjusting these intermediate transformers—not just provided as part of the equipment, but actually included in the chassis where clips are provided to hold it so it will not be mislaid. It may be seen, clipped into position, on one of the brackets supporting the front panel.

At the rear of the base will be seen the tip-jack terminals for headphones and loudspeaker. Both instruments can be left plugged in at all times, as the choice of either is provided by the switch on the front panel.



IN A COMMERCIAL SET-UP

Figure 2. Another view of the receiver as used in commercial airport installations. Details of the five panels are given in this article

Coming now to the circuit diagram, Figure 1, there are nine tubes in all, including six type −36, two type −37 and a single type −38. A superheterodyne circuit is used, with one stage of tuned r.f. ahead of the first detector. The coils L1, L2 and L3 are the plug-in coils to which reference has already been made. The electron-coupled oscillator was selected as the one providing the greatest degree of frequency stability, even where line voltage fluctuations are encountered.

Following the first detector are two stages of extremely high gain i.f. amplification, employing double-tuned transformer coupling throughout, which makes a total of six tuned i.f. circuits. In addition to the selectivity provided by this number of tuned circuits, the high impedance which they offer in plate and grid circuits permits the tubes to work at high efficiency, and this largely accounts for the great sensitivity of the receiver. The r.f. stage adds to the overall gain, of course, but serves another equally important purpose in that the selectivity added by this tuned circuit prevents image-frequency interference.

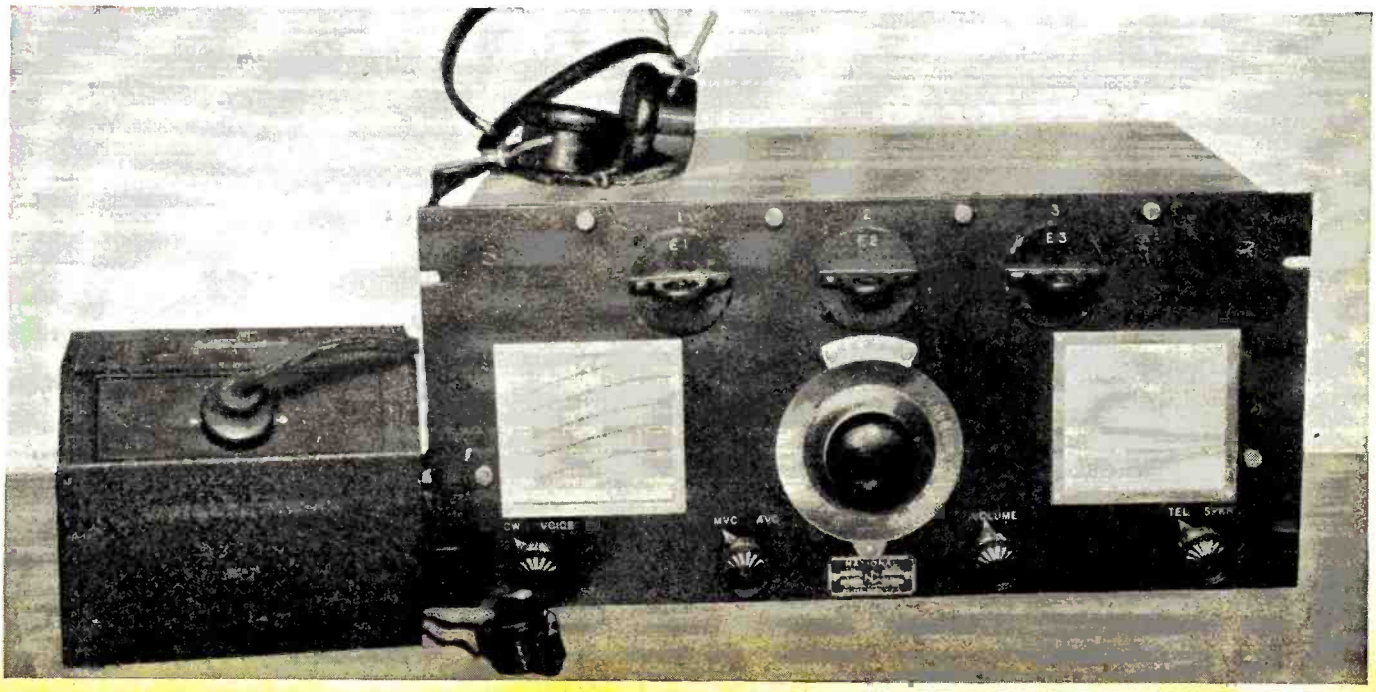
Unique Volume Control

The automatic volume-control system is not particularly out of the ordinary. A separate tube is used for the purpose, the variations in the voltage drop across the 250,000-ohm resistor in its plate circuit providing the regulatory grid voltage to control the r.f. and i.f. tubes. There is, however, one decidedly unique feature found here. That is the use of the volume-control tube in conjunction with manual as well as automatic control. Instead of using a manually controlled resistor in the grid circuits of the amplifier tubes to provide the necessary variation of grid bias, it is here placed only in the grid circuit of the volume-control tube, and this tube in turn determines the bias for the amplifier tubes just as it does when using automatic volume control. The result of this innovation is found in the absolute freedom from the grating and crackling noises so often resulting when moving contacts or variable resistors are in the grid circuits or grid-return circuits of r.f. and i.f. tubes.

The beat oscillator coupled to the grid circuit of the second detector requires no special explanation. It offers one point of interest, however, in that it is so adjusted as to provide an approach to "single signal" response which has recently been receiving much attention in amateur and commercial circles. Anyone who has tuned an autodyne circuit will have experienced the decreasing pitch of the heterodyne note as resonance is approached and the increasing pitch after passing the point of resonance. This has a (*Continued on page* 446)

AS A TABLE MOUNTING UNIT

Figure 3. Although designed for rack mounting, the receiver can be placed on the operating table



Mathematics in Radio

Calculus and Its Application in Radio

By J. E. Smith*

Part Nineteen

CALCULUS will show in a similar manner important relationships involved in an alternating-current circuit containing a condenser. For the study of such a circuit, there is introduced a factor concerning the quantity of electricity. In considering the capacitive circuit of Figure 1, we note that the condenser C is capable of storing a quantity of electricity. This quantity of electricity stored in the condenser is also known as the charge on the condenser. Let us denote it by the symbol "q." In an alternating-current circuit, q will necessarily change with respect to time, and this rate of change can be expressed by $\frac{dq}{dt}$. Now, in the same circuit, the current "i" will necessarily depend upon the quantity of electricity; thus:

(1) $$i = \frac{dq}{dt}$$

The rate of change of the charge "q" with respect to the time "t" in an alternating-current circuit can be represented as a sine function, thus:

(2) $$q = Q \max \sin \omega t$$

Equation (1) tells us that we can take the derivative of (2) with respect to "t." Therefore:

(3) $$\frac{dq}{dt} = \frac{d}{dt}(Q \max \sin \omega t)$$

Using the same methods which were employed in finding the derivative of equation (7), we find that the solution of (1) becomes:

(4) $$i = \omega Q \max \cos \omega t$$

Plotting the instantaneous value of the charge on the condenser and the value of the current i, as obtained in Equation (4), the graph, Figure 2, immediately informs us that the current in a capacity circuit leads the charge by 90°. Now, the charge in a condenser is directly proportional to the difference of potential "e" between its terminals; therefore:

$$q \propto e$$

Thus it is finally determined that the current in a capacitive circuit leads the impressed voltage "e" by 90°.

A great many problems occur in the use of mathematics in radio when it is necessary to know the value a quantity must have to produce the maximum results in the circuit. The rules governing all functions for maximum values apply in general to those for minimum values. Let us recall a few applications which may apply to the theory of radio circuits:

1. The maximum power output of an amplifier tube.
2. The maximum power input to a loudspeaker.
3. The maximum power delivered to a receiver load.
4. The maximum impedance across a parallel circuit.
5. The maximum current in the secondary circuit.

With reference to 1, it is known that when an impressed voltage is applied to the input of an amplifying tube that the output current will depend upon the value of the output impedance. Thus, with reference to Figure 3 (a), a voltage e_g applied to the grid of the tube will produce a current flow through the output resistance r. The maximum power delivered to this resistance is, of course, the value of r which will make i^2r the largest. It will be shown later that by the use of the differential calculus the relation for the maximum power is obtained quite easily. The circuit of Figure 3 (b) is the electrical equivalent of (a), where μ and ρ are respectively the amplification factor and the internal resistance of the tube.

With reference to 2, the maximum power which can be delivered to the windings of a loudspeaker is dependent upon several factors. Thus, with reference to Figure 4, it can be shown mathematically that the current i_2 through the loudspeaker winding will be a maximum when there is a definite relationship existing between the resistances and inductances of the complete circuit and the frequency. This relationship is again quite simply derived by the use of calculus.

With reference to 3, 4 and 5, these are mentioned only to show the possible conditions which are often encountered in radio theory. The discussion in the next lesson will show the method of investigating such problems.

HEREWITH is presented the nineteenth of a series of instruction articles on mathematics, emphasizing especially its application to radio. The articles which have appeared thus far are:

WHAT HAS GONE BEFORE

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Algebra in Radio.....	920	Apr., '31
Algebra in Radio.....	1004	May, '31
Geometry in Radio...	1088	June, '31
Geometry in Radio...	63	July, '31
Geometry in Radio...	230	Sept., '31
Trigonometry in Radio	288	Oct., '31
Trigonometry in Radio	292	Nov., '31
Trigonometry in Radio	491	Dec., '31
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Calculus in Radio.....	779	Mar., '32
Calculus in Radio.....	1004	June, '32
Calculus in Radio.....	38	July, '32
Calculus in Radio.....	162	Sept., '32

* President National Radio Institute.

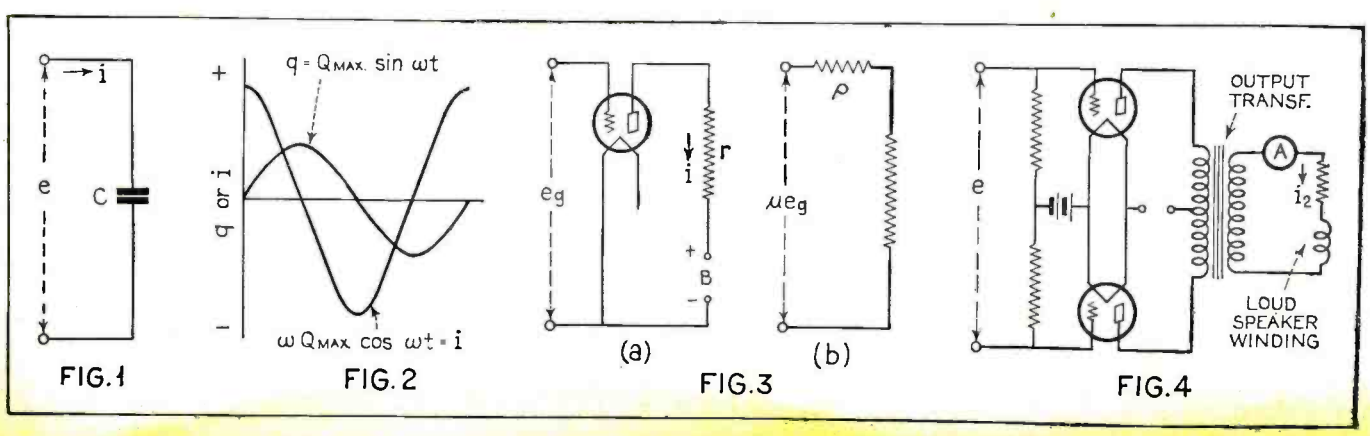
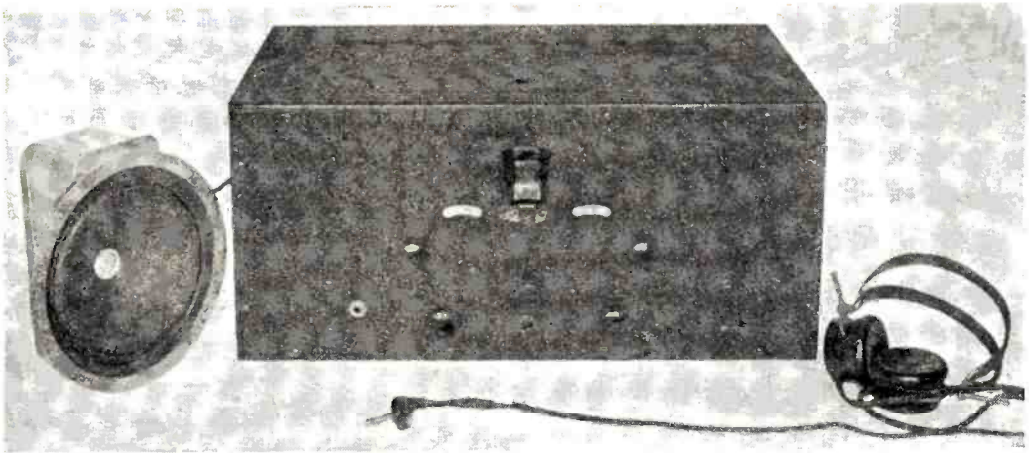


FIG. 1 FIG. 2 (a) (b) FIG. 3 FIG. 4



THE COMPLETE RECEIVER EQUIPMENT

A power output stage is included in the receiver itself, to operate the permanent-magnet dynamic speaker at the left. A metal cabinet is also provided, adding to the effectiveness of shielding

Improved 15-250 Meter Super

FOR PROFESSIONAL AND "HAM" SERVICE

Numerous improvements based on further laboratory development and on suggestions offered by users of the original "Pro" receiver, characterize the new model discussed in this article

By
S. Gordon Taylor
and
William C. Dorf

Part One

IN his article on the earlier model of the Hammarlund Comet "Pro" receiver, Gordon Fraser provided a detailed description of the circuit and physical design. The new Comet "Pro" described in the present article is in many respects the same receiver—yet from a performance standpoint it is an entirely different receiver. Its up-to-the-minute performance characteristics, which can be attributed primarily to valuable suggestions offered from many users of the original model, include the use of the new –50 series tubes and employment of new engineering developments. A –47 output tube provides full loudspeaker volume and automatically lower volume for headphone reception. Other new features include the use of an electron-coupled type oscillator, elimination of tuning interlock effects, complete stability of the oscillator and i.f. amplifier circuits, provision for using interference-reducing, balanced antenna systems and more complete shielding.

In general, the chassis size and general layout remain as before. Like the original model, the new one employs eight tubes, including the rectifier, but an important advance is shown in the use of the newest tubes throughout. Instead of the –24's, –35's and –27's used before, –57's, –58's and a –47 are now employed. This feature alone represents a considerable improvement in sensitivity, and the new tubes used in the r.f. and intermediate-frequency circuits provide absolute stability in operation.

The front panel layout remains as before, and the same unique band-spreading condenser arrangement is retained. It will not be necessary to discuss this in detail, as it was covered quite completely in the earlier articles.

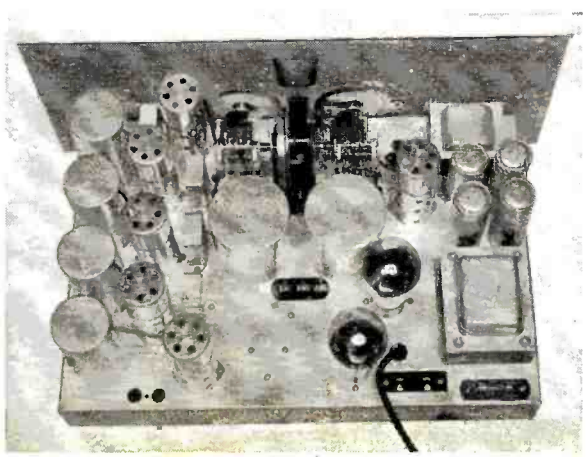
The most noticeable physical change has been in the adoption of a metal cabinet. This cabinet is crackle-finished to match the appearance of the metal front panel and is liberally ventilated by means of louvres. The wood cabinet, like that in which the early model was housed, is available for those who prefer it, but the metal cabinet offers the advantage of additional overall shielding which under some conditions will be found advantageous.

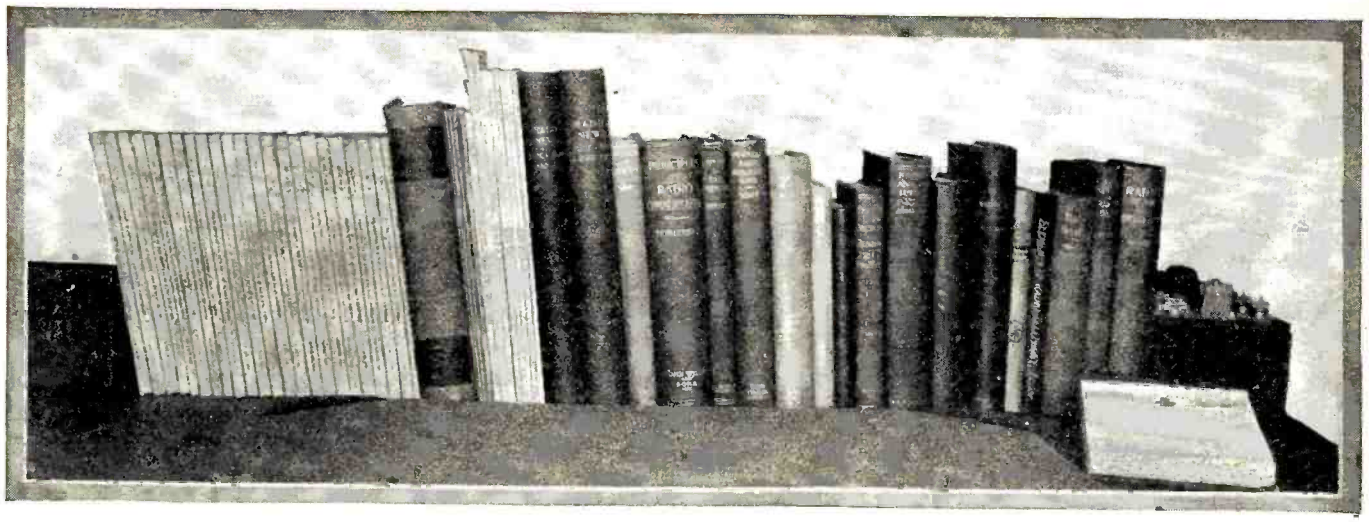
Looking at the chassis itself, the first change to strike the eye is the provision of shield cans over the two plug-in coils. This change is a radical one, because while dependence was placed on the inductive relationship between the oscillator and r.f. plug-in coils to provide the oscillator coupling in the earlier model, inductive coupling between these coils is purposely avoided in the new model. The high-frequency oscillator is now electron-coupled to the first detector circuit, and complete isolation of the two circuits, so far as extraneous coupling of any kind is concerned, is therefore necessary if full advantage is to be taken of the best features of electron coupling. More will be said of this coupling system later.

