TWO MAGAZINES—ONE PRICE

RADIO NEWS

DECEMBER
25 Cents

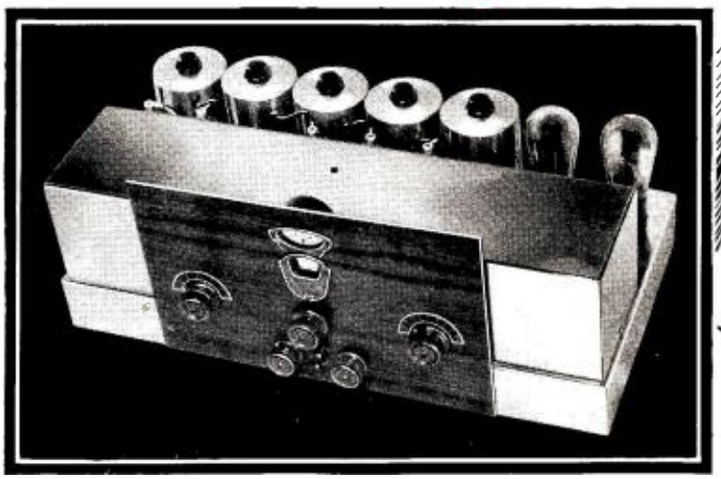
and
Radio Call Book Magazine
and
Technical Review

Boy Scouts
Learn the Code

An Absorption "Mike"
Microphones in Surgery

A Neon Oscillator
Home Recording Technique

WITH THE *Lincoln* DELUXE RECEIVER



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 a 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-12, 329 S. Wood St., Chicago, Ill.
Please send information on ☐ A.C. ☐ D.C. receivers.

Name _____

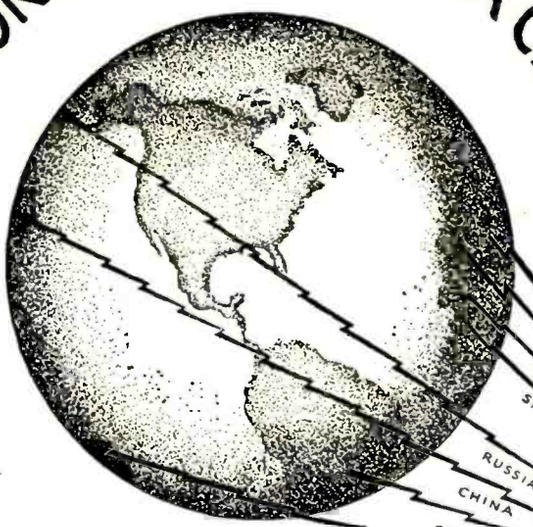
Address _____

City _____ State _____

Print name and address plainly

LINCOLN
DeLuxe Receivers

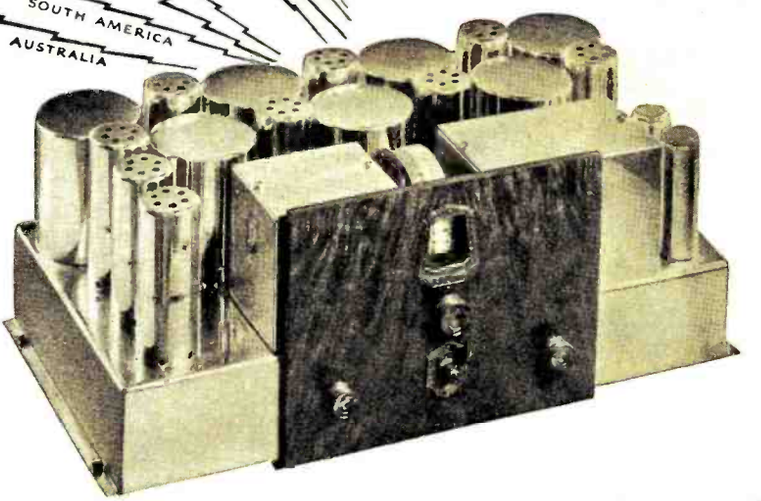
AROUND THE WORLD RECEPTION A CERTAINTY



Every Day in the Year

with the New 15-550 METER

SCOTT ALL-WAVE Deluxe



SCOTT-TRAVEL to the ends of the earth! Spin the whole globe's wealth of entertainment into your own home with the twirl of a dial. True single dial control does it — no trimmers or auxiliary dials, no fussing with plug-in or tapped coils. Here is performance so perfected that this receiver is GUARANTEED to bring in foreign stations, 10,000 miles or more away, with full loud speaker volume in all seasons, every week throughout the year.

Guarantee Based on History's Most Impressive Radio Performance Record

Verified Chicago reception, by a SCOTT ALL-WAVE operating under ordinary home conditions, of every scheduled program broadcast over a whole year's time from VK2ME, Sydney, Australia—more than 9,500 miles away . . . more than 19,000 logs of foreign stations submitted by SCOTT ALL-WAVE owners this year . . . are but two of many accomplishments.

It takes advanced, precision engineering—laboratory technique in custom construction—a background of nearly a decade of experience in building superfine receivers — to make such records possible, and to permit such a guarantee.

Yet here it is! Try it yourself. Thrill to the reception of stations in England—France—Germany—Spain—Italy—South America—far-off Australia. Listen in on gabbing telephony amateurs—hear land-to-plane messages—foreign news flashes on the short waves—a dozen and one new radio thrills await you. Get American, Canadian and Mexican stations you've never dreamed were on the air. Get them *all*—even those thousands of miles away—with full loud speaker volume and lifelike fidelity of tone. Tone so perfect that, in studio tests, music critics fail to distinguish between the actual playing of a hidden pianist, and the SCOTT ALL-WAVE DELUXE reproduction of a pianist's broadcast program.

Such performance results from micrometer-measured accuracy in custom building. It testifies to the incorporation of every worthwhile development in radio, plus many exclusive innovations made by Scott engineers. These betterments include full automatic volume control; visual tuning; the ultimate in selectivity; highest degree of sensitivity ever developed in a radio receiver; lowest known noise level of reception; new Class "A" linear amplification giving tremendous volume without distortion; new-type tubes; many other absorbingly interesting technical achievements.