The shielding of these coils provides another outstanding advantage in that direct pick-up of either signals or strays is eliminated. (*Continued on page* 425)

COMPLETE SHIELDING

One of the features is the shielding of the plug-in coils, made possible by a change in the type of oscillator coupling employed. These shields are the two large cans in the center of the chassis





Technical Review

RADIO SCIENCE ABSTRACTS

Radio engineers, laboratory and research workers will find this department helpful in reviewing important current radio literature, books, Institute and Club proceedings and free technical booklets

Conducted by
Joseph Calcaterra

Radio Engineering, by F. E. Terman; McGraw-Hill Book Co., 1932. Professor Terman's new book will be of great interest to students of radio communication as well as to engineers, operators and experimenters. There is, and has been for some time, a definite need for a textbook which should be more up to date than the ones now available.

The treatment of the subject is somewhat unusual; the author uses mathematics sparingly. He says in the preface that the average reader is confused by the many equations ordinarily appearing in an engineering book and loses sight of the most important expressions. Therefore the long derivations and trivial equations have been omitted.

The first chapters discuss circuit constants, properties of resonant circuits and of vacuum tubes. Then comes a remarkable chapter, entitled Triode Amplifiers. It contains an unusually complete treatment of all kinds of amplifiers and their characteristics. For each type of amplifier there are curves of the frequency characteristics showing how it is influenced by the value of the component parts. Then follow chapters on the other uses of vacuum tubes: oscillators and detectors. Chapter IX, on special types of vacuum tubes, contains a discussion of the screen-grid tube and its application as a radio-frequency and audio-frequency amplifier. Other special types discussed are the pentode, the variable-mu tube, the space-charge grid tube, the co-planar grid (Wunderlich) tube, the dynatron, the magnetron, etc. Later chapters discuss the design and construction of transmitters and receivers, antennas for long and short waves, directional antennas. Final chapters on propagation of radio waves, radio aids to navigation, radio measurements and sound equipment, complete the book. The last chapter deals with acoustics, the loudspeaker and the microphone.

Testing Radio Sets, by J. H. Reyner; Chapman and Hall, London; 1932. This British book on testing is totally unlike what Americans have been used to read. The author does not give so much attention to the measurement of currents and voltages and there is no so-called "analyzer" in his equipment.

Since many receivers in Europe are regenerative, the current readings might easily be deceiving. The author pays much attention to faults in the radio-frequency amplifier, faults in tuning and feed-back effects, all of which cannot be found with the analyzer. It is an instructive text for the serviceman to read and even for the designer and the experimenter. There are many types of faults discussed which are not generally known; the author gives their cause and cure.

In the latter part of the book one finds a treatment of laboratory measurements of receivers, bridge measurements and component testing.

National Radio Institute Advanced Course in Broadcasting, Commercial and Ship Radio Stations. Lesson 1CA—Technical development and commercial radio. Lesson 2CA—The arc transmitter. Lesson 3CA—Spark transmitters. Lesson 4CA—Pick-up devices; speech input analysis. Lesson 5CA—Impedance-matching networks, pads and volume controls. Lesson 6CA—Transmisison lines; volume indicators; monitors. Lesson 7CA—Modulation in tube transmitters. Lesson 8CA—The tube transmitter. Lesson 9CA—Typical transmitters and antennas. Lesson 10CA—Radio measurements in transmitters. Lesson 11CA—The radio compass. Lesson 12CA—Commercial receivers. Lesson 1SC—Learning the code. Lesson 2SC—A.C. and d.c. generators. Lesson 3SC—A.C. and d.c. generators and motors. Lesson 4SC—Alternators and a.c. motors. Lesson 5SC—Motor generators, a.c. and d.c. starters, dynamo troubles. Lesson 6SC—Storage batteries. Lesson 7SC—Radio laws and regulations. Lesson 8SC—Traffic handling.

The student who has mastered the contents of this course should be able to pass the government examination without difficulty.

Much of the information cannot be found in any book, so that one would have to search through files of all sorts of engineering magazines to compile the material contained in these twenty lessons. The question of impedance matching, transmission lines and measurements has been discussed in greater detail than is customary in such texts. Each lesson has a number of questions at the end whereby the student can test his progress.

Review of Articles in the October, 1932, Issue of the Proceedings of the Institute of Radio Engineers

Visual Test Devices, by O. H. Schuck. This paper traces the development and describes the construction and principle of operation of a device by means of which the frequency-response curve of a tuned-circuit, tuned-transformer, amplifier or a complete radio set can be shown on a screen while the units are under test. The frequency-response curve which appears on the screen changes simultaneously with any changes in the adjustment of the apparatus under test, so that the effects of any changes in the circuit are instantly apparent. The system is particularly adapted for lining up superheterodyne intermediate-frequency amplifiers.

Copper-Oxide Rectifier Used for Radio Detection and Automatic Volume Control, by L. O. Grondahl and W. P. Place. A description of a new type of detector which depends for its action on the rectifying properties of the boundary between copper and cuprous oxide. This detector makes possible circuits in which harmonic distortion is practically eliminated, a stage of audio-frequency amplification is dispensed with and automatic volume control of variable-mu tubes as well as other tubes is achieved without the necessity of using an auxiliary tube for the purpose.

A New Electrical Method of Frequency

Analysis and its Application to Frequency Modulation, by W. L. Barrow. This paper describes a method of analyzing an arbitrary combination of sine-wave voltages based on the appearance of certain figures, typical of definite frequency ratios, appearing in an oscillogram of the superposition of a constant frequency and a "search" voltage.

A Fourier Analysis of Radio-Frequency Power-Amplifier Wave Forms, by L. B. Hallman, Jr. A theoretical treatment of Class B and C radio-frequency amplifier wave forms, by means of the Fourier series, is presented in this paper. Ideal wave forms with which Class C operation would be obtained are analyzed. The extent to which the ideal forms may be approached in actual operation is considered and a wave form which may be approximated in practice is analyzed. The efficiency of the several wave forms is discussed.

Review of Articles in the August-September, 1932, Issue of the Journal of the Institute of Radio Service Men

Service Charges, by Henry A. Fischer. A discussion of the important factors which must be considered in establishing schedules of prices to be charged for service work if servicing is to be placed on a sound economic basis. The expense items of investment, cost of parts, cost of operating business, equipment, operation of car, advertising, training, insurance, losses, etc., are considered in their relation to the charges which must be made for service work.

Data on Sylvania Tubes, types 41, 42, 43 and 44, and on the Eveready Raytheon type 52 are found under "Institute News." These articles closely follow the preliminary technical bulletins issued by the companies.

Static Analysis of Radio Receivers, by J. C. Hoover. This paper describes an entirely new method for shooting trouble in radio sets and similar equipment which makes use of measurements of resistance, capacity, inductance and tube characteristics while the power source of the receiver is turned off and therefore provides an accurate means of checking the entire set and finding faults even while the set is inoperative.

Review of Articles in the October, 1932, Issue of the Bell Laboratories Record

Radiation-Cooled Power Tubes for Radio Transmitters, by H. E. Mendenhall. A description of the characteristics of a new line of radiation-cooled tubes with peak power-output ratings of 500, 1500 and 2000 watts for use in transmitters of 100 to 1000 watts rating. A discussion of the problems involved and the factors which were considered in the development of these tubes is also given.

A Low-Power Broadcast Transmitter, by A. W. Kishpaugh. A complete description with photographs and circuit diagrams of a low-power broadcast transmitter perfected by the Bell Laboratories which is designed to cover the power range from 100 to 1000 watts. The unit is designed to operate entirely from alternating-current circuits.

Review of Technical Booklets Available

2. *1933 R.F. Parts Catalog.* An 8-page folder containing complete specifications on the entire line of Hammarlund variable and adjustable condensers, r.f. transformers, sockets, shields and miscellaneous parts for broadcast and short-wave receivers, complete short-wave receivers and transmitting variable condensers.

4. *A 15 to 200-Meter Comet "Pro" Superheterodyne.* A description of the outstanding features of the Hammarlund-Roberts high-frequency superheterodyne designed especially for commercial operators for laboratory, newspapers, police, airport and steamship use.

5. *Volume Control and Variable and Fixed Resistor Catalog.* A series of folders containing complete specifications of the Electrad line of fixed and variable resistors, voltage dividers, and volume controls for original equipment or replacement use, together with volume-control circuit diagrams, specifications of replacement volume controls for standard receivers and announcement of the Resistor Replacement Handbook.

9. *Catalog of Fixed, Metallized and Precision Resistors.* This 16-page catalog gives complete specifications of the International Vacuum Rectifiers; Communication and Industrial Tubes.

Review of Contemporary Periodical Literature

Patent Problems in the Field of Electronics, by H. A. Toulmin, Jr. Electronics, October, 1932. This article points out some interesting and valuable facts regarding the importance of finding out what has already been done in a given field before wasting time and money in rediscovering and reinventing things which have already been patented. It also points out the difference between design and invention and explains the meaning of contributory infringement.

Characteristics of American Electronic Tubes, by Keith Henney. Electronics, October, 1932. A tabulation of the mechanical and electrical characteristics of American tubes, with the various tubes separated into the following classifications: Three-Electrode Power Tubes; Four-Electrode Tubes; Radio Receiving Tubes; Photocells; Grid-Controlled Rectifiers; Gaseous Rectifiers; High

Police Radio System in New York City Proving Successful. Radio Engineering, October, 1932. A description of the methods being used in New York City to reduce crime losses by using radio patrol cars which are in constant communication with headquarters.

Power Transformer Testing, by Richard Shea. Radio Engineering, October, 1932. A complete description, with circuit diagrams, of a test board for power transformers, on which it is possible to make all the necessary current and voltage measurements under proper load conditions.

Stabilized "B" Supply for A.C. Receivers, by D. Dekker and W. Keeman. QST, October, 1932. A description of a method of using neon lamps to prevent extreme voltage fluctuation of the "B" supply of a.c.-operated short-wave receivers.

Transmisison Line Feed for Short-Wave Antennas, by True McLean. QST, October, 1932. A detailed technical discussion of the factors entering into the efficient design of short-wave antennas and the methods of connecting them to the associated transmitting apparatus.

Radio Markets of the World, 1932, by Lawrence D. Batson. U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce. A detailed analysis of the condition of broadcast services throughout the world. Statistics regarding financial condition, population, resources and possibilities for sales of American radio equipment in the various countries is given in detail. Tables showing the number of receivers in various countries, as compared with those in the United States, are given. A list of all foreign broadcast stations is included, together with information regarding call letters, frequency and power. The type of lighting and power lines used in the various countries is indicated for the information of those who are contemplating sales of receivers for lighting-line operation.

Check-List of Radio Bills Pending in the Seventy-second Congress. Air Law Review, October, 1932. A list and summary of the bills which are pending, arranged according to the particular subject covered by the bills.

B Eliminators: Rotary vs. Vibrators, by William W. Garstang. Radio Industries, October, 1932. A discussion of the relative advantages of rotary and vibrator B eliminators, especially as regards their use for automobile radio installations.

Free Technical Booklet Service

THROUGH the courtesy of a group of radio manufacturers, RADIO NEWS now offers to its readers this Technical Booklet Service. By means of this service readers of RADIO NEWS are able to obtain quickly and absolutely free of charge many interesting, instructive and valuable booklets and other literature which formerly required considerable time, effort and postage to collect.

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Resistance Co. line of metallized, wire-wound and precision wire-wound resistors, motor-radio suppressors, handy servicemen's kits, valuable technical data and list of free bulletins available on the building of servicemen's test equipment.

10. *Information on the Suppression of Motor Radio Noises.* This interesting and useful folder of the International Resistance Co. gives complete information on how to overcome motor-generator, ignition coil, interrupter and spark-plug noises in automobile radio installation.

12. *Certified Tube Plan for Servicemen and Dealers.* A special plan of the Triad Mfg. Co. which makes it possible for servicemen and dealers who maintain a service department to obtain tubes direct from the factory, at discounts that enable them to make tube replacements at attractive profits is described in this folder.

16. *RMA Standard Resistor Color Code Chart.* A handy post-card size color code chart designed by the Lynch Mfg. Co. to simplify the job of identifying the resistance values of resistors used in most of the standard receivers. It also contains a complete list of the most commonly used values of resistors with their corresponding color designations.

25. *Transposition Noise-Reducing Antenna System.* A detailed description, with technical data, on a new antenna system, perfected by the Lynch Mfg. Co., which is effective in eliminating the majority of electrical noise interference on both broadcast and short-wave reception. It is especially suited for application on all-wave receivers which have heretofore given unsatisfactory results because of objectionable interference on the shorter waves. It can be applied to existing installations and offers a big field for profitable jobs for the serviceman. Its use on amateur receivers makes possible more and better QSO's.

26. *The Basic Training a Serviceman Needs.* This is an outline of a course of instruction used by the National Radio Institute to prepare the beginner or established serviceman to meet the rigorous demands of modern radio servicing. The outline covers

The Economy "Eight"

(*Continued from page* 405)

resulting in better frequency response. The small fixed condenser, C16, shunted across the transformer secondary, provides a means of tone control, and it may be switched in or out of the circuit by switch SW2. With this condenser connected in the circuit, the higher frequencies are eliminated and hence the low notes predominate.

The output pentodes, in push-pull, deliver tremendous power output without minimizing the stage gain. The use of pentode output tubes not only permits greater volume, but also minimizes distortion and insures smoother reception. The push-pull arrangement of these tubes results in truly superior tone quality.

A medium-size dynamic speaker is specified for use with the Economy Eight, and even this is not ordinarily operated at full volume in the average-size room. Due to the large amount of power inherent in this receiver, it is possible to operate the largest type dynamic speaker with it, and have sufficient volume to fill a fairly large auditorium.

A single, compact transformer, T1, supplies all the filament and the high-tension voltages. Conventional full-wave rectification is employed, using a type -80 tube. The 2500-ohm speaker field acts as the audio choke of the filter system. Electrolytic condensers, C20 and C21, are connected so as to by-pass each side of the field to ground. Condenser C19 acts as a tuned hum filter.

The push-pull output transformer, having a primary impedance of 7000 ohms on each side of the center-tap, is mounted on the speaker. All connections to this transformer and to the speaker field are made by means of a plug which fits into socket J3, mounted on the rear chassis wall.

And now for the good news for the set builders. A complete kit of parts is available for the Economy Eight, with every component ready to put in place, from the big four-gang condenser to the smallest fixed resistor. Even the necessary hardware is provided.

Best of all, however, is the fact that a chassis is available, bent to the exact specified size, with *all* mounting holes drilled. All the hard manual work is thus eliminated. The set builder merely fastens the parts in place as indicated in the various illustrations. Wiring is then performed in accordance with the wiring diagram. Special detailed diagrams show socket connections, coil connections and transformer connections, so that even a novice is certain of success in building this receiver.

The following procedure is suggested. First mount the four tube sockets, V1, V2, V3 and V4. The bases for the tube shields are also mounted with the sockets, using ½-inch, 6-32 screws. Next, mount sockets V5, V6, V7 and V8; also mount the socket for the speaker connection, J3.

Mount the four r.f. coils, L1, L2, L3 and L4. The leads on top of these coils which connect to the grid caps of the tubes should face the tube socks. The r.f. coil with the red primary windings is the antenna coupler (coil L1). Mount the four r.f. coil shields by means of the eye-screws supplied in the hardware kit, bringing the grid leads through the hole in the top of the shield.

Mount the antenna and ground posts, the "phono" jack, the two trimmer condenser strips and the four-gang tuning condenser. Mount the tone control-switch, volume-control switch, the power transformer T1, audio transformer T2, and the two electrolytic

Technical Review

(*Continued from page* 421)

for the antenna and each receiver—which now makes possible the use of a shielded noise-reducing antenna lead-in of any length, without loss of signal strength. This system is designed exclusively for electrical noise elimination on the broadcast frequencies, and because of its low cost, the ease with which it can be installed, and the means it provides for using several receivers on a single aerial, it offers many opportunities for profitable jobs for servicemen, experimenters and set builders.

...dance-matching system of unique design—including impedance-matching transformers
(*Continued on page 422*)

...spective sockets. Connect the supply plug into a 110-volt a.c. lighting socket or baseboard outlet. Connect the antenna and ground and turn the switch SW1 "on." Advance the volume control to maximum and rotate the tuning condenser until some form of signal is received. Adjust the trimmer condensers with a screwdriver until maximum results are obtained on some station located at that point.

In order to peak the trimmer condensers more accurately, make all other adjustments with volume reduced to a point where it is just audible. The volume is kept down by means of the manual volume control, R1. In this way it is possible to detect a slight change more readily. Next, tune in a broadcast station on the high-frequency end—that is, with the condenser rotor plates completely "out"—and adjust the trimmers for maximum volume. Repeat this procedure at various other points, in order to insure perfect alignment. The receiver will then function without further adjustment.

Parts List

BP1, BP2—Eby twin binding posts
C1, C4, C6, C8—4-gang Scoville variable condenser, .00035 mfd. each section
C2, C5, C7, C9—Trimmer condensers, two on a strip, 2 to 35 mmfd. each
C3—Cornell cartridge type condenser, .1 mfd.
C10—Cornell cartridge type condenser, .3 mfd.
C11—Cornell cartridge type condenser, .2 mfd.
C12—Trutest mica condenser, .001 mfd.
C13—Trutest cartridge condenser, 1 mfd.
C14—Cornell cartridge type condenser, .01 mfd.
C15, C22—Trutest 35-volt cartridge type condensers, 5 mfd.
C16—Cornell cartridge type condenser for tone control, .004 mfd.
C17, C18—Faradon condenser block, two sections, 2 mfd., 1.5 mfd.
C19—Cornell cartridge type condenser .005 mfd.
C20, C21—Trutest 500-volt dry electrolytic condensers, 8 mfd.
J1, J2—Eby twin jacks for phonograph connections
J3—5-prong wafer type sockets
L1—Special Trutest low-loss shielded antenna coupler
L2, L3, L4—Trutest low-loss shielded r.f. transformers
L5, L6—Trutest r.f. chokes, type 4C-1867 (use full winding)
R1—Electrad volume-control potentiometer, 5000 ohms, with switch SW1
R2—Trutest carbon resistor, 400 ohms, 1 watt
R3—Trutest carbon resistor, 20,000 ohms, ½ watt
R4—Trutest carbon resistor, 2 meg., 1 watt
R5, R6—Trutest carbon resistors, 100,000 ohms, ½ watt
R7—Trutest carbon resistor, 500,000 ohms, ½ watt
R8—Trutest carbon resistor, 3000 ohms, 1 watt
R9—Trutest carbon resistor, 40,000 ohms, ½ watt
R10—Trutest carbon resistor, 250,000 ohms, ½ watt
R11—Trutest carbon resistor, 40,000 ohms, 2 watts
R12, R13—Trutest resistors, 600 ohms, 10 watts
R14—Wire-wound 20-ohm center-tap resistor
R15—Trutest carbon resistor, 50,000 ohms, 1 watt
SW2—Toggle switch for tone control
T1—Polymet power transformer, flush-mounting type
T2—Sangamo push-pull input transformer
V1, V2, V3, V4—6-prong wafer type sockets
(*Continued on page 424*)

Form F5.

Radio for Tow-Cars

(*Continued from page* 398)

friends with them as we met oftener. They began bringing in work. Soon I had a whole string of cops' cars to care for, and while this is not a fortune-making line, it helps in the long run.

To begin with, I had an old Lincoln tow-car, badly in need of paint but otherwise O. K. I painted the whole thing white, had it lettered neatly, and kept it shined up at all times thereafter.

Four weeks after equipping my tow-car with radio I had to buy another car, business was growing so rapidly. Needless to say, I installed radio on it also.

Besides the radio tow-cars, I have a set in my office, so that I receive calls the same as do the cars when they are out. If I get a call when one car is out, I immediately send another one. The driver picks up calls when on the run to a wreck. At such times he 'phones in to the office.

You can readily see the efficiency of this system. Not bad, eh? By thus employing radio in this unique method, I have more than trebled my business in eight months. I have moved to larger quarters and now have eight men working days and four on nights.

My greater profits have enabled me to hire the best mechanics, to whom I pay very good wages. I am justified in so doing. They know it, and reciprocate by turning out the best work of which they are capable.

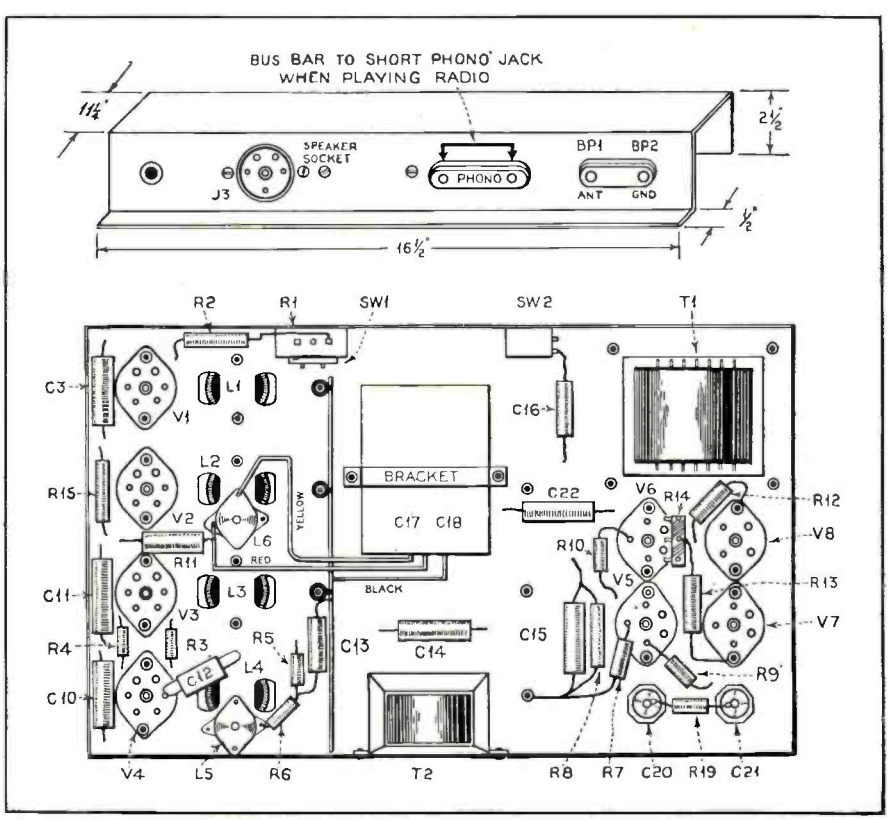
My equipment is always shiny and neat, the cars driven by clean, courteous chaps who adhere strictly to my formula of getting business. Each is a salesman in his line, *selling* tow-car service; not a dirty, careless, indifferent fellow, driving a pile of junk out somewhere to pick up another pile—any old way.

I have installed short-wave sets in two other out-of-town garages. I am, therefore, writing this account of the success of radio in my own business with the thought that here might be another opportunity for radio servicemen—to install short-wave radio automobile receivers in cars operated by garages specializing in this type of repair work.

The Economy "Eight"

(*Continued from page* 423)

V5, V6, V7—5-prong wafer type sockets
V8—4-prong wafer type socket
VT1, VT2, VT3—Arcturus –58-type variable-mu pentode tubes
VT4—Arcturus –57 type tube
VT5—Arcturus –56 type tube
3 special finish knobs
1 bracket for mounting Faradon condenser block
1 metal chassis, bent to shape and completely drilled, 16½ inches by 11¼ inches by 2½ inches high



THE CHASSIS DETAILS

VT6, VT7—Arcturus PZ or –47 type output pentode tubes
VT8—Arcturus type –80 full-wave rectifier tube
1 full-range vernier dial with escutcheon plate and pilot light
4 Trutest shields for new type tubes
1 Lafayette 8-inch dynamic speaker with 2500-ohm field and output transformer to match push-pull –47's. Speaker 5-prong plug
Hardware assortment

Short-Wave "Super"

(*Continued from page 418*)

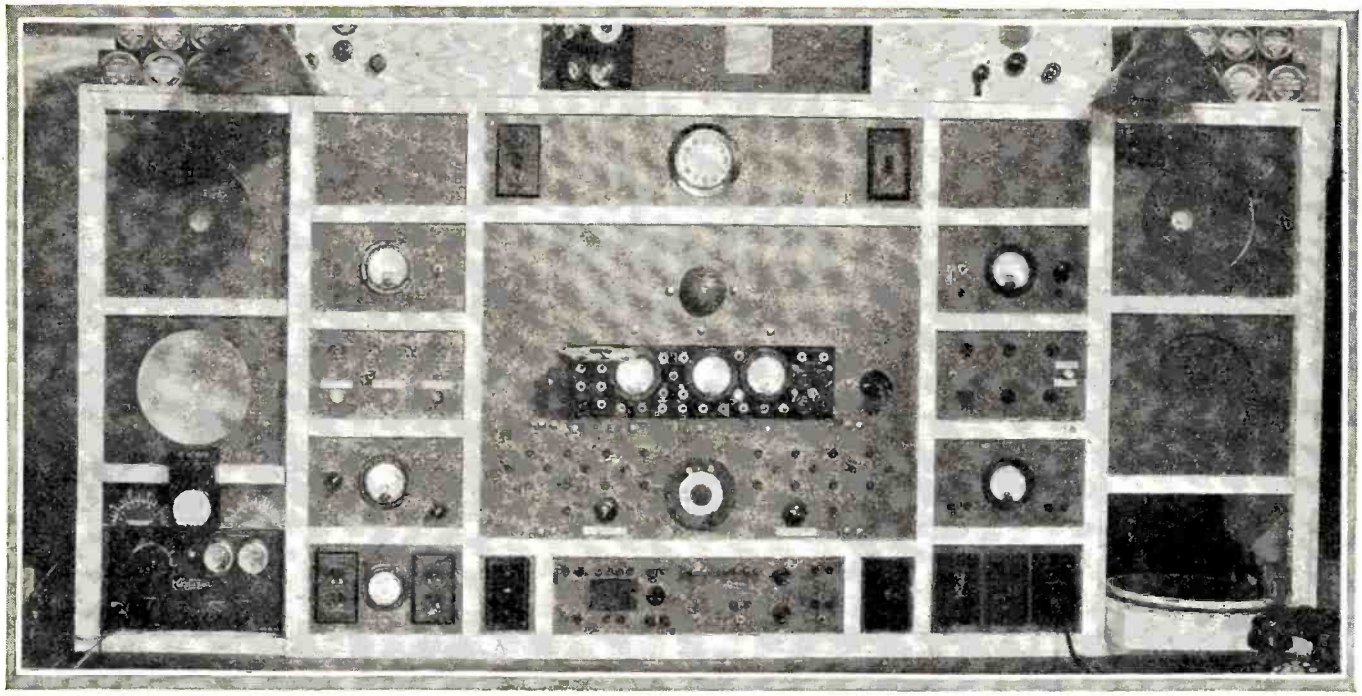
Anyone familiar with short-wave work will realize that on wavelengths around 50 meters and lower, the direct pick-up provided by a single unshielded coil is adequate under certain conditions to make audible the signals from stations a thousand miles away or more. Also the lack of proper shielding permits the direct pick-up of stray interference, whereas, with pick-up limited to the antenna proper, such interference may be largely attenuated by the relatively loose coupling provided in the antenna coil, and the signal input is more directly under the control of the operator.

Skipping now to the output of the new receiver, another and rather extensive revision is found. In the earlier model a type –27 tube was employed in the audio output stage, providing a limited amount of audio-frequency gain and relatively low power-handling ability. It was suitable for headphone output and for moderate loudspeaker volume, but where greater volume was required it was necessary to resort to the use of an external power stage.

In substituting a type –47 tube for the old –27, both gain and power-handling ability have been greatly increased, with the result that plenty of volume and power are provided for good loudspeaker operation without resorting to the use of additional amplifier equipment. But for headphones—and many operators and "hams" demand headphones—the output of a –47 tube is too great to be practical. An output transformer was added, and tapped to provide a considerable step-down in signal voltage to the headphones. This not only has the effect of reducing headphone volume, but the transformer eliminates direct current from the 'phones and speaker windings. This is, of course, essential when a plate current of the magnitude of that required by a –47 tube is present.

To further improve headphone reception, a 25,000-ohm resistor is inserted in series with the headphone jack. The signal output divides between this resistor and the headphones in proportion to their impedance. At the lower audio frequencies the average headphone has an impedance of a low order, therefore most of the signal voltage is spent along the 25,000-ohm resistor, only a portion of it being impressed on the 'phones. As the audio frequency increases, however, the headphone impedance rises and a proportionately larger part of the signal voltage is impressed across the 'phones. The overall results is that the low frequencies, which are of relatively small importance in headphone reception, particularly c.w. reception, are considerably attenuated, along with low-frequency noise. The higher frequency signals, on the other hand, are increasingly strong, thus accentuating the portion of the audio range which includes the voice and c.w. frequencies.

This audio-frequency discrimination system by itself would have the drawback that the audio frequencies above the useful range would be accentuated more than those which are desired. But this possibility is eliminated by the tone control mounted on the receiver panel. This is a variable shunt across the primary of the output transformer, designed to attenuate the high frequencies. Inasmuch as this latter system is variable, the control knob may be adjusted to cut off frequencies above the desired range so, with one system cutting off the unnecessary lows and the tone control system cutting off the highs above the desired range, maximum signals are obtained with a minimum of noise.



The Service Bench

Eliminating Noise in Auto Radio Installations: Sources, High-Tension Interference, Low-Tension Circuits, Importance of Bonding—The Service Salesman—Service Shops—Service Hints: Installing Radio in Chevrolets, Transposed Lead-ins, Amateur Activities

Conducted by
Zeh Bouck

THE principal problem associated with the operation and service of automobile radio installations is the reduction or elimination of noise. Noise in such installations can be categorically attributed to three general causes:

1. Electrical sources peculiar to auto radio.
2. Mechanical vibration peculiar to auto radio.
3. Noise conditions common to all radios but accentuated by the circumstances of operation in automobiles.

Electrical Noise Sources

Electrical disturbances may arise in both the low and high-tension circuits. Noises having their origin in the low-voltage section are carried to the radio receiver through common circuits. High tension noise may be radiated, to be picked up by the antenna and the lead-in, or may be partially conducted by the low-tension circuits, other conductors, and capacitatively by the occupants.

The possible sources of interference are best understood following a brief review of the functioning of a typical ignition system. The ignition system on the modern automobile is fundamentally similar to the old make-and-break systems common with the early cars, and consists of a low-potential source, the storage battery, fed to the primary of an induction coil through a breaker actuated by the engine timing mechanism. One side of the primary circuit is usually completed through the car frame and chassis. It is thus considered the low potential or "grounded" side. The high-tension or secondary circuit consists of the secondary of the induction coil which is fed through the distributor, to one spark-plug at a time, the return circuit being made through the cylinder block, motor assembly and chassis. The induction coil therefore has a common secondary and primary terminal and is, in more ways than one, an "auto" transformer.

Sparks are fertile source of radiated and conducted interference, and there are three legitimate generators of sparks in the automobile ignition system. As the circuit breaker, or interrupter, contacts open, the sudden fall of the magnetic flux about the secondary winding gives rise to the secondary voltage responsible for ignition. However, there is sufficient inductance in the primary winding to induce therein a voltage, much higher than the 6-volt primary source, which tends to break down, in a spark, across the interrupter gap. This spark is absorbed to a great extent by a condenser, integral with the ignition system, connected across the contacts. However, some spark remains, and it is inadvisable to use a much larger condenser than that designed for the particular ignition system employed, as higher capacities result in difficult starting and "missing" at high speeds.

The distributor, as mentioned, is in the high-tension circuit and the sweeping arm does not actually touch the "contacts", the circuit being closed by a small spark—with considerable reduction of frictional wear.

Last, but by no means least, is the spark across the points of the plug, within the cylinder. It may be argued that this spark should be of minor importance, being perfectly shielded by the cylinder itself. However, it is never the spark, *per se*, that creates the disturbnce. It is the oscillatory current, set up by the spark, in the spark-producing and associated circuits. This condition in the high-tension leads will be considerably aggravated by the use of spark intensifiers, which are nothing more than series gaps in the spark-plug circuit. (It may be said here that it is practically impossible to eliminate noise from intensifiers, and they should never be employed if satisfactory radio reception is desired. Their use is generally frowned-upon by automotive engineers. The slightly increased efficiency is gained through the fact that the higher potential spark required to break down the double gap, is more effective for ignition purposes—an improvement rarely noticeable unless there is something fundamentally wrong with the ignition and carburetion systems of the car. The higher potentials cause a rapid deterioration and ultimate break-down of the high-tension insulation system—with additional, if indirect, noise effects.)

Reduction of High-Tension Interference

Noise from high-tension sources is reduced by the use of suppression resistors and shielding. Suppression resistors, of an order of 25,000 to 50,000 ohms, are connected in series with each spark-plug, and often in the common distributor lead. The current to the spark-plug is extremely low and the voltage drop across the resistors is therefore not sufficient to interfere with efficient ignition. However, the dampening effect on the oscillatory circuit is enough to quench oscillations—i.e., radiated interference.

Some installations provide suppressor resistors only at the plugs. In complaints of noise with such receivers, a suppressor resistor should be tentatively tried in distributor-arm circuit.

In cases of a sudden rise in the noise level, with an installation employing suppressor resistor, a detective resistor—probably open—should be suspected. Engine

operation may not be affected—the open resistor functioning as a spark "intensifier".