Still, with all these superiorities, a SCOTT ALL-WAVE DELUXE costs no more than many models of ordinary receivers. And it is the *only* receiver with an iron-clad warranty. Every part (except tubes) is guaranteed for five years against breakage or service failure, instead of the ordinary 90-day period.

Learn about this new wonder of the radio world! The set that not only gets 'round-the-globe reception, but that is used around the world—Scott owners in 75 different foreign countries enjoy this remarkable performance. The whole story of the SCOTT ALL-WAVE DELUXE is the most vitally interesting news of radio quality, performance and value ever published. Get it today! Mail the coupon below for complete information, including technical data, performance proofs, and everything you want to know.

SEND COUPON NOW FOR PROOF

E. H. SCOTT RADIO LABORATORIES, INC.
4450 Ravenswood Ave.,
Dept. N-122, Chicago, Illinois

Send me complete information about the New Scott All-Wave Deluxe Receiver, including technical details, performance proofs, prices, etc. This request is not to obligate me in any way.

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Address.....

City.....

State.....

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4450 Ravenswood Avenue Dept. N-122 CHICAGO, ILL.

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RADIO NEWS

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Edited by Laurence M. Cockaday

VOLUME XIV | December, 1932 | NUMBER 6

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RADIO CALL BOOK SECTION

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It's just as true—or even truer—in business as in sport. The man with real, practical TRAINING is the one to win. Now that business is returning to normal there's going to be a harder race to win the prizes of big-pay jobs, independence and a future, than ever before. Are you "all set" to race? Have you the necessary TRAINING to bring you in among the winners! If not, DON'T WAIT! Get the training NOW while there's still time!

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Here's the most fascinating, fastest-growing field in the world today. In Radio there are thousands of jobs paying BIG MONEY—up to $50 a week and more. COYNE TRAINING fits you to hold better jobs—prepare to be a Designer, Inspector or Tester . . . a Radio Salesman, Service or Installation Man . . . Operator or Manager of a Broadcasting Station . . . a Wireless Operator on a Ship or Airplane . . . Coyne trains you, too, for Talking Picture and Television and Sound Work! In just a few short weeks, by exclusive Coyne methods, you are trained for a future that holds marvelous opportunities for top-notch salaries, or for a business of your own and real independence. Find out about this great game—get all particulars—see how simple it is for any ambitious man to get into it with the help of this great, nationally-recognized school.

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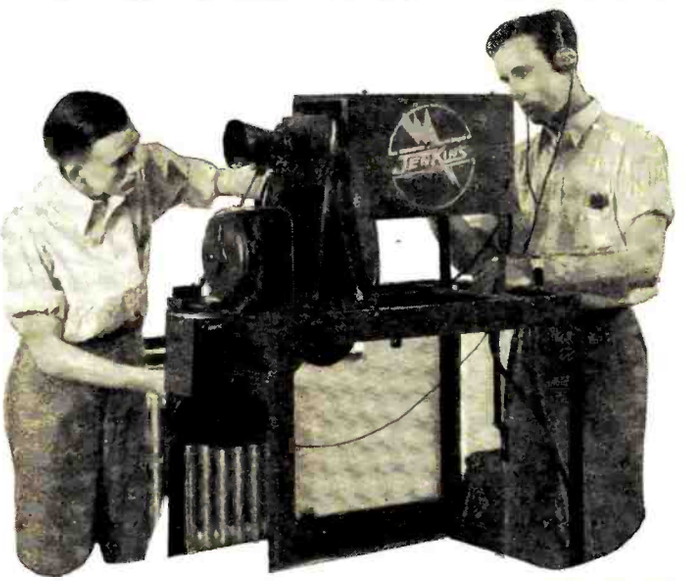

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Don't let lack of ready cash hold you back in getting the TRAINING you must have to be a winner. Many COYNE students make all or a good share of their living expenses while going to school. If you need that kind of help just let me know. We run an efficient Employment Service to help you get spare-time employment while you are here—and that aids you in finding full-time jobs whenever you need them during your whole life. COYNE has been training men for nearly a THIRD OF A CENTURY—its value has been tested and proven by thousands of men who are now successful and happy. YOU can have a future like that—YOU can be one of the winners in the race of life. Why not learn how easy it is?

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Just mail the Coupon! It will bring you a thrilling big book, illustrated with actual photographs taken in COYNE SHOPS and showing how our methods TRAIN you so practically that employers are glad to have you if you have a background of COYNE TRAINING. This book tells you everything you want to know about the tremendous RADIO FIELD—describes the vast opportunities that exist in it—tells about the future in it for men who know. It's a book of FACTS that is more fascinating than fiction. You'll enjoy every word of it—and it may be the means of starting you on a real, successful, prosperous career. GET IT AT ONCE. Just mail the coupon!

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Radio Division, Coyne Electrical School,
500 S. Paulina St., Dept. 92-8C, Chicago, Ill.

Dear Mr. Lewis: Send me your Big, FREE Radio Book, and tell me how I can get the TRAINING that will make me a WINNER.

NAME.....

ADDRESS.....

CITY.....STATE.....

The Editor—to *You*

A GLANCE at the cover this month reveals an addition to the name of the publication. The following announcement explains this change.

* * *

BUILDING upon the firm foundation that RADIO NEWS has already established as the world's leading radio publication, we have purchased and are combining with this December issue another radio magazine, *The Radio Call Book Magazine and Technical Review*, which in the past has been second in volume of circulation in the United States. We believe this to be a significant example of the growth of RADIO NEWS, combining as it does the interests of the two largest groups of radio readers in a single family. This, the first issue of the combined magazines, will contain the leading and most popular features of both publications and the added circulation and increased advertising revenue makes it possible to give our readers increased editorial value for their money.

LEE ELLMAKER, Publisher.