Fundamentally, the suppressor system is undesirable, as it complicates the ignition system, introduces new sources of trouble and a slight loss in efficiency becomes more and more apparent as the car ages. Complete shielding is preferable as the pound of cure, and is almost universally employed on aircraft. The entire high-tension system should be shielded by means of plug caps or cans, shielded cables, and, if necessary, a tin or copper box built around the distributor. (Where the distributor arm and contacts are very close together, shielding here may not be required. Where a relatively large gap exists, shielding is preferable to building up the contacts or hammering out the arm.)

When the addition of high-tension shielding results in hard starting or other symptoms of ignition trouble, this is generally due to reduced spark-plug voltages occasioned by the capacity of the leads, and can be corrected by the substitution of a 30,000-volt coil for the usual 20,000-volt installation. The Mallory coil makes a convenient substitution unit.

A gradual increase of noise with a well-shielded installation, points the finger of suspicion at breaking down insulation, accompanied with corona effects. This condition will, of course, be accelerated somewhat by the use of the high-voltage coil. It may also be noticeable on non-shielded installation, but the deterioration here will be slower.

If placing the hand over the coil increases interference, a shield here, preferably of sheet iron, will be effective.

In suppressor systems, the desirability for partial shielding will vary with the relative positions of the receiver and high-tension coils and leads. Where both the receiver and the coil are mounted under the dash, the high-tension lead should always be shielded.

Needless to say, all shielding should be grounded.

The Low-Tension Circuit

Interference conveyed through the low-tension circuit is best combatted by judicious bypassing with high-grade, high-capacity (2 to 5 mfd.) paper condensers. The quality of the condenser is stressed, because, in many positions, a break-down will result in a burned-out ammeter.

Condensers should be connected tentatively between various points in the primary circuit and ground—care being observed, however, that they are not shunted across the condenser integral with the interrupter circuit.

Bypass condensers are usually most effective when connected between the ammeter (the battery side, for safety) and the instrument panel. Occasionally a small r.f. choke coil consisting of about 20 turns of number 16 wire on a ¾-inch form in the dome-light circuit and bypassed, is used.

Shielding may be used effectively in the low-tension circuit, when low-tension wires run close to high-potential carriers—notably the lead from the coil to the interrupter.

The Importance of Bonding

There are several possible conductors of interference aside from the bona fide electrical system of the car. These are any of the control channels running through the bulkhead, from the instrument board to the engine compartment, such as choke and throttle rods, thermometer capillary, speedometer cable, etc. These should be thoroughly bonded, i.e., grounded to the chassis. Accidental grounds will not suffice, as such microphonic contacts give rise to a second type of interference caused by the variation in resistance of closed circuits in the antenna field—a more or less mechanical source of noise peculiar to automobiles and airplanes.

Loose brake rods, light cables, etc., will occasionally give rise to this effect. Bonding, again, is the cure. Needless to say, poor electrical contacts responsible for flickering lights, will cause noisy reception.

The mechanical vibration of driving will induce the noise effects, common to radios in general, in a much shorter order than the time required for them to make their appearance in a parlor installation. These are noises caused by poor tubes, loose connections, etc., and should be serviced in the usual way.

In any case, it will invariably simplify noise diagnosis and location if the ignition system is first given a cursory checking. Any let-down in the efficiency of this system will result in noisy reception. The plugs should be clean, the porcelain uncracked, and the gaps correct. The interrupter points should be burrless, close with parallel surfaces, and should be properly adjusted. The distributor points should shine with a polished surface. An offen neglected source of noise is a dirty commutator on the charging generator.

THE SERVICE SALESMAN

Our prize sales idea for the month is contributed by C. J. Penther of the Taylor Electric Company, Berkeley, California, and is illustrated in Figure 1. The photograph and details, by Mr. Penther, tell the story—

"After diagnosing trouble as 'Bypass Condenser', 'Audio Transformer', etc., doesn't your customer always ask, 'What's that', 'What does it do', 'What makes it fail'? And haven't you been sorely put to give him answers which he can understand?

"I have solved the problem for store customers and at the same time created an attention getting display of many uses.

"A plywood board about 2½ feet by 4 feet was painted a jet black and on it were

(*Continued on page* 447)

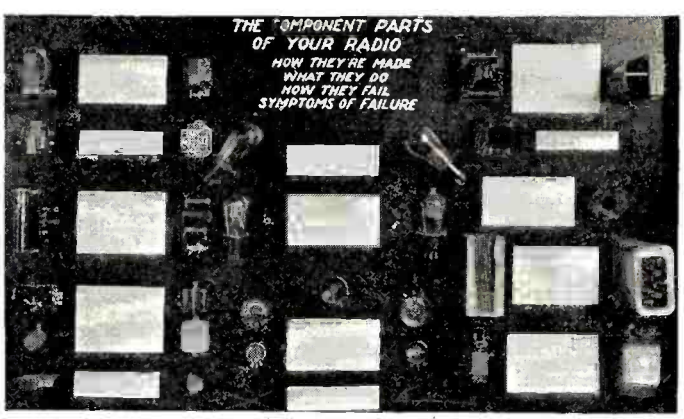
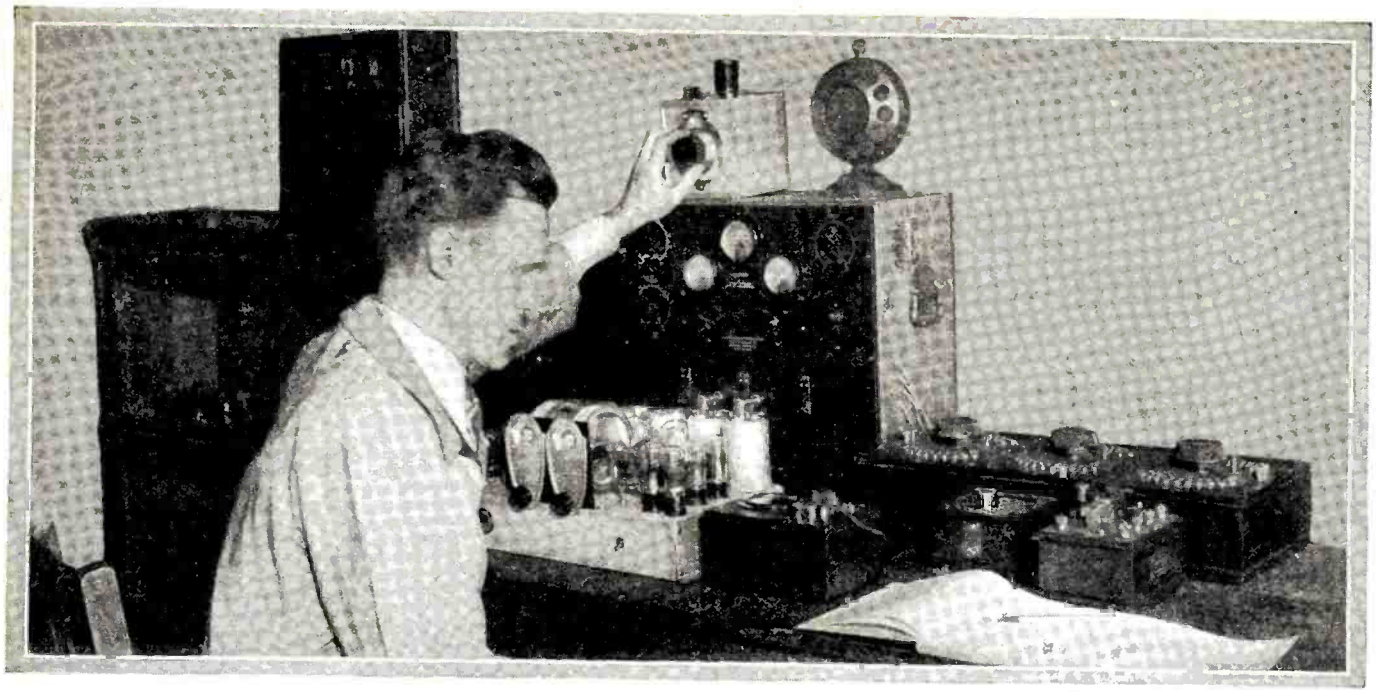


FIGURE 1



With the Experimenters

Time-Delay Switch for a Dime, New Tube Book Free, Improved Short-Wave Antenna Coupling, Home-made Push-Button Switches, Morse Telegraphy by Radio

Conducted by

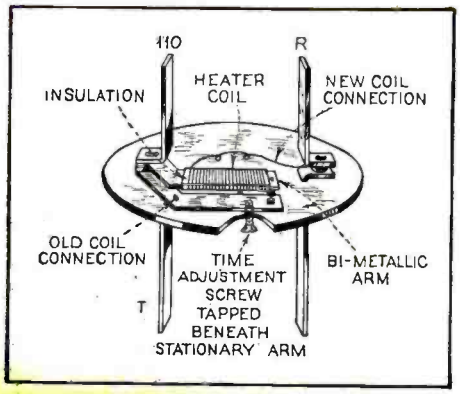
S. Gordon Taylor

Time-Delay Switch for a Dime

A "flasher" adaptor of the type sold in five-and-dime stores can be converted into a useful 110 volt a.c. or d.c. thermostatic delay switch with little trouble.

Remove the "innards" by straightening out the retaining crimp of the protective case. Disconnect the heater coil lead to the stationary contact arm and, carefully scraping the enamel from the end of this fine wire, solder it instead to the prong marked R in the accompanying drawing. Then drill a hole tap-size for a short metal-screw through the composition disc, directly beneath the stationary contact arm and about ¼ inch back from the contact, and thread the screw into it. The stationary arm may be swung to one side during the drilling.

Now, if the heater coil is connected across a 110 volt line in series with a 1,000 ohm, 5-watt resistor it will be found that the contacts can be made to close from approximately 3 seconds to 1 minute after the juice is applied, depending upon the contact spacing and this in turn is determined by the metal-screw adjustment.



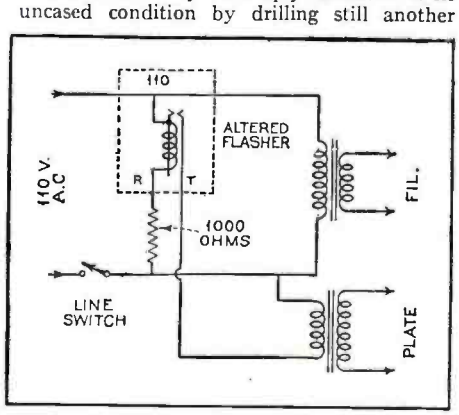
Though more rapid action can be obtained by reducing the series resistance it will be found that with less than 900 ohms the heater coil gets too hot for anything but intermittent operation. Slower action can be secured with complete safety, however, by using series resistance up to 1,500 ohms, where thermostatic action usually ceases.

One practical use for the converted flasher is the automatic delay of plate voltage application to tubes until filaments attain proper operating temperature. The value of such delay will be especially appreciated in connection with mercury-vapor rectifiers, the life of which is adversely affected by simultaneous application of both filament and plate voltage. The circuit diagram shows the switch so applied to the supply leads of an amateur transmitter power supply unit. Closing the line switch immediately furnishes filament current to the rectifier while the primary of the plate transformer does not become energized until the delayed contacts close.

It will be noted that the bi-metallic element is somewhat sluggish in its cooling action, hence time must elapse to permit the contacts to open after the line current is cut off. This is not important in the application described above, however, as the thermostat usually has ample time to cool while the operator copies. The contact spacing adjustment should be made after the unit is warm as minimum delay occurs at this time.

Other uses for the delay switch will occur to the reader. Numerous circuit variations are possible if the adaptor prong marked R is bent down over the bi-metallic element to form a back-contact. This permits the thermostatic switch to be used in opening a circuit as well as closing one.

The switch may be simply mounted in its uncased condition by drilling still another hole through the fiber disc. Pass a wood-screw somewhat longer than the adaptor prongs through this hole and through a bushing long enough to prevent the prongs from striking bottom when the screw is entered in wood.



W. MACDONALD,
Elmhurst, N. Y.

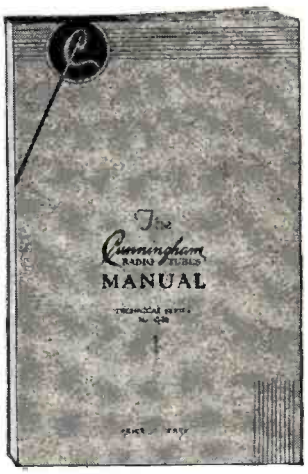
New Tube Book Free

Servicemen and experimenters will be glad to know that the United Sales-Engineering Service, representing R. C. A. Radiotron and Cunningham, has just brought out an 83 page manual on radio tubes. This book not

only gives complete technical and practical data on all present day tubes but also devotes a large amount of space to a discussion of various types of tubes, circuit design, etc.

Through a special arrangement readers of RADIO NEWS may obtain copies of this book without charge, although the normal price is 25c per copy.

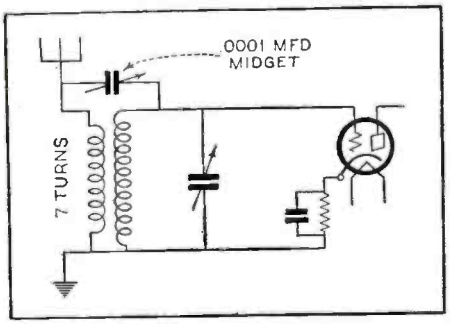
Simply address a request to Department



RC, RADIO NEWS, 222 West 39th Street, New York City, New York, and state that a copy of the radio tube manual, technical series No. 10 is desired. All requests must be submitted by mail.

Short-Wave Antenna Coupling Improved

With the following simple arrangement for coupling the antenna to the r.f. tube of



a s.w. set, I totally eliminated dead spots on all coils. There is also a decided increase in sensitivity, in the lower wavelengths around 20 meters.

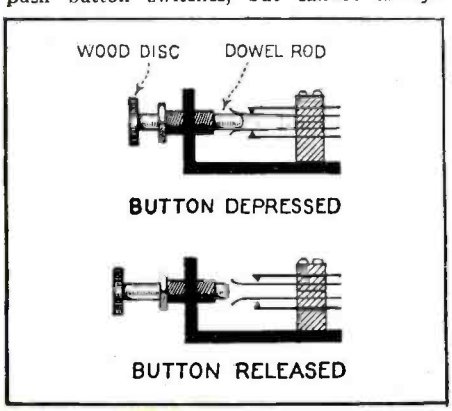
ALLEN D. RICKERT, JR.,
Souderton, Pa.

Home-made Push Button Switches

The experimenter frequently has need for push button switches, but cannot always afford the price, particularly for the multiple types.

The inclosed drawing illustrates a push button switch made from an old phone jack. These jacks can be found in most any experimenters junk box. Or they may be purchased for a fraction of the cost of a push button switch.

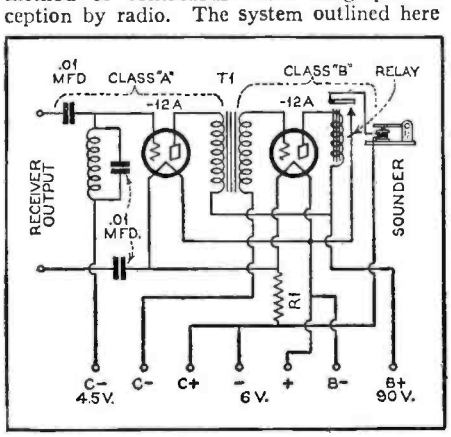
The drawing illustrates how a double pole single throw switch can be constructed. Switches of other types can also be constructed by the same method. The leaves of the jack are bent as shown. A piece of dowel rod is inserted in the hole provided for the plug, with one end of the dowel rounded as shown. A flat piece of wood is glued to the other end. No spring is required to make the dowel rod come up after it has been pushed down as the leaves of the jack serve to push it up. This action will be more certain if a little soap or grease is smeared on the rounded end.



WILLIAM NAKEN,
Chicago, Ill.

Morse Telegraphy by Radio

In copying code I favor a standard telegraph sounder in preference to the orthodox method of continuous wave telegraph reception by radio. The system outlined here



makes it possible to reproduce standard c.w. signals from amateur and other stations on a standard land-line sounder, or a printing recorder. The equipment outlined here will operate in connection with standard short-wave regenerative or other receivers using three or more tubes.

The circuit is shown in the diagram. Two -12A type tubes are used, the filaments of which may be operated from the receiver storage battery if a d.c. filament job is used. If an a.c. receiver is used heater type tubes are advisable and may in some cases be run from the a.c. filament supply of the receiver.

The first amplifier stage has a tuned input which is peaked at approximately 1000 cycles. L1 is the secondary of a Ford spark coil of the model T vintage, having both the core and the primary removed. The value of capacity across the coil L1 may be varied within small limits. T1 is a standard audio transformer which delivers excitation to the Class B second stage. When a signal is applied to the input of the unit a strong exciting voltage appears on the grid circuit of the Class B amplifier which causes plate current to flow through the relay in the tube's output circuit. The closing of the relay circuit then causes the local battery circuit to close, operating a sounder or other device. The relay is of the type designed to work out of vacuum tube circuit, is very sensitive and may be purchased on the market.

A Class B amplifier is defined as one whose power output is proportional to the square of the exciting voltage on the grid and has a grid biasing voltage sufficient to reduce the plate current almost to zero

(*Continued on page* 447)

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A Set Tester Adapter

(*Continued from page* 408)

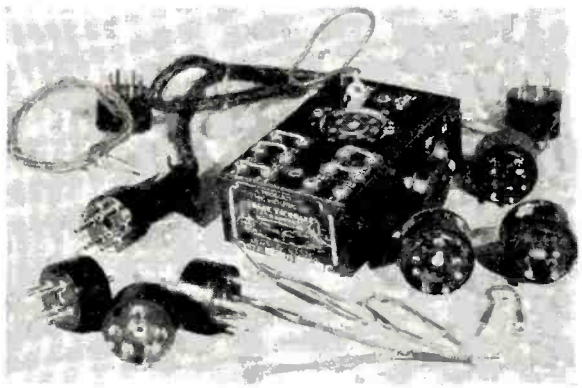
currents by simply replacing the C1 and C2 and P1 and P2 jumpers by C1 to P2, and P1 to C2 jumpers, by means of short lengths of wire provided with phone tips.