* * *

THE Editors are therefore happy in welcoming to the fold all of the subscribers and newsstand readers of the *Radio Call Book and Technical Review* and in reiterating their promise to these new readers of faithful service in obtaining for them the type of articles that will be valuable and helpful. Our policy will continue, primarily, to give all the news of radio, new developments, new experiments, new knowledge and new applications in the radio field, authoritatively and clearly. The Editors will appreciate hearing from readers, both new and old, as to their needs, their suggestions and constructive criticisms. This has always been a feature of RADIO NEWS and our Editors want to make our readers feel "at home" and that this magazine is truly *their own* magazine.

* * *

... of the *Radio Call* ... carried on, ... in ... andria, Ohio. Donald Ransomer, secretary and treasurer, writes and tells us that the president is Byron Hollinger, with following officers: Andy Hinkle, vice-president; Donald Ransomer, secretary and treasurer; Emmet Hollinger, sergeant-at-arms.

The boys in the society now have a complete clubhouse; exterior and interior views are shown. Some of the members are taking radio courses with the Signal Corps at Fort Benjamin Harrison in Indianapolis and at Camp Knox in Kentucky. All the boys are studying the fundamentals of radio and working toward securing a government license for an amateur station.

* * *

THE Editors feel that this increase in the number of young men becoming interested in radio is a sign-post pointing toward a greater future for the radio science, art and industry.

* * *

... are also in line ...

really the 'berries.' It is a book that one can read and learn what is going on in the radio field today. It gives information on new sets, new tubes, new developments. In reading through the book I found an article on just the subject I had been looking for."—George E. Lowrey, Brampton, Canada.

* * *

"I AM a well-advanced amateur and the owner of a well-equipped chemical and physical laboratory. I also service radio sets, but prefer to confine my efforts to experimental work. Recently I bought a copy of RADIO NEWS on the newsstand, and I liked it so well that I have followed it up ever since. I am, therefore, a new reader and a very satisfied one."—Thomas A. Callahan, New York City, N. Y.

* * *

"HAVING been a reader of RADIO NEWS only since last December, I would like to convey to you my appreciation of the contents of your publication. Although only a beginner in radio, there are a number of sections which are very interesting to me. And of course there are also some too advanced for my present knowledge."—J. Gordon, Cottesloe, Western Australia.

* * *

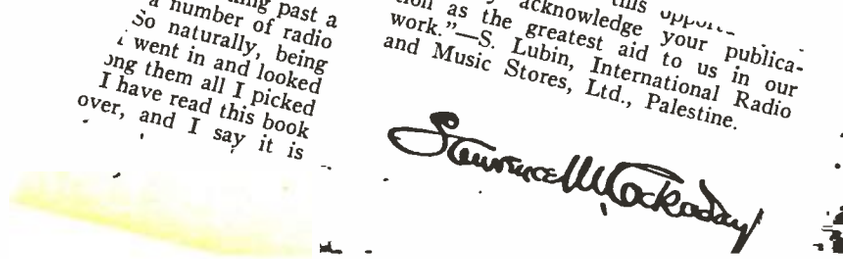
"THE writer has just received the September issue of RADIO NEWS and the free technical booklets I requested. Since subscribing to your great magazine, I have obtained my present post as instructor in the Pittsburgh School of Trades and the booklets were obtained having the interest of my students at heart."—James P. Jackson, Radio Division, Pittsburgh School of Trades, Pittsburgh, Penna.

* * *

"SINCE subscribing to RADIO NEWS, I will say there is no magazine on anybody's newsstand that fills the purposes of radio as RADIO NEWS does. Keep up the Service Bench; I always look for it first. Here is wishing you great success in the future."—W. C. Mathews, Bessemer, Ala.

* * *

AND our friends have not forgotten us, for coming over the Editor's desk are many letters such as this:



...past a
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...I have read this book
...over, and I say it is

...this oppor...
...acknowledge your publica-
...tion as the greatest aid to us in our
...work."—S. Lubin, International Radio
...and Music Stores, Ltd., Palestine.

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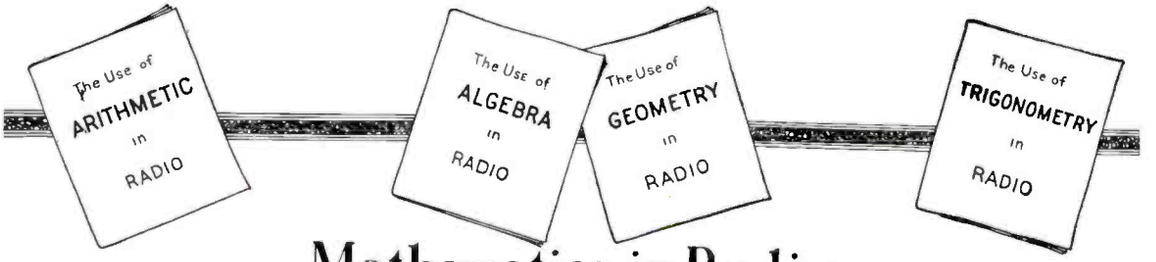

Mathematics in Radio

DURING 1931 there was published in RADIO NEWS a series of articles describing the use and application of mathematics in radio, written authoritatively by Mr. J. E. Smith, President of the National Radio Institute, of Washington, D. C.

These articles begin with the simple rules of Arithmetic, and extend through Algebra, Geometry, and Trigonometry. Each subject is treated carefully, and in simple terms, clearly illustrated with easy-to-read diagrams and charts.

At the insistent request of our readers, we have arranged to have these articles reprinted in booklet form, one booklet of each subject. We are now prepared to offer the complete set as illustrated above FREE with each subscription for RADIO NEWS for 11 issues at the special price of $2.

***Special Offer No. 1*—"Mathematics in Radio" FREE with 11 issues of RADIO NEWS for $2**

Special Offer No. 2

101 Radio Hook-Ups — Now 25c

Here's a big, attractively bound (Red Bristol) edition of the book that every man interested in radio has been eagerly looking for! As its name implies, this book contains complete diagrams and descriptions of the most popular types of receivers, short-wave transmitters, test apparatus and amplifiers or units thereof used in virtually every field of radio activity. Popular demand has resulted in the publishing of this edition, priced to meet the current market.