To use the new adapter as a set analyzer, insert the plug P1, either directly or through a 7 to 6, or 7 to 5, or a 7 to 4 adapter, into the tube socket under test and place the tube either directly into the 7-prong socket or through a 6 to 7 or 5 to 7 or a 4 to 7 tube adapter. While this is done it becomes an easy matter to test all d.c. and a.c. voltages between any two prongs or to measure the current flowing through any tube element except the filament (which latter measurement has been abandoned by servicemen). By removing any one of the links, for instance SG1 to SG2, and inserting into them the terminal leads of a milliammeter, the corresponding tube element current (in this case the screen-grid current) can be read off directly. By placing the voltmeter terminals across any two pin-jacks, the voltage between the corresponding tube elements is had automatically. Thus it becomes an easy matter to take every possible measurement that the average analyzer, less this adjunct, does not take, such as:

Filament No. 1 or No. 2 to plate (P)
Filament No. 1 or No. 2 to screen grid (SG)
Filament No. 1 or No. 2 to control grid (G)
Filament No. 1 or No. 2 to space charge grid (SC)
Filament No. 1 or No. 2 to additional grid (SG)
Filament No. 1 or No. 2 to cathode (C)
Cathode to P, SG, G, SC, CG
Additional grid to SC, G, SC, P
Space charge grid to G, SG, P
Control grid to SG, P
Screen grid to P

In the case of a –47 type tube and a.c. voltmeter placed across the screen and plate prongs will give a reading that will be proportional to the audio-frequency power output of a given receiver or amplifier, and the unit can thus be used as an output meter to check the overall amplifications and performance of the unit under test or to indicate a defective loudspeaker.

Another of the many features of this adapter is the fact that, after having shut off the current supply to the unit under test and without a tube in the adapter, all resistance values between any two socket prongs, as well as between any prong and the frame (or ground) of the unit under test, can be read off directly with an ohmmeter. In this way it is possible to "trouble shoot" any receiver without removing it from a cabinet or other stationary position.



THE COMPLETE TESTER

Parts List

1 bakelite moulded case, 2⅞ inches by 4⅝ inches by 1½ inches
1 bakelite panel, drilled and engraved
1 "Cinch" 7-prong wafer socket
1 EBY sub-panel-mount bakelite 5-prong socket
1 Redrite 7-prong analyzer plug and cable
1 grid cap
1 Hart & Hegemann s.p.s.t toggle switch
1 .83-ohm, 7½-watt resistor
14 Yaxley phone tips nd jacks
1 Readrite 7 to 6 analyzer plug adapter
1 Readrite 7 to 5 analyzer plug adapter
1 Readrite 7 to 4 analyzer plug adapter
1 Readrite 6 to 7 tube adapter
1 Readrite 5 to 7 tube adapter
1 Readrite 4 to 7 tube adapter
1 special 7 to 5 adapter, No. 1
1 special 7 to 6 adapter, No. 2

The Velocity Microphone

(*Continued from page* 406)

this means that it will no longer be necessary to crowd entertainers on one side of the microphone. Performers may speak their lines while facing each other on opposite sides of the microphone and large orchestras may be more advantageously placed for the best ensemble effects. It also simplifies the problem of studio acoustics, because reverberation pick-up may be varied simply by adjusting the angle of the microphone. In sound motion picture recording it is possible to place the camera at right angles to either sensitive side of the microphone where sound pick-up is almost down to zero and eliminate entirely the noise of the camera grinding, and even permit whispered directions to performers which this most sensitive of microphones will not transmit.

Although the most delicately responsive microphone ever developed, the new microphone is extremely rugged and impervious to changing atmospheric conditions because of its all-metal construction which includes no paper or fibre material at critical points to give trouble.

Engineers of the National Broadcasting Company have for some time been studying experimental models of the velocity microphone with the view of making them standard equipment in all their studios.

Student's Radio

"B" BATTERIES AND

By Alfred A.

This series deals with the study of the physical information of particular value to physics colleges. The text material aids teachers

ALTHOUGH the modern a.c. electric radio receivers have eliminated the use of B and C batteries for plate and grid voltage supply, the use of dry batteries is still widespread for many other radio uses. The development of satisfactory automobile, motorboat, airplane and farm home receivers has created new fields in which batteries are the only convenient sources of filament, plate and grid voltages.

"B" batteries are dry-cell batteries used in battery-operated receivers to furnish voltages of 22½ volts or more for the plate circuits of the vacuum tubes. As the total current drawn from the B batteries by the tubes in the receiver rarely exceeds about 50 or 75 milliamperes (.050 to .075 amps.), the individual dry cells used in B batteries are much smaller than the standard 6-inch dry cell already described, but they are constructed exactly like the larger cell.

Dry-cell "B" batteries are made in two standard sizes, considered from the voltage standpoint. One size contains 15 cells connected in series, and delivers a total voltage of 1.5×15, or 22½ volts. The other size contains 30 cells connected in series and delivers a total voltage of 1.5×30, or 45 volts. The cells are assembled into cardboard-encased blocks with suitable terminals provided. The 22½-volt units may have taps brought out to provide intermediate values of voltages. The 45-volt units are usually provided with a tap at + 22½ volts, in order to provide proper plate voltage for some types of detector tubes, or to allow variations in plate voltage on radio-frequency amplifier tubes.

"B" Battery Rating

Dry-cell B batteries are rated according to their capacity in *milliampere-hours;* that is, their ability to deliver a certain number of milliamperes for a given number of hours. The rating for the heavy-duty cylindrical-cell battery is 4500 milliampere-hours, that of the medium size is 1200, and that of the small size is 450. It is more economical to use the large size.

Small dry-cell batteries for providing 4½, 9, or 22½ volts to the grid circuits of vacuum tubes are also manufactured. They are called "C" batteries.

Batteries used for "C" supply, or "negative bias" on the grids of vacuum tubes, have a service life practically equal to their shelf life; for the reason that they are called upon to deliver but a very small amount of current, if any at all.

"B" batteries should be tested while normal current drain is being taken from them; that is, with the radio receiver turned on. When the voltage of a 22½-volt block drops to 17 or when the voltage of a 45-volt block drops to 35 volts, the battery should be replaced with a new one. Beyond this point the voltage of the battery drops very rapidly as it is used. This results either in poor operation or failure of the set to operate at all.

"B" batteries may be connected in series to obtain higher voltage than a single battery provides. Thus two 45-volt B batteries connected in series gives a total voltage of $45 \times 2 = 90$ volts, three in series gives $45 \times 3 = 135$ volts, four in series gives 180 volts, etc.

Primary and Secondary Batteries

We have seen how a difference of electric potential or e.m.f. can be produced by arranging two dissimilar materials so they can be acted upon chemically by an acid or alkaline solution. The e.m.f. produced will cause a flow of electrons (current flow) if a complete closed circuit is provided. Such a battery will furnish e.m.f. until the chemical action has changed all of the electrolyte or electrodes into some other chemical form. It is then said to be "dead." In a *"primary cell"* it is not possible to reverse the chemical actions which have occurred in it so as to attempt to change the materials back to their original form and composition after the cell has become dead. Therefore the cell could only be renewed by renewing both the electrolyte and the electrodes. This is not practical or worth while in the usual commercial forms of cells, so they are discarded and replaced with entire new cells when they have reached the end of their useful lives.

In a "storage" or *"secondary cell"* the chemical reactions which take place between its electrolyte and electrodes on *discharge* can be completely reversed by sending a current through the cell in the opposite direction, from some external source of e.m.f. This is called *"charging."* When a cell has been fully charged in this way its interior ingredients have been completely re-converted to their original composition and are all ready to enter into chemical action to produce e.m.f. again on discharge. Thus the difference between a primary and secondary cell is that the former cannot be "recharged" after use, while the latter can.

The Lead-Acid Storage Cell

Usually two or more storage cells are connected in series to form a battery commonly called a "storage battery." It should be remembered that a storage battery does not act as a storage reservoir for electricity as its name would seem to imply. In a storage battery, electric current is sent in during charging. This is stored up in the cell in the form of *chemical energy* in the active material of the electrodes or "plates" and the electrolyte. The chemical energy is converted back into electrical energy during discharge of the battery. There are two main types of storage cells: the lead-acid type most commonly used, and the Edison nickel-iron alkaline type. The former will be studied first. Storage batteries are used extensively in all kinds of electrical work where a source of steady e.m.f. is essential. They find a wide use as a source of e.m.f. for the starting, lightning and ignition systems of automobiles, and for supplying filament current for the vacuum tubes in automobile and aircraft radio receivers. They were used more

* Radio Technical Pub. Co. Publishers, Radio Physics Course.

Physics Course

STORAGE CELLS

Ghirardi*

aspects of radio phenomena. It contains teachers and students in high schools and in laying out current class assignments

extensively in the early days of radio than at present, as a source of filament current supply for the 5-volt tubes of the 201-A type used in battery-operated home receivers. Storage batteries are still used extensively in automobile receivers, talking moving pictures and television transmitting equipment.

The storage cell has two electrodes, one of spongy lead and one of lead peroxide immersed in a dilute solution of sulphuric acid and water. These elements are usually contained in a hard rubber case which will not be attacked by the chemicals. The usual storage battery is made up of three cells connected in series by heavy lead-alloy *straps*. As the voltage of each cell is about 2.2 volts when fully charged, one of these batteries delivers 3×2.2 or 6.6 volts when fully charged. This is commonly called a "6-volt storage battery."

Each storage cell contains several positive electrodes and several negative electrodes. These are commonly called *plates* since they are wide and flat. Each plate has for its backbone a cast *grid* made of a stiff alloy of lead and antimony for strength. There are many styles of plates in use, but in radio batteries they are usually pierced to form an open framework or grid. This construction forms little "grooves," "channels" or "pockets" which are used to hold the softer active material in place. This framework of the plates does not take part in the chemical actions going on in the cell to any great extent. The pockets on one face of the grid are staggered from those in back.

The active material is a paste of litharge, or red oxide of lead, mixed with dilute sulphuric acid. This is forced into the little pockets in the grids, under great pressure. Upon drying, it "sets" like cement, and the pockets in the grids are filled with the hardened active material.

After the paste has hardened the plates are placed in a solution of sulphuric acid and water, and a current of electricity is sent from one group through the electrolyte to the others. This is known as the "forming charge." It changes the active material on one group of plates to spongy lead (grayish in color), and that on the other plates to lead peroxide (reddish brown in color).

All plates are provided with an extension or *lug* for connection to a common strap. A certain number of the negative plates (usually 6 or 7) are "lead burned" to an alloy *strap* forming a single negative group. In the same way a number of the positive plates (usually 5 or 6) are connected in parallel into a negative group as shown. In this way a large surface area of active material is exposed to the electrolyte so as to store a large amount of chemical energy.

The negative group usually has one more plate than the positive so that when all the plates are assembled together to form an *element*, each outside plate is a negative. In this way all of the positive plates are worked as nearly equally as possible from both sides, equalizing expansions and contractions of the active material when it is changed from lead sulphate to lead peroxide, and minimizing the tendency to buckle. The negative plates are not subject to this tendency since their active material does not greatly change in volume when transformed from spongy lead to lead sulphate.

Thin separators of wood with a grooved surface grooved on the side which goes against the positive plate are inserted between each positive and negative plate in order to keep them out of mechanical contact and thus prevent short-circuits between them. In some makes of batteries a perforated rubber sheet is also inserted between each wood separator and positive plate.

The elements and electrolyte are either contained in a single molded hard rubber case with three separate compartments, or else in three separate hard rubber jars placed in a wooden case. The former type is most popular. Projecting ribs stick up from the bottoms of the jars and support the plates. The spaces between the ribs act as sediment chambers to allow all active material shedded from the plates, etc., to collect without bridging across or short-circuiting the plates.

A hard rubber cover is sealed on to each compartment with a pitch sealing compound. Each cover has a filling tube and vent plug. An alloy collar supports the jar cover, a soft rubber gasket being placed between. A threaded seal nut on the post clamps the cover tight with a soft-rubber gasket underneath to give a very effective seal. The three cells are connected together in series by the cell connectors. The positive terminal is usually marked either with a red terminal or large cross, or in some other way.

The electrolyte is a dilute solution of sulphuric acid and water. When e.m.f. is supplied by a lead storage battery to a complete electrical circuit so as to produce a flow of current, it is produced by the acid of the electrolyte soaking into and combining with the porous active material of the plates. In the positive plates it is lead peroxide (PbO_2) and in the negative plates it is metallic lead in spongy form (Pb). When the sulphuric acid (H_2SO_4) combines with the lead (Pb) in the active material of both positive and negative plates, a new compound lead sulphate ($PbSO_4$) is formed.

As the discharge continues, the active material in both the positive and negative plates is being converted into lead sulphate. The electrolyte becomes weak or more dilute by the amount of acid taken out of it and used up in the plates, and additional water is formed due to the chemical combination of the hydrogen (H) and oxygen (O) in the cell. The chemical reaction taking place is as follows:

$$\underset{\text{Negative Plate}}{Pb} + \underset{\text{Positive Plate}}{PbO_2} + \underset{\text{Electrolyte}}{2H_2SO_4} = \underset{\text{Both Plates}}{2PbSO_4} + \underset{\text{Water}}{2H_2O}$$

Lead + lead peroxide + sulphuric acid becomes lead sulphate + water. As the formation of sulphate continues on the plates, it fills the pores and retards the free circulation of the acid into the active material and then since the acid cannot get into the plates fast enough to maintain the normal action, the battery becomes less active as indicated

(*Continued on page* 441)

Backstage in

Personal interviews with broadcast artists and executives

By
Samuel Kaufman

CAPTAIN HENRY'S Maxwell House Show Boat program on the NBC Thursday nights features one of the most unusual arrays of talent on the air. The full-hour program stars headliners of the theatrical, concert and broadcasting fields including Charles Winninger, of the Ziegfeld "Show Boat" production; Jules Bledsoe, noted Negro baritone; the Hall Johnson Choir; Lanny Ross, popular radio tenor; Annette Hanshaw, "blues" singer; Mabel Jackson, soprano, and January and Molasses, blackface comics. Don Voorhees and his Orchestra and a cast of ten dramatic performers are also heard on each of the elaborate presentations. The NBC has announced that the program is an original radio script and has no connection with the stage "Show Boat" play. If Eastern listeners recognize the voices of January and Molasses, it may be interesting to them to know that they are the Pick Malone and Pat Padgett, of WOR minstrel fame. The series is not only chockful of outstanding talent, but is also well-produced from carefully written scripts.

LANNY ROSS

IRENE TAYLOR, a Chicago singer, was recently brought to New York by the NBC to be featured with Paul Whiteman's orchestra at the Biltmore Hotel in addition to several studio programs. Although a newcomer to New York, Miss Taylor is not new to broadcasting. She has been featured with some of the best known orchestras in the Middle West. She is a native of Cape Girardeau, Missouri. She was educated in Texas and made her professional debut with the Coon-Sanders orchestra in Kansas City. She entered the radio field through Whiteman's encouragement as the result of an audition in the Chicago NBC studios. She was previously featured with Charlie Agnew and his orchestra from the Edgewater Beach Hotel in Chicago. On the Whiteman broadcasts, Miss Taylor replaces Mildred Bailey who has gone into vaudeville.

MUSIC-LOVERS throughout the nation are delighted to learn that the NBC will broadcast several performances of the Metropolitan Opera Company from New York during the current season. In announcing the programs, M. H. Aylesworth, president of the NBC, declared that the enthusiastic reception accorded last season's programs leaves no doubt that the opera has a place on the air. He said that increased attendance at the opera as a result of the broadcasts has proven also that radio equipment has a place in the opera house. At the time of this writing, the detailed schedule has not been announced, but it is certain that the opera broadcasts will be on the air by the time this item is published. The new type of velocity or "ribbon" microphone will be utilized to bring the opera broadcasts to listeners with greater fidelity than ever before, NBC officials assert. O. B. Hanson, NBC manager of technical operation and engineering, has been conducting experiments with the new microphones and the NBC will first use them on a regular series from the Metropolitan Opera House because of their pronounced directional characteristics at all frequencies. Hanson disclosed that the velocity microphones will eventually be placed in all NBC studios as standard equipment. He said that they cannot be put in immediately because they require an entirely new production and control technique, which in turn will require many weeks of experimental work.

IRENE TAYLOR

CHARLES WINNINGER

ONE of the season's most auspicious additions to the CBS schedule is the Sunday series of concerts broadcast by the

Broadcasting

Chatty bits of news on what is happening before the microphone

JOHN C. DALY

New York Philharmonic-Symphony Orchestra. The series which started on October 9 will continue until April 23. The programs originate in three of New York's most famous concert halls — the Metropolitan Opera House, Carnegie Hall and the Brooklyn Academy of Music. This is the symphonic organization's ninety-first season in New York and its third season on the CBS. Conductors for this season include Arturo Toscanini, Bruno Walter and Issay Dobrowen. Toscanini conducted the first eight weeks of the concerts and will again direct the orchestra from February 27 to April 23. Walter will conduct from December 26 to February 26. Debrowen was scheduled to direct from November 28 to December 25. The American radio audience is already acquainted with Toscanini and Walter. Debrowen's appearance with the orchestra this season marks his American microphone debut. He is a native of Russia and has scored many successes on the Continent. In 1930, he served as guest conductor of the San Francisco Symphony Orchestra. Many eminent soloists are heard on the Sunday programs which are presented from 3 to 5 p. m., Eastern Standard Time. A supplementary series on the CBS is the Saturday morning "young people's concerts" directed by Ernest Schelling. This is also presented by the Philharmonic-Symphony Orchestra and is heard from Carnegie Hall.