Special Offer No. 3

101 Radio Hook-Ups (*FREE with subscription for* RADIO NEWS *for next 5 issues*) *for* **$1**

Special Offer No. 4

Short-Wave Manual — Now 25c

(*Regular price 50c*)

Experience the thrills of the Short Waves—of hearing Europe, Africa or Australia, direct as clearly as native stations. This big book, replete with illustrations and how-to-build diagrams and plans crowded with 28 chapters by foremost S-W authorities, represents the last word in authentic S-W data. Brings you more information than books selling at ten times its price.

Special Offer No. 5

Short-Wave Manual (*FREE with subscription for* RADIO NEWS *for next 5 issues*) *for* **$1**

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(*Regular price 50c*) — **Now 25c**

If you own a radio, you need this book. Everything you want to know about radio is in it, from "How to Kill Outside Radio Noises," to a clear description of the newest tubes and how to use them. If you have a question on radio, here is your answer and a thousand more. 96 illustrated pages. Large, 9 by 12 inch size. Beautiful colored cover.

Special Offer No. 7

This book FREE with subscription for RADIO NEWS *for next 5 issues for* **$1**

Special Offer No. 8

Short Waves, by Leutz — Now $1.50

(*Regular price $3*)

This is the most complete book on short waves yet issued, published by Charles R. Leutz and Robert B. Gable. The chapters on the propagation of short waves and directional antennas with their applications to the transatlantic radio links are the most complete of any yet available in book form. Skip distance, useful range and how they are affected by day, night or season are exhaustively treated. Amateur and broadcast equipment, airplane radio, television and medical applications are among the other subjects covered. All the latest systems for the guiding of airplanes in fog, American and European television systems, the bloodless electric knife and many other late developments have here been brought together for the first time in a single volume.

Special Offer No. 9

How to Make Money in Radio Servicing

Written by Zeh Bouck, especially for RADIO NEWS, this book is the answer to the burning question of the hour. Prepared after months of effort, and at great expense, it tells the radio serviceman how to make his business show a profit. And what is more important in times such as these?

The active serviceman, and also the amateur experimenter who desires to turn his knowledge and experience into practical money-making channels, will find this book indispensable. It tells you how, and when, and why to do things. It is practical, up to the minute, and complete.

This book is not for sale at any price. But, you do not need to pay for it—it is our gift to you, with a specially reduced price subscription for RADIO NEWS for the next 7 issues at $1. You save 75c over the newsstand price of the magazines, in addition to securing this book without extra cost.

Special Offer No. 10

Advertising Mat Service — $1

Servicemen and dealers will find the mats (nine in all) included in this advertising service will be very helpful and a big saving in connection with their newspaper advertising work. Each one of these has been tried and proven. For full description see page 951, in the May, 1932, issue of RADIO NEWS.

Special Offer No. 11

Radio Trouble-Finder — Now 15c

(*Formerly 25c*)

If you do not have a copy of this book in your radio library, here is your chance to get one at a saving. The Trouble-Finder is worth its weight in gold when your radio fails to perform when a big program is on. It tells you what to do to quickly find and repair the trouble.

Special Offer No. 12

23 Lessons in Radio (*With the next 7 issues of* RADIO NEWS) *for* **$1**

Radio men, young and old, needing a reference book which contains the fundamental principles of radio—more experienced men wanting the latest dope on the essentials—all will find "23 Lessons in Radio" the answer!

A Few of the Subjects Covered:

Elementary Radio Theory—The Detector Tube—Construction of a Two-Stage Audio-Frequency Amplifier—How the Radio-Frequency Amplifier Works—A Short-Wave Receiver—Principles of Transmitting and Receiving—Complete Chart of Standard Radio Symbols—How to Build R.F. Tuner—A Three-Stage Resistance Coupled Audio-Frequency Amplifier—The How and Why of B-Power Units—Breaking Into the Amateur Game—A Code Test Outfit—Circuit, Constructional and Operating Details of a Low-Power Transmitter—How the Vacuum Tube Works—Battery Construction Details—How to Analyze Receiver Circuits.

RADIO NEWS, Dept. 12, 222 W. 39th St., New York, N. Y.

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

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to get into Radio quickly how to get better jobs-better pay

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"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 your school."—J. G. Dahlstead, Radio Station KYA, San Francisco, Cal.

Radio Service Man Doubles Salary

"I spent 15 years building and repairing Radios, but felt I could refresh my memory and learn about developments I had overlooked. Upon completion, I was appointed Manager of the Service Department of Parks & Hull, and was immediately repaid for the cost and time spent in study. I give the N. R. I. full credit for my success in the Radio field—it immediately increased my earnings 100%."—J. K. McLaurine, 1511 Guilford Ave., Baltimore, Md.

From $10 to $50 a Week in Spare Time

"Besides being employed by the Power & Light Company to locate Radio interference in this district, which is a very good position, I have a service business of my own that nets me from $10 to $50 a week in spare time. I owe all my success to the National Radio Institute, as I was only a common factory worker before taking the course."—H. L. Penie, 812 W. High Street, Piqua, Ohio.

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. In a period of nine months I have made at least $3,500."—C. J. Stegner, 28 So. Sandusky St., Delaware, Ohio.

gineers, 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. Radio operators on ships enjoy life, see the world, with board and lodging free, and get good pay besides. 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 it at once. Just clip and mail the coupon.

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Hold your job. There is no neeed 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

I'll give you more training than you need simply to get a job—I'll give you your choice, and not charge you extra either, of my Advanced Courses so that you may SPECIALIZE in 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.

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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 you Get my book AT ONCE

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 what my graduates are doing and making, where the good jobs are in Radio, 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. 2NR, NATIONAL RADIO INSTITUTE
WASHINGTON, D. C.

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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.

I have doubled and tripled the salaries of many. Find out about this tested way to BIGGER PAY

Get a Job with a Future

FILL OUT AND MAIL THIS COUPON TODAY

J. E. SMITH, President
National Radio Institute, Dept. 2 NR
Washington, D. C.

Dear Mr. Smith: I want to take advantage of your Special Offer. Send me "Trouble Shooting in D.C., A.C. and Battery Sets," 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 places me under no obligation.