ARTURO TOSCANINI

SAX ROHMER and Booth Tarkington, noted novelists, are now writing for the radio. Mr. Rohmer's famous character, Dr. Fu Manchu, has been recreated for the Mystery Drama series broadcast over the CBS Monday nights. The Tarkington series, on the NBC Wednesday and Saturday mornings, is entitled "Maud and Cousin Bill" and deals with incidents in the lives of a typical American girl and boy. Charles Warburton, an English actor, was engaged to play the role of Nailand Smith, the leading character in the Fu Manchu dramas. The part of Fu Manchu is filled by John C. Daly, also a veteran British actor. Rohmer made a special trip to America from England to take part in the opening broadcast of the series. The Tarkington sketches are written especially for the microphone. They are produced by Winifred Lenihan, supervisor of the Theatre Guild Dramatic School. Vivian Block has the role of Maud while Andrew Donnelly plays the part of Bill.

RICHARD C. PATTERSON, JR.

RICHARD C. PATTERSON, JR., former commissioner of correction of the City of New York, is now executive vice-president of the NBC. Mr. Patterson resigned from his important municipal post to enter the broadcasting industry. He replaces George V. McClelland who has been appointed assistant to the president. Marlin H. Aylesworth, president of the NBC, made the following statement at the time of the appointments of Messrs. Patterson and McClelland to their new posts: "While I shall retain the active presidency of the National Broadcasting Company, my new duties as president of the Radio-Keith-Orpheum Corporation make it necessary for me to divide my time between the two organizations, and I have asked Vice-President McClelland of the National Broadcasting Company to become assistant to the president of the National Broadcasting Company." As commissioner of correction since 1927, Mr. Patterson became widely known for improvements in the city's prison system. His original methods were copied by other municipalities throughout the nation. In 1919, he served in Paris as administrative officer of the American Commission to Negotiate Peace. He is a Colonel of the Officers' Reserve Corps.

?QRD?

A column devoted to the commercial operator and his activities

Conducted by GY

THE sleuths of this department have had their noses about worn out keepin' on the trail of the elusive dope for the Radiotelephone and Aeronautical licenses. At last the official "info" comes from the Secretary of the FRC—Mr. James W. Baldwin. To quote: ". . . for the examination for the radiotelephone second-class license (valid only for telephone operation of stations in the aviation service). This examination has recently been revised, and the only subject other than radio included in the examination in its present form is meteorology. The study of any textbook dealing with elementary meteorology should permit an applicant to pass the meteorological portion of the examination. . . ."

There are prospects that the "tourist-ops" will be given a break. An old-timer to take them ashore, show them the ropes and break them into the general routine of operating aboard ship. A great idea, sez I!

Although a rooky does know his stuff, it is improbable that he can take the responsibility which may be thrust upon him during times of danger. Confidence in himself, through proper guidance by seasoned operators, would be assured.

Already familiar with the theoretical end of radio, he would be doubly proficient because of the practical training received from an operator with years of experience to his credit. The proper procedure, copying of weather, time ticks, etc., are as necessary to efficient operating as the ability to send and receive.

An apprenticeship of one year is being proposed to help the "youngsters" until their "wings are strong enough for them to fly alone."

The American Telephone and Telegraph Company has been installing radiotelephone stations in the principal seaports. To date, installations have been made at Boston, San Francisco and San Pedro (harbor for Los Angeles). Plans call for equipping fishing trawlers of the Bay State Fishing Company and the Massachusetts Trawling Company with radiotelephone apparatus. The Dollar Steamship Company has taken an interest in this new service and tests are being made to determine the practicability of equipping the large Dollar passenger liners with ship-to-shore telephone service.

Gentlemen of the glass arm—it is sad, but the truth must be told. There are 12,078,345 families which the last census gives as owning radio receivers. Can you imagine, if they were all put together, side by each, and all turned on to the same station, full volume, what a lot of noise they would make? And that is only forty percent of the homes throughout the country. Oh me, oh my.

Now that radiotelephony has been brought to universal use, it wouldn't be a bad idea if some of the brass-pounders went in for voice culture. Beneath the window of one guy I know (he used to say "Path down the thoop, pleath"), it would sound like an embryonic opera star strutting his do-ra-mi-fa-so. A real he-man's voice would go over big—"Yeah, that's the weather, so take it and like it." Who would give him back talk, eh?

The New York Times Radio Station, call letters WHD, is broadcasting press twice daily, at 1900 on 11,355 kc. and at 0548 on 8360 kc. Both GMT. The latest news summary is transmitted on each broadcast The transmitter is a 500-watt self-rectified outfit, utilizing high-voltage, 500-cycle a.c. on the plates of two 250-watt "bottles." This is the same transmitter which kept in contact with Rear Admiral R. E. Byrd's Antarctic Expedition for almost two years, day by day.

Gordon McCallum deserves great praise for his excellent work in the recent foundering of the ill-fated tanker "S. F. DeBardeleben." Captain Knight expresses his appreciation through his letter, from which I extract a few lines: ". . . written in an effort to show my appreciation for your excellent service rendered . . ." ". . . dispatch of our communications and the readiness with which you understood and carried out my instructions could only have been accomplished by an operator of wide experience . . ."

M. R. writes in requesting information as to the whereabouts of his old pal, "Flying Bill" Ehmer. So the bloodhounds of this department beg to advise that Ehmer is still with the Pan-American Airways and is now combination flight mechanic and radio op, flying between Port-au-Spain and Barranquilla, Colombia. That's service, eh, M. R.? Give us a hard one.

We also hear that the "Fresh Water Boys" led by Jimmy Barr are going to give the "Salt Water Gadgets" a bit of competition through this column. His first shot out of the mill is "the gales are bigger and better on Lake Mich." Can you beat that? And him a bug-artist on the Big Pond in the good old days. Come on, you S.W.'s—three silent cheers and a dumb whistle—get into a clinch and retaliate. Let not that crack go by uncontested.

Did you know that: There are about 11,000 commercial radio operators in the U. S. and only 38 of these are holding Extra First-Class tickets?—That British ops must have had one year's experience on ships equipped with direction-finding apparatus plus a year of experience with c.w. transmitters before they can obtain a first-class ticket?—There is a new license, Radiotelephone Operator, which can be obtained by passing a theoretical exam., viz:—see new regulations covering operators' licenses which went into effect July 1, 1932.—This segregation of the telegraph and telephone classes of ops should provide a more efficient personnel for both classes of stations and help to make seagoing and land berths more secure.

This is the time of year when everyone's thoughts turn to Xmas, Xmas cheer, stockings hung up around the fireplace, gifts, giving and receiving, homefolks, the girl we left behind, and a few other things. Let me, here and now, give you the official greetings of the season from this RADIO NEWS magazine and myself. I hope that you will have a pleasant, cheerful and healthy Xmas and may the New Year bring only the good things of life to you, one and all. May the turkey the boys will try to digest have legs this Xmas, and for the gang of Ops on the high seas, I pray that their turkey has been fed on milk instead of shoeleather, and may the fixin' be as delectable as the ads show them. So here's a big "hlo" and "GE."—"73s."

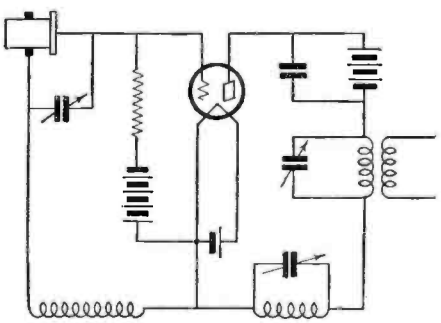
Latest Radio Patents

A description of the outstanding patented inventions on radio, television, acoustics and electronics as they are granted by the United States Patent Office. This information will be found a handy radio reference for inventors, engineers, set designers and production men in establishing the dates of record, as well as describing the important radio inventions

By Ben J. Chromy*

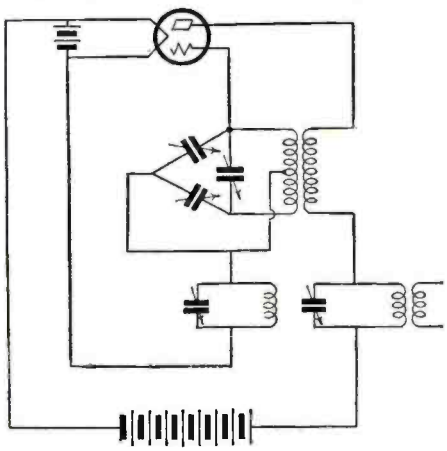
1,861,862. PIEZO-ELECTRIC CRYSTAL OSCILLATOR SYSTEM. AUGUST HUND, Bethesda, Md. Filed June 7, 1929. Serial No. 369,237. 9 Claims.

1. In a piezo-electric oscillator system, a piezo-electric crystal element, electrodes encircling said element adjacent opposite ends thereof, and an electrode encircling said element intermediate the opposite ends thereof, for establishing oscillatory paths through said element remote from the optical axis of said element.



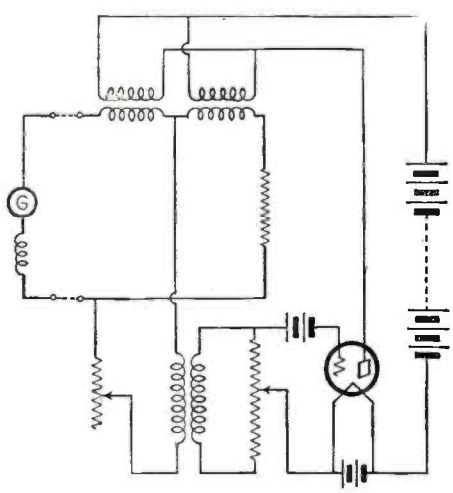
1,863,564. METHOD AND APPARATUS FOR CHANGING FREQUENCY FOR RADIO SIGNALING. LUCIEN CHRETIEN, Paris, France. Filed Jan. 14, 1928, Serial No. 246,878, and in France Jan. 15, 1927. 5 Claims.

1. A device for changing frequency having a three-element electron tube and inductively coupled grid and plate circuits, comprising a first oscillating circuit furnishing a local frequency, a second oscillating circuit carrying the frequency to be transformed, said first and second circuits being introduced both into the said grid circuit, a third oscillating circuit introduced into the plate circuit and carrying the transformed frequency, and a pair of variable condensers each having one of their plates connected to the terminals of said first oscillating circuit, the other plates being connected to the middle point of the inductance of said first oscillating circuit forming an equipotential connection to which is connected the second oscillating circuit.



1,863,566. NEGATIVE RESISTANCE. MIHRAN M. DOLMAGE, Washington, D. C. Filed Jan. 13, 1927. Serial No. 160,978. 11 Claims.

1. An electrical network, means to connect said network to an outside circuit, a detecting-amplifying system in said network, and means to superimpose upon said outside circuit the electromotive force of the final output circuit of said amplifying system in combination with means to prevent said electromotive force from being impressed upon the input circuit of said amplifying system.



1,861,183. RADIO RECEPTION SYSTEM. CLINTON W. HOUGH, New York, N. Y., assignor, by mesne assignments, to Wired Radio, Inc., New York, N. Y., a Corporation of Delaware. Filed July 10, 1925. Serial No. 42,691. Renewed May 8, 1931. 6 Claims.

1. In a system for distributing signaling energy over a three-wire power distribution network, the combination of an antenna system, a receiving set having its input circuit connected to said antenna system, the output circuit of said receiving set being connected to each of the wires of said three-wire power distribution network for the purpose of impressing signaling energy received by said antenna system upon said power distribution network, means connecting a plurality of sound-reproducing means to said network whereby the signaling energy impressed upon said network may be reproduced, part of said sound-reproducing means being connected to the neutral wire and another wire of said three-wire network, and another part of said sound-reproducing means being connected to the neutral wire and the other wire of said three-wire network.

* Patent Attorney, Washington, D. C.

What's New in Radio

A department devoted to the description of the latest developments in radio equipment. Radio servicemen, experimenters, dealers and set builders will find these items of service in conducting their work

By The Technical Staff

Universal Portable Receiver

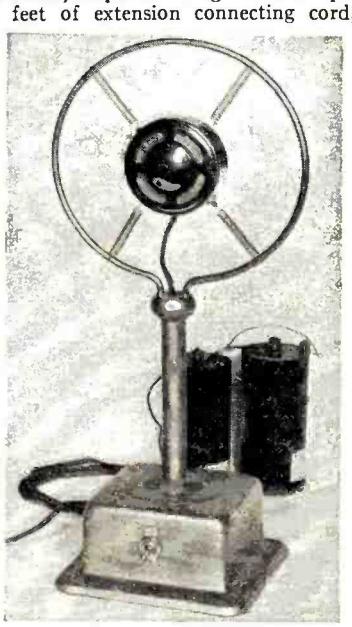
Description—This attractively designed portable set operates from 110-volt (either a.c. or d.c.) line supply, and is also easily adapted for 220-volt operation. The circuit employs the following type tubes: three –39,

one –37, one –85, two –89 and one –80 rectifier. This receiver features automatic volume control, diode detection and a noise-suppression system. The radio chassis and a dynamic type speaker are enclosed in a brown or black leatherette traveling case, measuring 16 inches by 12 inches by 8 inches. The total weight of the equipment is 25 pounds.

Maker—Ansley Radio Mfg. Co., 147 W. 23rd Street, New York City.

Microphone

Description—This inexpensive microphone, model No. 56-W, is complete with metal table stand, suspension ring and four springs, fifty feet of extension connecting cord, an



"on-off" toggle switch and an input-matching transformer. The microphone mounted on the table stand measures 14 inches in height. Instructions accompany each unit, showing the simple method of attaching the microphone to any radio receiver. This microphone, in combination with the audio amplifying system of the receiver, can be used for reproducing your own entertainment in the home and it is adaptable to the many occasions where a simple address system is required.

Maker—Connecticut Telephone and Electric Corp., Meriden, Conn.

Auto B Eliminator

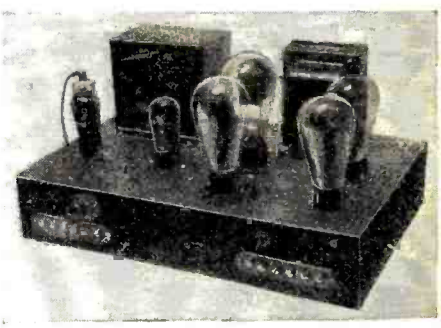
Description—A compact B eliminator for automobile radio receivers. It obtains its operating voltage from the 6-volt car storage battery. The complete unit measures only 10 inches long by 7 inches wide by 3¼ inches high and is easily installed in the numerous small spaces available in a motor-car. It will insure unvarying B voltages for the tubes in the set. A very important operating feature of this eliminator is the

Mallory-Elkonode device. It changes the storage battery current into what is essentially an alternating current. The electrical connections of this unit are brought out to a tube base which permits it to be slipped in or out of the chassis as easily as a vacuum tube. By selecting the proper Elkonode unit, this new B eliminator is adaptable to any make of motor-car radio receiver.

Maker—P. R. Mallory & Co., Inc., 1131 Newton St., Indianapolis, Ind.

A New Line of Power Amplifiers

Description—This model 101 power amplifier is a three-stage job employing the following type tubes: one –58, one –56, two –50 and two –81 rectifiers. It has a power output rating of 11 watts with less than 4

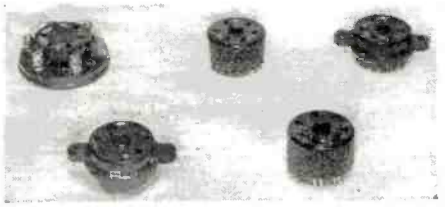


percent second harmonic distortion. Its gain is 87 decibels. A smaller unit, model 107, is a two-stage push-pull Class A Prime amplifier using two –57 type tubes, two –45 type and one –80 rectifier. The power output from this amplifier is 4 watts with less than 1 percent second harmonic distortion and the gain is 75 decibels. Both amplifiers are designed for universal input and output impedances.

Maker—Federated Purchaser, Inc., 23 Park Place, New York City.

Five New Sockets

Description—The three 6-prong type sockets shown at the top of the illustration are as follows, from left to right: Model 486 for breadboard mounting; model 426, a but-

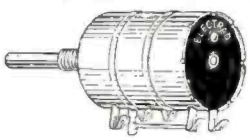


ton type socket designed for mounting on panel with one center screw or eyelet, has a diameter of $1\frac{3}{16}$ inches; model 436 mounts above or below panel, mounting holes $1\frac{1}{32}$ inches center, panel hole $1\frac{3}{16}$ inches. The two 7-prong type sockets at the bottom of the photograph are, left to right, Models 437 and 427. These sockets have the same style mounting and diameter as type Nos. 436 and 426, described above.

Maker—Alden Manufacturing Co., Brockton, Mass.