Name.....

Address.....

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

"M"

The Famous Course That Pays For Itself

Radio Broadcasting on Trial

Who is to be the ultimate judge of the types and varieties of broadcast programs in America? This question is easily answered if one considers to whom the broadcasts are directed. Of course, the ultimate judges of broadcast programs are the listeners themselves, and if the programs are not such as to interest, educate and entertain, the listener will no longer be interested and broadcasting must surely fail. Sustaining programs, as well as sponsored programs, must be stepped up in interest and variety if the future of this type of radio dissemination is to be a successful one.

Radio News

VOLUME XIV December, 1932 NUMBER 6

LISTENERS' SURVEY OF RADIO

An unprejudiced survey recently conducted by the author on behalf of an independent market research organization has uncovered some facts which should be of particular interest to all those concerned with the planning and production of sponsored programs. Some of the major findings are set forth here, together with a few of the charts and tabulations taken from the complete report

By Affie Hammond

ALMOST every day broad assertive statements concerning the public's reaction to radio programs appear. The basis upon which these statements are founded is usually clouded in mystery. Are they "psychic" revelations of those who see a menace to their own interests in the success of radio as a medium of exploitation, or are they conclusions drawn from study of facts scientifically obtained from the listeners themselves? Do they express a cross-section of the opinions of the radio audience or do they merely express the preconceived ideas of a few who presume to interpret the tastes of *all* listeners?

Derogatory statements of these kinds, concerning the effectiveness of radio as a medium, are doubtless swallowed "hog-whole" by many, including some disappointed sponsors of unsuccessful radio programs who have not seen results increase to the extent they anticipated when they decided to "go on the air." It is obviously unfair and dangerous to accept, without question, these reflections upon the effectiveness of the newest and least understood of all mediums for reaching the public.

"Radio listeners are not 'up in arms' against advertising on the Air simply because it is advertising. . . . They do resent radio advertising practices that are abusive to common intelligence."

A radio columnist recently set forth the argument that the difficulty of producing a program which would entertain and exploit while at the same time appealing to widely differing classes of listeners was turning sponsors back to the safer and more efficient mediums of exploitation. A scientific collector of facts and an unbiased interpreter of their significance, who has no axe to grind, feels called upon to challenge these "Doubting Thomases" who are so very obviously ready to condemn.

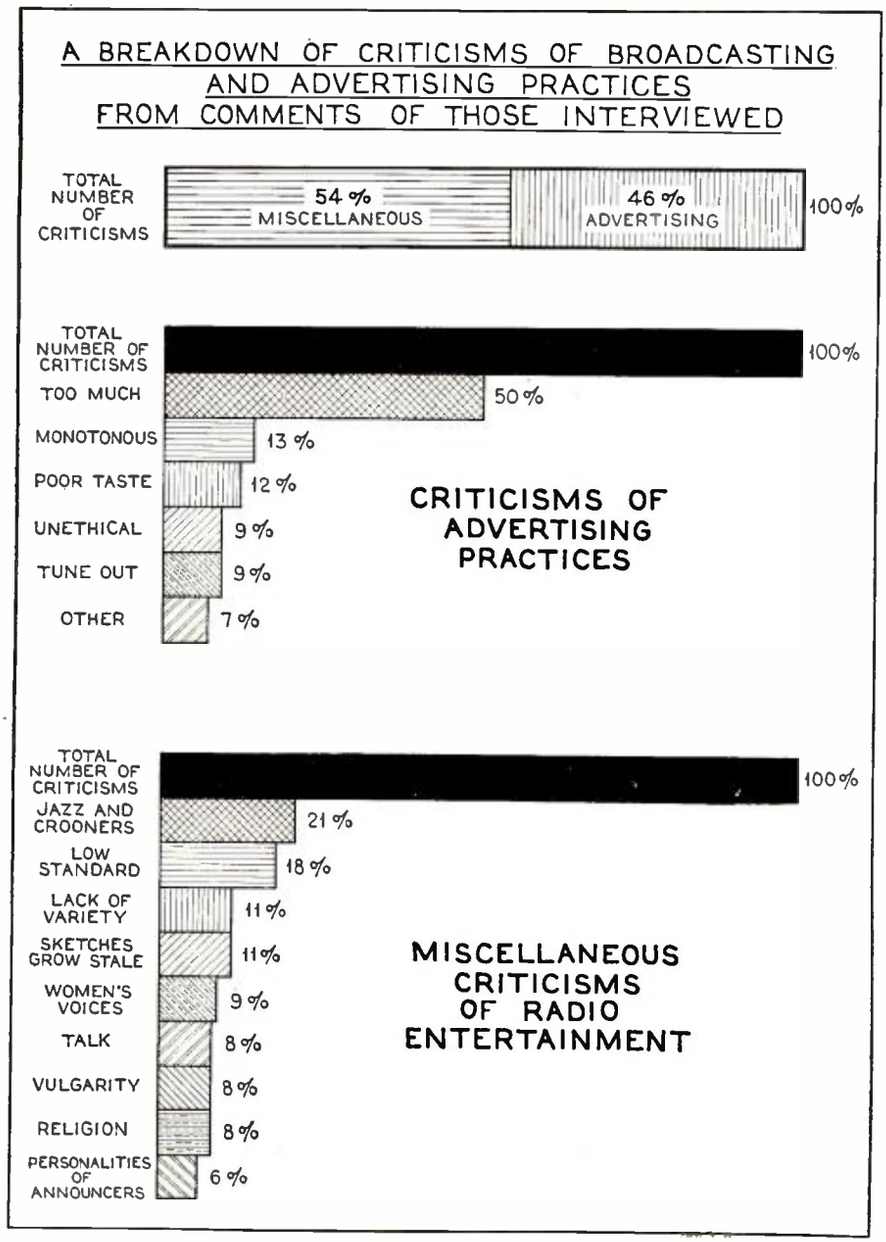
Perhaps the first step in following up the challenge should be in a bold discussion of the alleged shortcomings which have been checked up against radio. The first of which it stands accused is:

All inclusive coverage which creates the necessity of reaching all types of listeners by means of the same program; a difficulty stressed by this columnist.

It is pertinent to point out that certain types of newspapers and magazines go only into certain types of homes. An advertiser with a product having an appeal for a diversified market uses many of these mediums in order to obtain complete coverage. In the case of radio, sponsors are not so handicapped. They can *by giving their program a universal appeal* use the national networks and enter as many types of homes as are represented among radio owners throughout the country. It is true that no radio program on the air pleases every individual radio listener, but it is also true that no written material appearing in any medium is read and approved by every person who buys the medium.

By giving their programs a universal appeal—therein lies the problem of successful radio programs, commercial or otherwise. Sponsors acquainted with their unseen audience can meet this challenge and know the satisfaction of seeing their radio appropriations translated into increase response to their programs and in sales, if that is looked for.

The course of universal appeal is not uncharted. There



WHAT LISTENERS CRITICISE IN BROADCASTING

Figure 1. From this chart is seen that only 23 percent of the listeners who offered criticism of the broadcast fare directed this criticism at the amount of time consumed in advertising talk. An equal amount of criticism concerned the type and make-up of the selling talk and more than half of all criticism was directed at the program material itself

Radio history itself, short though it is, does not lack examples of programs which have won their success through achievement of universal appeal. This is indicated by the results of a personal interview survey among radio listeners of all classes. Those programs which rate highest in numbers of listeners are programs relatively high in favor among *all* classes. As we go further down the line in degree of popularity there is a proportionate disturbance of balance among the various classes of listeners.

Another criticism of radio as an advertising medium is:

> Listeners do not buy radios to "listen to advertising." They buy them to provide entertainment and education for themselves and their families.

This is no more true of radios than of newspapers, magazines and other mediums. There is no proof that the public buys these in order to read advertisements any more than there is proof that they do not buy radios in order to hear advertising.

Listeners' Views

In the survey previously referred to there is no definite indication that the radio listeners are up in arms against advertising, simply because it *is* advertising. Their criticisms are qualitative, quantitative and, on the whole, intelligent.

The chart shown in Figure 1 indicates the extent to which those interviewed criticised advertising by radio and explains the specific nature of their criticisms. A study of these criticisms indicates that the problem of achieving an advertising radio message acceptable to all listeners is a comparatively easy task.

To offset these criticisms of advertising are many expressions on the part of listeners to the effect that they believe sponsors who provide entertainment are entitled to time in which to put across their messages. It is also significant that *few* of the objectors to methods of radio advertising *are in favor* of a tax on radios or of government control or censorship. All they ask is a little restraint and consideration on the part of advertisers—a little more appreciation of the intelligence of listeners.

In connection with the plea of listeners for a little more

are classic examples of its achievement throughout the history of man's existence. Political success is often achieved by those who make themselves "all things" to "all men." What chance would a political candidate have of election if he were unable to sell himself and his platform to a nation made up of every type of voters? And how is he able to influence these voters? He knows their interests, their prejudices. He knows the universal characteristics of human beings which do not vary with class, creed or locale. If he knows these things sufficiently well he can steer a clear course.

Successful stage productions strike responsive chords in the hearts of those who sit in the galleries as well as in the hearts of those who occupy the choice seats.

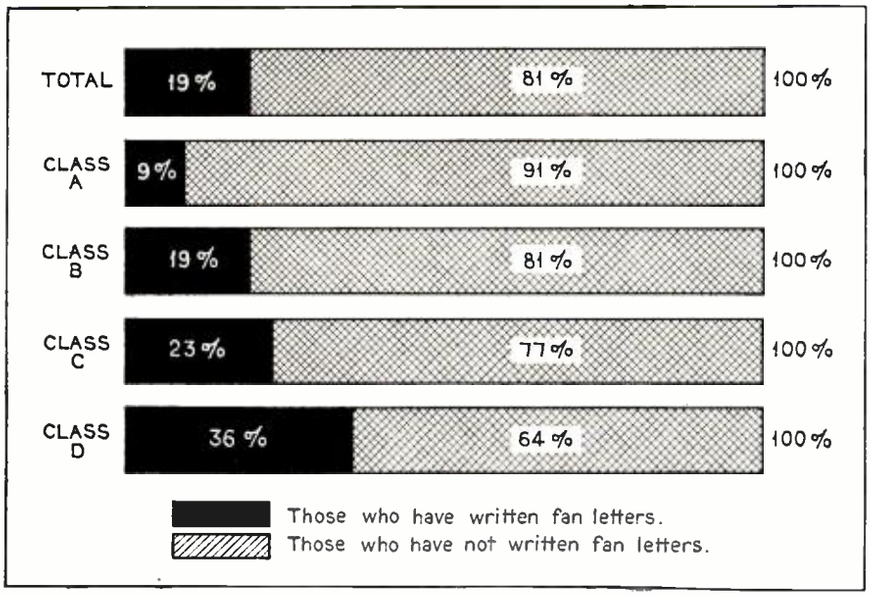
MAKE-UP OF THE RADIO AUDIENCE

Figure 2. During the past three years families with small incomes have been joining the radio audience in much heavier proportions than those with larger incomes. This is an important fact to those who are concerned in the presentation of sponsored programs. The income classifications are: A—Over $5000; B—$3000 to $5000; C—$1000 to $3000; D—under $1000

CLASS OF LISTENER	YEARS WHEN LISTENERS BOUGHT THEIR FIRST RADIO SETS										
	BEFORE 1923	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932
CLASS A	14%	2%	14%	2%	5%	15%	8%	22%	11%	2%	5%
CLASS B	10%	4%	7%	4%	5%	14%	8%	20%	18%	9%	1%
CLASS C	11%	1%	7%	5%	8%	24%	8%	15%	12%	8%	1%
CLASS D	3%	-	3%	-	3%	10%	7%	21%	38%	10%	5%

WHO WRITES FAN MAIL?