Attenuator

Description—A constant impedance "T" pad attenuator designed to control volume in microphone and phonograph pick-up circuits and in any type of sound-reproducing

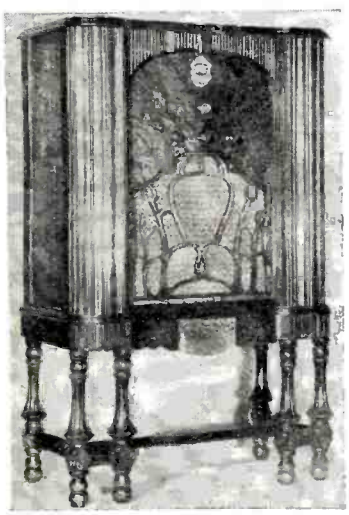


system where the control is required to maintain a constant impedance throughout its adjustment. This attenuator is available for the following line impedances: 15, 200, 500, 3000 and 5000 ohms.

Maker—Electrad, Inc., 175 Varick St., New York City.

A 32-Volt All-Electric Receiver for the Farm

Description—A console seven-tube superheterodyne receiver especially designed for the country home or farm where the light supply consists of a 32-volt d.c. current electric plant. The modern construction of this receiver includes tone control, pentode output tubes and twin speakers. The development of the new Delco electrifier has elimi-



nated the necessity for B batteries heretofore essential for the plate supply on earlier 32-volt radio receivers. The cabinet measures $39\frac{1}{8}$ inches high by 26 inches wide by $16\frac{7}{8}$ inches deep.

Maker—Delco Appliance Corp., Rochester, N. Y.

An Effective Antenna

(*Continued from page* 397)

the increased lead-in length will produce.

The directional properties of such a system have confused a number of old-timers who have it fairly well rooted in their minds that an inverted L antenna will receive best in the direction opposite the free end. They cannot understand, if that is true, why the use of the doublet should bring in signals best in the direction at right angles to the flatter portion of the antenna. However, with a doublet of this variety, whether it be of the tuned or untuned variety, reception will be best in the plane 90° off the direction of the doublet. In other words, if you want to receive stations in Australia and in Europe, consulting a mercatorial map or looking at a globe will indicate that the direction from almost any portion of the United States will put Australia to the southwest and Europe to the northeast. Reference to Figure 2, showing the directional properties of the doublet, suggests that the best direction for the running of the antenna

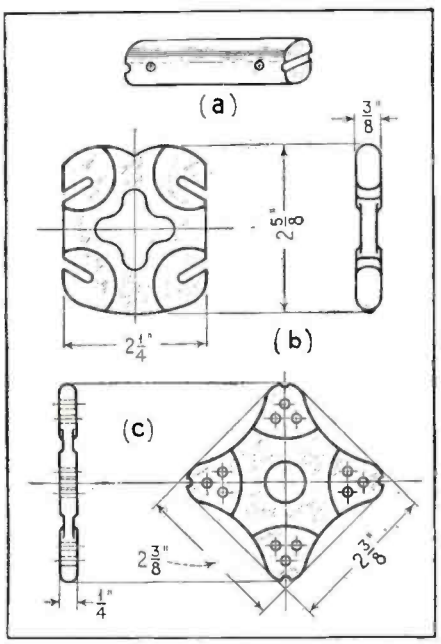


FIGURE 7

is, therefore, southeast and northwest, or at right angles to a line drawn on a globe from Australia to Europe.

Inverted "L" Type Antenna

The inverted L type antenna is probably the easiest to erect, but the modern version is provided with a suitable transposed transmission line lead, as shown in Figure 3. The lead is taken from the end of the flap-top from which we wish to receive. For instance, if we wish to receive from Europe, our flat-top should preferably run in a general northeast and southwesterly direction, with the transposed transmission line lead, taken from the northeasterly end. This is not imperative, however, as its directional properties are not marked.

As shown in Figure 3, the top end of the second wire (d) in the transmission line lead goes nowhere. That is, it goes nowhere electrically. Physically it is terminated at the opposite end of the insulator to which the terminal for the lead-in end of the flat-top is attached. It is but natural that the question of an unbalanced system, with a rather long flat-top and its down lead on the one hand, is opposed by nothing but the down lead itself on the other. The system is partially unbalanced, but the greater part of

the effect of this unsymmetrical condition is reduced by the simple process of placing a suitable resistance (R1, 2) in each of the base positions of the two wires which go to make up transmission line lead-in, as shown in Figures 1 and 3. In this connection it will be found that the value of the resistances for optimum results at given frequencies will vary. It is a simple matter to incorporate a suitable resistor mount in each lead and make the necessary changes by having a supply of fixed resistors on hand, offering a range of resistance from two hundred to about one thousand ohms. But in many instances it will be found that there will be plenty of signal, especially if the length and the height of the flat-top portion of the antenna system is great, so that adjustment of the resistance in series with the coupling coil is unnecessary. This is particularly true when it is possible to adjust the coupling between the transposed lead-in and the tuned circuit of the receiver to which it is coupled. In such cases the value of the resistors, for best average results, is in the neighborhood of 400 ohms each. A very simple means for coupling a transposed lead to any sort of receiver, other than those in which the antenna coil is completely enclosed within a shielded can, is shown in Figure 5.

To operate a completely shielded type of receiver in conjunction with a transposed transmission-line type of lead, regardless of the character of the flat-top, it is but necessary to locate the primary of the antenna coupling transformer. This is generally a very simple matter, because one end of the primary is connected to the binding post marked ANT. The opposite end of the coil is either grounded directly to the chassis or is run to the binding post marked GND. Once this second wire is found, it is opened somewhere between the lower end of the coil itself and the point at which it is grounded. The lower end of the coil is then connected to one end of a single resistor mount and the opposite terminal of the resistor mount is connected to one end of transposed down leads. The other down lead is connected through a similar resistance mount and resistor to the regular antenna binding post on the receiver. Reversing the leads does not, as a rule, make much difference, but it does no harm to try it. In some cases, performing this operation on

Radio News Technical Information Service

The Technical Information Service has been carried on for many years by the technical staff of RADIO NEWS. Its primary purpose is to give helpful information to those readers who run across technical problems in their work or hobby which they are not able to solve without assistance. The service has grown to such large proportions that it is now advisable to outline and regulate activities so that information desired may come to our readers accurately, adequately and promptly.

Long, rambling letters containing requests that are vague or on a subject that is unanswerable, take up so large a portion of the staff's working time that legitimate questions may pile up in such quantities as to cause a delay that seriously hinders the promptness of reply. To eliminate this waste of time and the period of waiting, that sometimes occurs to our readers as a consequence, the following list of simple rules *must* be observed in making requests for information. Readers will help themselves by abiding by these rules.

Preparation of Requests

1. Limit each request for information to a single subject.
2. In a request for information, include any data that will aid us in assisting in answering. If the request relates to apparatus described in RADIO NEWS, state the issue, page number, title of article and the name of the device or apparatus.
3. Write only on one side of your paper.
4. Pin the coupon to your request.

The service is directed specificially at the problems of the radio serviceman, engineer, mechanic, experimenter, set builder, student and amateur, but is open to all classes of readers as well.

All questions from subscribers to RADIO NEWS will be answered free of charge, provided they comply with the regulations here set forth. All questions will be answered by mail and not through the editorial columns of the magazine, or by telephone. When possible, requests for information will be answered by referring to articles in past issues of the magazine that contain the desired information. For this reason it is advisable to keep RADIO NEWS as a radio reference.

Complete information about sets described in other publications cannot be given, although readers will be referred to other sources of information whenever possible. The staff cannot undertake to design special circuits, receivers, equipment or installations. The staff cannot service receivers or test any radio apparatus. Wiring diagrams of commercial receivers cannot be supplied, but where we have published them in RADIO NEWS, a reference will be given to past issues. Comparisons between various kinds of receivers or manufactured apparatus cannot be made.

Only those requests will be given consideration that are accompanied by the current month's coupon below, accurately filled out.

JANUARY, 1933

Technical Information Coupon
RADIO NEWS Laboratory
222 W. 39th Street
New York, N. Y.

Gentlemen:

Kindly supply me with complete information on the attached question:

☐ I am a regular subscriber to RADIO NEWS, and I understand this information will be sent me free of charge.

☐ I am not yet a subscriber to RADIO NEWS.

☐ I wish to become a subscriber to RADIO NEWS, and enclose $2.50 to receive the magazine regularly for one year, and to receive this valuable technical information service free of charge.

Name.....

Address.....

the receiver brings about a tendency to oscillate when the volume control is run pretty well up. This is generally overcome by reversing the position of the plug going to the regular a.c. feed line.

The third fundamental type of antenna is one which is recommended for use in areas where the space available will not admit of the use of the horizontal doublet and where equal reception from all directions is desired. The mechanical details for such a system are given in the drawing, Figure 6. The length of a flat-top of this nature does not need to be as great as the length of a single wire for picking up the same signal voltage, but the flat-tops for any of the three systems described should be not less than thirty-five feet.

New Economical P. E. Cells

Longer life and more uniform operation of a photoelectric cell are said to be made possible by new manufacturing processes developed by the Continental Electric Company of St. Charles, Illinois. The new Cetron photoelectric cell is available in types to operate in any sound head.

The Giant's Voice

(*Continued from page* 401)

bombing planes, which are notoriously noisy, with a plane a mile up in the air, and signals have been heard as far as nine miles away. It is interesting to note in this connection that communication with the plane flying under 500 feet high was not possible. At such shorter distances the noise-to-sound ratio is too high.

An interesting sidelight of the clarity with which speech is transported over considerable distances was found during the political campaign at Boston. The daughter of one candidate took down in shorthand the complete speech of her father, who spoke 4 miles away! It was amplified and put through this same gigantic horn as described above and received, purely acoustically, over all this distance.

On another noisy plane, like the Navy T-4M plane, flying one thousand feet high with the motor running at 1500 revolutions per minute, orders could be given to the plane, which were understood and carried out by the pilot in spite of the leather helmet covering his ears.

Thus applied, radio engineering has succeeded in harnessing the lungs, larynx and mouth of the Gargantuan robot, creating sound intensities of a volume never heard before.

Radio Physics Course

(*Continued from page* 433)

by a rapid drop in voltage when it reaches a certain "critical" point in its discharge. Also as the electrolyte becomes a weaker acid and therefore a poorer conductor, and the lead sulphate on the plates is also a poor conductor, the internal resistance of the battery increases as it discharges, especially after the critical point mentioned above is reached.

In order to re-charge a storage battery *direct* current must be passed through the cells in the direction *opposite* to that of discharge. This current reverses the chemical changes which took place in the cells during discharge. The lead sulphate on the plates now combines with the water. The positive plates are re-converted into lead peroxide (PbO_2) and the negative plates are re-converted into spongy lead (Pb). Sulphuric acid (H_2SO_4) is returned to the electrolyte solution. The chemical equation which ex-

presses this change during charging as follows:

$$\underset{\text{Both Plates}}{2PbSO_4} + \underset{\text{Water}}{2H_2O} = \underset{\text{Negative Plate}}{Pb} + \underset{\text{Positive Plate}}{PbO_2} + \underset{\text{Electrolyte}}{2H_2SO_4}$$

Lead sulphate + water becomes spongy lead + lead peroxide + sulphuric acid.

As this equation is exactly the reverse of the one representing the reactions on discharge, the materials in the cells will all be converted back to their original composition and be ready to combine again to produce electrical energy.

Small storage cells are available for use as B batteries for radio receivers. These consist of 12 or 24 cells connected up in series to form B battery units of 24 or 48 volts respectively. Glass jars are used for the cells. This battery has a capacity of 600 milliampere-hours. It is evident that the storage cell really stores chemical energy, which makes itself available as electrical energy or discharge.

A Class B Amplifier

(*Continued from page* 403)

Figure 3 shows the universal application of double-button carbon microphones, phonograph pick-ups and radio connection to the primary or input windings of transformer T1. The transformer T5 is an output unit from detector plate to universal line, and the transformer T6 is a mixing unit from universal line to universal line. Different combinations of input constant impedance gain controls will suggest themselves to the radio experimenter and sound engineer.

Facing the front of the amplifier as in Figure 2, to the extreme left, from front to rear of the chassis are mounted the audio transformer T1 and the audio chokes L1 and L2. The output transformer T3 and the filter choke L4 are mounted in the front center of the amplifier and directly to the rear of these units, reading left to right, is the transformer

RADIO NEWS Export Service

AS a service to our readers in locations outside the United States of America, either commercial, professional or private individuals, RADIO NEWS will arrange to provide contact with leading American manufacturers of radio supplies and receiving equipment.

To utilize this service, clip and fill out coupon below and send it attached to your letter on which you list the types of apparatus you are interested in.

Our Export Service Department will refer your inquiries direct to the proper manufacturers, asking them to send you full particulars, catalogues, prices, etc.

* * *

ALS einen Dienst für unsere Leser, entweder Kaufleute oder Privatpersonen ausserhalb der Vereinigten Staaten von Amerika, kann RADIO NEWS mit den führenden Amerikanischen Fabrikanten von Radio Apparaten Kontakt herstellen.

Für den Gebrauch dieses Dienstes schneide man den Kupon aus und sende denselben mit einer Liste von Apparaten die für Sie von Interesse sind.

Unsere Export Abteilung wird Ihr Schreiben umgehend an die betreffenden Fabrikanten weiter befördern, mit der Bitte Ihnen Auskünfte, Preise und Kataloge zu senden.

* * *

POUR rendre service à nos lecteurs demeurant hors des Etats-Unis d'Amérique (commerçants, professionnels ou particuliers), RADIO NEWS vous fera entrer en relation avec les principaux fabricants d'appareils de T. S. F. en Amérique.

Pour profiter de cette organisation, il vous suffira de remplir et de découper le coupon ci-joint, et de l'envoyer attaché à votre lettre, en énumérant les types d'appareils qui vous intéressent.

Notre service d'Exportation fera suivre directement vos demandes aux fabricants intéressés en les priant de vous adresser tous renseignements, catalogues, prix, etc. . . .

* * *

COMO un servicio especial a nuestros lectores que se encuentran fuera de los Estados Unidos de America, ya sean comerciantes, profesionales o personas privadas, RADIO NEWS tendra a bien ponerlas en contacto con los principales centros manufactureros de radio, de aparatos receptores y accesorios.

Para beneficiarse de tal servicio, sirvase recortar el coupón de esta página, enumere los tipos de aparatos que le interesen, y envienosla con su carta.

Nuestro Departamento de Exportación se encargará de ponerse en contacto directo con dichos centros, pidiendo le envien información completa, catalogos, precios, etc.

* * *

RADIO NEWS Export Service Department

Kindly put me in contact with American firms manufacturing the class of radio apparatus noted on attached sheets.

Name.....

Address.....

Business.....

1931 total income. The 1931 income of NBC was $25,607,041. The same year, the CBS income was $11,895,039. Both of the totals should be surpassed in 1932, on the basis of income the first nine months of the year. The much larger NBC earning as compared to the CBS is largely due to the fact that it includes the "red" and the "blue" hook-ups, one keyed by WEAF, the other by WJZ. The CBS chiefly functions as a single network keyed by WABC, although there are some exceptions when the chain is split for conveying more than one program simultaneously.

As far as the broadcasters are concerned, there is certainly money in the air! But to keep on getting it out of the air, the programs must improve in interest so that listeners will continue to listen!

Modern Auto Radio

(*Continued from page* 413)

quality of what otherwise would be good amplifiers.

Returning to the circuit again, we find the output of the –85 tube is fed through a coupling condenser and the volume control to the grid of the –37 tube. This tube is used as a driver for the two –38's, operating as a Class A amplifier. This type –38 tube supersedes the LA type which was used in the model 7T474 receiver.

While the LA type tube had some excellent characteristics, including a very low plate impedance, which was an important factor in adjusting the load impedance for minimum third harmonic distortion. It was a filament type Pentode tube and was more costly to use in conjunction with a vibrator type power pack. The –38, using a cathode heater, eliminates the use of additional filtering which is necessary in a filament tube such as the LA.

The maximum output of this receiver is about 2½ watts. This is a far cry from the first automobile receivers, which with their little horns strained and squeaked under 700 milliwatts.

The model 61 differs from the 88 only in the audio circuit, as shown in Figure 4. The r.f. circuit is identical with the 88. The output circuit of model 61 consists of a single –41 tube. This is a new pentode which has been developed by the Everready tube division of the National Carbon Co., with the co-operation of the Motorola engineers.

The model 61 receiver is designed to sell at a lower price and to meet the needs of those who do not require a receiver with the output of the 88.

Both models are remote controlled by a unit clamped to the steering column. The tuning condensers are driven by a flexible shaft with a pinion gear on both ends. One end of this shaft meshes with the large gear on the condenser shaft in the receiver. The other end engages with the toothed celluloid scale in the control unit. As the gear ratios are the same at both ends, the scale is always in exact step with the condensers.

Volume is controlled by a 500,000-ohm variable resistor in the control unit. The power is controlled by a lock switch also in the control unit. All external wiring of the receiver is shielded 100 percent.

Before being presented to the public these receivers have been tried out in practically every known make of automobile in this country. These installations have been studied and observed by factory engineers and considerable information collected on the peculiarities of the different makes of cars. This information is available to Motorola servicemen and gives the necessary steps to be taken to insure quiet operation in every make of car.

New S.W. Design

(*Continued from page* 416)

effect of apparently spreading the signal out either side of the resonance point, and therefor broadens tuning.

In the "AGS" receiver this ideal is partly accomplished. The beat oscillator is adjusted slightly off i.f. resonance. When an incoming signal is converted to the intermediate frequency by the action of the main oscillator, the heterodyne beat will be much more evident on one side of the resonance point than on the other, being stronger when off resonance on the same side as the beat oscillator.