Figure 3. Only 19 percent of those interviewed have ever written a fan letter. Those with the lowest incomes are the most prolific letter writers—partly because radio is a more vital factor in their lives, and partly due to the prizes and sample products obtainable by writing for them. Obviously fan mail is not an entirely dependable barometer in judging the popular appreciation of a program because, as shown by this chart, it does not represent a true cross section of the radio public

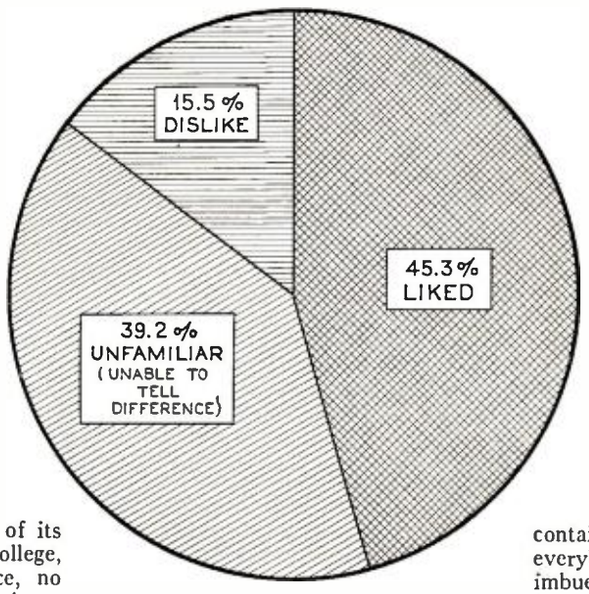


appreciation of their intelligence, the findings of this survey indicate that advertisers, in their desire to pigeonhole the public and put most of the inhabitants of this fair land away as morons, have classified even the morons as a bit more moronic than they are. Unless those who disseminate advertising propaganda wake up and use their own brains more than they are doing, conceivably, they may learn too late that their morons have evolved and squirmed out of their pigeonholes.

Times have been hard for most people during the last few years. Necessity has made the once-contented public begin to *think* in order to survive. Using any part of the body develops that member. This applies to that magnificent organ, the human brain. Full-grown bodies do not thrive on infant diet. Mature, normal minds do not accept childish or moronic ideas. The difficulty in radio advertising is not with the physical medium, but *with those who make misguided use of it!*

The following is a lucid example of misguided use of radio advertising: A large advertising agency turned over the entire management of the radio program of one of its clients to a youth, fresh from college, who had no advertising experience, no knowledge of dramatics and no experience with radio broadcasting. Result: the program was a flop. The sponsor, blaming radio, deserted the air waves forever.

Examples are plentiful of radio executives who, when they decide to go on the air, depend upon their personal tastes in entertainment to guide them in arranging their programs. Perhaps they go a little further and invite their friends—as like themselves as peas in a pod—to an audition and rely upon their reactions to guide them. This is much like adding ten ears of corn to ten ears of corn and expecting to get something besides twenty ears of corn.



ELECTRICAL TRANSCRIPTIONS

Figure 5. A few years ago the broadcast of phonograph selections was heartily disliked. Today 85 percent of the listening public like them as well or better than other programs. The remaining objection is probably the result of the few stations which have not installed modern equipment for reproducing the recorded programs

Others rob radio entertainment of freshness and interest by *copying successful programs already on the air!* The result is that their programs are so like others that it is beyond the powers of listeners to remember who sponsors which or how! Still others, in an effort to achieve universal appeal, devise a hodge-podge program partaking of the successful elements of many programs. They think they will thus achieve variety and so attain the interest of all types of listeners. The result is that the programs have no definite character of their own and contain something which may cause everybody to tune out. And yet others, imbued with the idea that listeners object to advertising on the radio, employ the expedient of acting as if they, too, think advertising a "lot of hooey" and so engage a comedian to kid the advertising. This practice takes away the dignity due the sincere exploitation of any meritorious product. The listeners may get a kick out of the program, but it is doubtful whether they are moved to go out and buy the brunt of the comedian's jokes.

Other advertisers apologize for intruding on the listeners' time and thus put into their minds the idea that they are being imposed upon. In a breathless voice, like a child speaking out of turn, the announcer (*Continued on page* 372)

METHODS USED BY THOSE INTERVIEWED IN SELECTING PROGRAMS	CLASS A	CLASS B	CLASS C	CLASS D
NEWSPAPER LOGS	73 %	64 %	44 %	34 %
BY GOING AROUND THE DIAL	45 %	41 %	41 %	44 %
OTHER MISCELLANEOUS METHODS	1 %	8 %	3 %	3 %
(Some gave more than one method)				

HOW PROGRAMS ARE SELECTED

Figure 4. In general the newspaper program pages are the most commonly used means for program selection. However, the proportion of "dial twisters" is still quite high, particularly in the lowest income group, where newspapers are not so commonly found in the home. It appears that where newspapers are available they constitute the most popular reference

In Memoriam

Reginald Aubrey Fessenden

On July 22, 1932, in Bermuda, there passed away this great scientist, radio pioneer, inventor and deep thinker. Outside of scientific circles, where he was well known, little was heard of Fessenden, as he was of a retiring nature and would rather let his accomplishments speak for themselves