The beat oscillator, by the way, is always in the circuit, but when c.w. reception is not desired the plate voltage supply to this tube is cut off by the action of the "c.w.-phone" switch. In hunting for weak modulated signals the beat oscillator may be left in operation until the carrier is encountered and tuned in to best advantage, then the switch can be thrown to cut out the beat. Thus the old favorite method of locating DX stations by a "birdie" whistle may be employed to full advantage.

Actual operating tests of the "AGS" were conducted by the authors at Fairfield, Connecticut, and throughout the tests the receiver behaved with beautiful effectiveness. The reception conditions at this location have already been described two or three times in past issues, so they need not be reviewed in detail here. Suffice it to say that the antenna employed was an ordinary single wire, 70 feet long and varying from 12 to 15 feet above ground—certainly nothing to brag about.

All of the usual foreign stations broadcasting on short-waves were brought in with good regularity throughout the test period which extended over several days in September.

The same effectiveness found in receiving foreign broadcasts was also present when tuning in amateurs. Any number were tuned in, both American and foreign, on c.w. and 'phone. The automatic volume control was found particularly useful in listening to amateur 'phones, the great majority of which seem to have the bad habit of swinging in and out. This fading was largely overcome by the automatic control. The one drawback during the amateur tests was found in the somewhat crowded tuning due to congestion in these bands. Unfortunately, the amateur band-spread coils were not available for the tests. If they had been, the one possible flaw in the receiver for amateur work would have been overcome. Inasmuch as such coils are now available, this receiver will be found by amateurs to be a close approach to the ideal—with its sensitivity, selectivity, low noise level, partial single-signal feature—and honest-to-goodness one-dial tuning, without trimmers, antenna equalizers or other auxiliary gadgets.

World's Smallest Microphone

What is claimed to be the smallest completely protected and workable single-button microphone in the world has come from the plant of the Universal Microphone Co., out in Inglewood, Cal.

It is the result of more than a year of practical test and laboratory research and is known as the "Perfected Watch Microphone," models "W" and "Y." Besides certain radio broadcast uses, it may also be used in concealed spaces as a detectaphone or as a coat lapel device. The watch model microphone is particularly small and compact, yet it has an unusually high degree of sensitivity. Technically it is a 200-ohm microphone, with a pure gold spot center diaphragm which is wholly enclosed.

INDEX TO ADVERTISERS

Home-made Photo-cell

(*Continued from page 407*)

at sunrise this duty-bound little instrument turns off the man-made sunlight in the chicken coop and at the same time unlocks the doors to the runway and, by releasing the counter-weights, opens them.

While light cannot deteriorate these cells, the builder should house them in small boxes with openings. This keeps them more or less dark until light from a certain direction hits them. The writer has made several small cells that he has housed in the wooden 3 by 5 card-index files which may now be purchased in the five and ten-cent stores. The covers of the box may be provided with a catch and two holes drilled in the top for the entrance of the connections. The hole should be about one inch in diameter and should be so located as to permit the incident light beam to strike it fairly in the center. If the box is to be used outside it should be covered with tar paper or tin to protect it from the weather.

With the Experimenter

(*Continued from page 429*)

with no excitation voltage in the grid circuit. In the case of this Class B tube circuit the bias voltage may be arrived at by increasing it in small steps until the relay just opens the local battery circuit.

With some radio receivers troublesome feedback may be had when the additional amplification of this two tube unit is present. Such a feedback is usually caused by insufficient shielding and the lack of audio bypass or filter circuits in the receiver. In some cases isolating the unit a short distance from the receiver may be sufficient to eliminate the feedback trouble. In other cases a reduction in the gain or redesign of the audio amplifier will be necessary.

KENNETH ROCKWELL,
Syracuse, New York.

The Service Bench

(*Continued from page 427*)

transformers, power transformers, volume controls of all types, sockets, tubes, etc.

"Several cross-sections of the various parts were made in order to show their construction. A neat job was done with no other machine tools than a hacksaw and file.

"This apparatus was mounted in symmetrical groups and each group was explained with a typed card giving the following information in simple, concise statements which a layman could understand.

MATERIALS AND METHOD OF MANUFACTURE
THE FUNCTION OF THE PART IN THE SET
THE MANNER OF FAILURE
THE SYMPTOMS OF FAILURE

"I have also used this as a window display when featuring tubes and other accessories. When not in use in our store, it is circulated throughout the vacant store windows in town with appropriate advertising display."

THIS MONTH'S SERVICE SHOP

Neatness, efficiency, adequate equipment, good display, ample room, and light are all

exemplified in the service shop (shown in the heading) of "Rebennack's Radio Servicenter"? New Orleans, La.

The test panel is constructed around a Supreme Diagnometer, below which is mounted a General Radio 500 mmfd. shielded variable condenser for adjusting the 600 trimmer on superhets. Four speakers are available for various test purposes—a Sparton type 301, a Sparton magnetic, an S-M 851 Universal and a midget dynamic. All voice-coils are led to tip jacks for output-meter connection, and the four speakers wired to the speaker panel just below the main panel.

A Jewell oscillator and output meter are mounted under the left bank of speakers. The broadcast and intermediate charts have been enlarged and are mounted one on each side of the output meter.

The equipment in the next vertical column, from top to bottom, is—a direct reading 0 to 2 meg. Weston ohmmeter; a neon short tester; a double-scale resistance meter, reading accurately as low as 1 ohm; and an a.c. line-voltmeter, with toggle switch and four outlets. On the right hand column, in the same order, are a Weston ohmmeter reading from 1 meg. to 10 megs, (which is also used for testing condenser leakage); a heater rack with six sockets; a Weston low-resistance continuity tester; and two double outlets with a master switch.

On the extreme lower right is a phonograph pickup, which slides in when not being used. Two receivers with a 677B amplifier are mounted above the test panel, either receiver being immediately available through a switch control below the edge of the table.

Portable equipment consists of a Jewell type 444 analyzer and two Supreme diagnometers.

ALL IN A DAY'S WORK

Apropos of this month's lead, Roy Hollis, of Albany, N. Y., contributes the following item on servicing auto installations in Chevrolets—

"I have serviced three different makes of auto radios installed in Chevrolet cars for the same complaint—noise. The disturbance was not really bad, but just persistent enough to be annoying. After checking everything from suppressor resistors to shielding, and finding the entire installation okay, I tried bypassing at various points in the low-tension circuit with no real results. The trouble finally capitulated, in each of the three instances, when I reversed the leads to the primary of the coil."

Transposed Lead-ins

Harvey Volney, of New York City, comments on the utility of transposed lead-ins for noise reduction in d.c. districts.

"Having experimented with these arrangements and found them particularly effective with noisy direct-current installations, I distributed several thousand circulars in my immediate neighborhood guaranteeing to reduce noise—definite improvement or no charge—made sixty-two installations in two months at $10.00 a throw.

Amateur Activities

Amateurs in the vicinity of New York City will be interested in the monthly meetings held under the auspices of the Hudson Division of the American Radio Relay League at the Army Building, 39 Whitehall St., New York City, at 8 p.m., on the dates given below. Technical discussions of latest developments in short waves are held at these meetings. The dates are: December 29, 1932; January 27, February 24, March 30, April 28, 1933. There is no charge of any kind.

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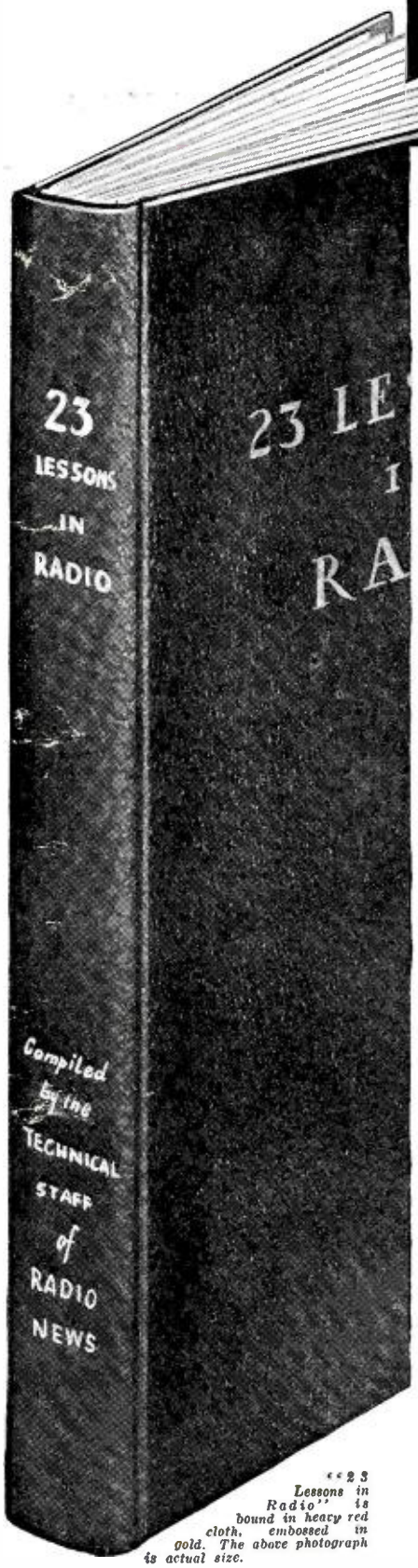
And Now A New Supply Is Ready!



"23 Lessons in Radio" is bound in heavy red cloth, embossed in gold. The above photograph is actual size.

"23 Lessons in Radio" *Yours* FREE! With *Radio News*

WE have been flooded with requests for copies of our book, **"23 Lessons in Radio,"** which proved so popular upon its release last season. In response to this demand a new supply has been printed and we are offering again copies of this well-known book with a subscription to *Radio News*.

Those just beginning radio training—young men needing a reference book containing the fundamental principles of radio—more experienced men wanting dope on the essentials—all will find **"23 Lessons in Radio"** *the* book on fundamentals.

You—the readers of *Radio News*—have asked us to reprint this book, and we are glad to present it to you *Free!*

A Foundation for All Radio Men

All radio men know the tremendous value of a good background in this field. To be well grounded in the first essentials is the kernel which develops success!

"23 Lessons in Radio" furnishes this background. It is written in clear, concise language and contains innumerable illustrations, charts and schematic diagrams. Just for example, the first few lessons are an exposition of radio principles, and they tell how to build, step by step, a complete 5-tube radio receiver. Later lessons include instructions for building a short-wave converter for this same receiver.

There is a chart explaining the standard radio symbols used in schematic diagrams—a chart of the International Morse Code—and a thousand other things which make this book a thoroughly comprehensive training for the radio set builder, the experimenter, the service salesman and the dealer.

What Do You Want To Know About Radio?

Here are a few of the subjects covered in **"23 Lessons in Radio":**—Elementary radio theory;—How the detector tube works;—Construction of a 2-stage audio-frequency amplifier;—How the radio-frequency amplifier works;—How to build a short-wave converter which enables you to listen to police reports, amateur stations, and other short wave stations;—Principles of transmitting and receiving;—Standard radio symbols;—How to build a 3-stage resistance coupled audio-frequency amplifier;—Breaking into the amateur game;—How to build a code test outfit;—Circuit, constructional and operating details of a low-power transmitter;—How the vacuum tube works;—How to analyze receiver circuits;—and many other outstanding radio features.

Take Advantage Of This Special Offer

"23 Lessons in Radio" is not for sale *anywhere!* But, by subscribing to *Radio News* for a period of 11 months at the special price of $2 you will receive this great book free! And, that is not all, you save 75c over the newsstand cost of 11 issues. Simply fill out the coupon below and send it to us with your remittance of $2. We will immediately mail you **"23 Lessons in Radio"** and your first issue of *Radio News*.

Mail This Coupon Today For Your Free Copy!

RADIO NEWS, Dept. 1
222 W. 39th St., N. Y. C., N. Y.

Enclosed please find $2. Send my copy of "23 Lessons In Radio" by return mail and enter my subscription for the next 11 issues of Radio News. If renewal subscription check here ☐.

Name.....

Address.....

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

Are you a Serviceman ☐ Engineer ☐ Dealer ☐ Experimenter ☐ Radio Technician ☐

Foreign Price $3.00
Canadian Price $2.50

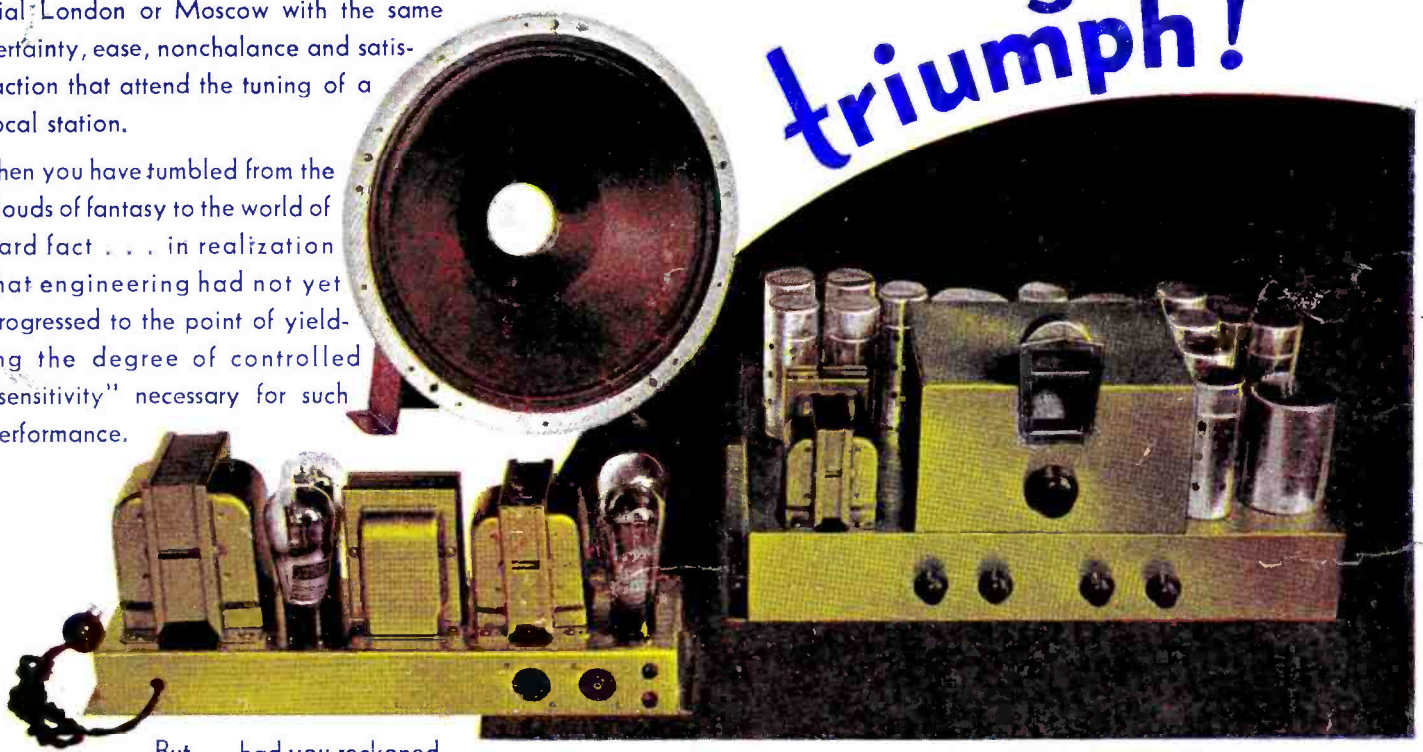
McMurdo Silver

presents

his latest, greatest triumph!

YOU—whose chief interest and hobby is Radio, have often allowed your fancy to conjure dreams of a mighty receiver—one that would dial London or Moscow with the same certainty, ease, nonchalance and satisfaction that attend the tuning of a local station.

Then you have tumbled from the clouds of fantasy to the world of hard fact . . . in realization that engineering had not yet progressed to the point of yielding the degree of controlled "sensitivity" necessary for such performance.



But . . . had you reckoned with the resourcefulness of McMurdo Silver? Were you mindful of the fact that from his laboratory have come 39 major advancements in the radio art? Had it occurred to you that from his laboratory might come the link that would surely and finally complete the chain of world-wide reception certainty?

Exactly that has transpired. McMurdo Silver, working alone and unfettered, has produced a 15-550 meter receiver—the sensitivity of which sets a new mark far beyond the range of the most precise laboratory measuring instruments.

Now . . . your hopes for a mighty receiver and for certainty of extreme distance reception can be realized. Now . . . you can accept the challenges of your DX friends with full knowledge that your receiver will out-point theirs by an indisputable margin.

The Silver MASTERPIECE

A 15-550 meter precision instrument that very definitely transcends all previous engineering effort . . . and that completely shatters all existing concepts of international Short Wave and Broadcast performance.

Unmeasurable sensitivity—unlimited range—one channel selectivity—positively no cross modulation under any circumstances—single accurately calibrated dial—no plug in coils—meter tuning—automatically silent tuning between stations—automatic volume control—tuned R.F. input stage—lowest signal-to-noise ratio ever achieved in a radio receiver—both automatic and manual tone controls—absolutely complete shielding—42 pound speaker having 4 times the apparent output of any other available today.

. . . and, each receiver personally tested by McMurdo Silver on reception from at least 3 foreign stations not on the North American continent. Each receiver accompanied by its own individual laboratory performance measurements.

Mail the coupon from this announcement or WRITE for 16-page book containing complete technical description. Enclose 3c stamp to cover cost of mailing.

McMURDO SILVER, INC., 1130 W. Austin Avenue, Chicago, Illinois

McMURDO SILVER, INC., 1130 W. Austin Ave., Chicago, Ill.
3c stamp enclosed. Send me your 16-page book giving full technical description of The Silver MASTERPIECE.

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