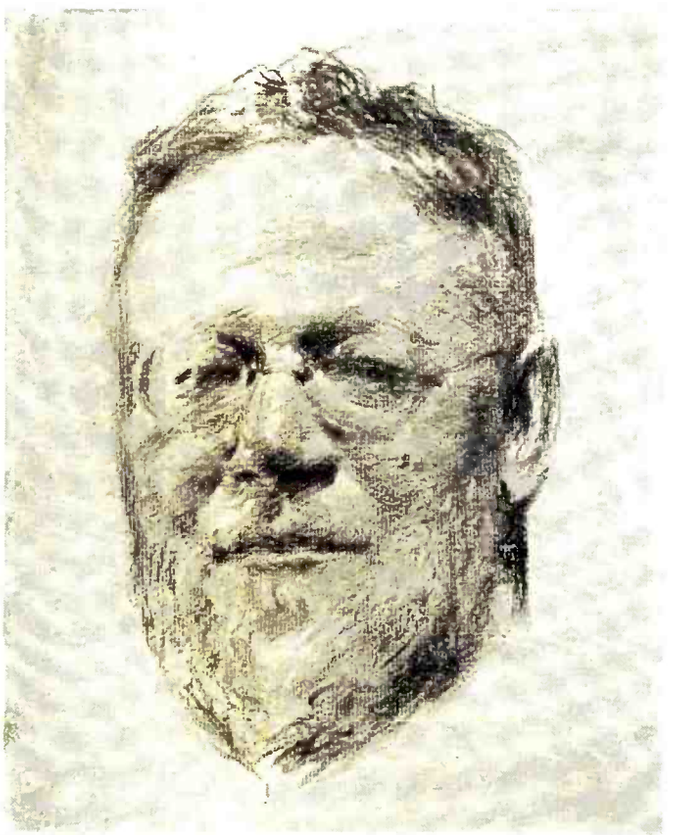
REGINALD AUBREY FESSENDEN was born of stern New England stock in the little town of Milton, Province of Quebec, Canada, on Oct. 6, 1866. Although born in Canada and living in Bermuda for a considerable period Fessenden never relinquished his American Citizenship and made many valuable inventions for the use of his Country. His Summer home in Boston was a rendezvous of the technical and financial brains of America. After his early education he graduated from Bishop's College, his father's Alma Mater, in the Province of Quebec and from 1885 to '86 was principal of the Whitney Institute of Bermuda. A little figuring will show what a young man he was to be principal of an established school. During the period of 1887-90 he was head chemist of the Thos. A. Edison Laboratories, leaving there to become from 1890 to '92 electrician for the Westinghouse Company of Newark, N. J.

Man and Scholar

His love for educational work again asserted itself and he became Professor of Physics and Electrical Engineering at Purdue University from 1892 to '93. He became Professor of Electrical Engineering at Western University of Pennsylvania from 1893 to 1900.

Entering Government Service he became from 1900 to 1902 Special Agent in the U. S. Weather Bureau in charge of Investigation of Wireless Telegraphy and the daily collection of weather reports.

From 1902 to 1910 he was General Manager of the National Electric Signalling Co. which controlled the famous Fessenden System which was able to compete with the then established wireless companies and showed several marked advantages without infringing existing patents. In fact, an examination of the U. S. Patent Office will show over 500 patents issued to him, and that he is well up among the first ten individuals holding the most patents.



DISTINGUISHED RADIO PIONEER*
1866 1932

Since 1910 he had been Consulting Engineer for the Submarine Signal Co. and had been active until the end.

While in Bermuda he met the girl who was later to become his wife and they were married in 1899. One son, Reginald Kennelly Fessenden, was born of that marriage which through all the years has always been a beautiful association.

Fessenden was a man of imposing appearance and was never forgotten if you once met him. He was well over 6 feet tall with sandy hair and Van-Dyke beard, which in later years was pure white and added dignity to his appearance. He was an advocate of the white suit and black-lined Inverness cape from his long residence in Bermuda and he often was so attired on his trip to the states. His entrance into a crowded restaurant in New York City brought all eyes his way.

A Keen Analyst

His kindly blue eyes, and keen mind were felt immediately when in his presence. His grasp of a problem was enormous and he quickly absorbed all phases of the problem and then drew on his enormous store of knowledge so rapidly that he seemed to make snap judgment answers to problems. Usually after long research on a line that was new to you, it was found that he was right and had hit on the simplest method of approach.

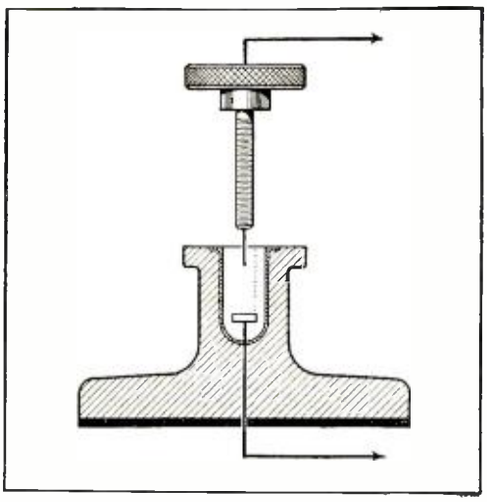
The following resume of a few of his patents is not in any way complete but is included to show the wide range of science he was familiar with. Early in the radio art Fessenden found that the telephone receiver was more sensitive at about one thousand cycles than on the low rough frequencies then in use. He conceived the idea that if he could make his transmitter emit a musical note he would be able to cover longer distances and partly overcome static. He conceived the whole theory of the synchronous rotary gap, where the wheel carrying the spark electrodes was mounted on the generator shaft in such a manner that the spark discharge took place at the peak of the voltage. He foresaw that he must so design the generator and transformer that when the

* Drawing reproduced through courtesy of David L. Hardenbrook.

spark took place and short-circuited the transformer the secondary voltage immediately dropped to zero. This quenched the spark and in consequence it was ready for the next discharge. The early Fessenden sets were remarkable for their bell-like tone and distance-carrying ability.

Early Inventions

Fessenden's first great invention in the radio art was his discovery of the electrolytic detector, which was much more sensitive than existing detectors of the time and had the ability of keeping its adjustment for long periods. To show the way Fessenden's mind worked when confronted by this problem, he conceived the idea of rectifying by dipping a fine point into a dilute acid solution at the same time applying a low potential across the junction so that electrolysis would cause a bubble to form over the electrode that would be broken down by received signals. He found that the area of the wire dipping into the acid had a marked effect on the sensitivity of the detector. After experimenting with various wires he decided on a platinum wire as it was acid proof. He was unable to get platinum wire less than one one-thousandth of an inch in diameter, so he suggested that this fine wire be heavily plated by silver and again passed through a drawing die. This resulted in the birth of Wollaston wire. When the silver coating was dipped in nitric acid, the silver dissolved and left the fine platinum wire one-ten-thousandth of an inch in diameter, ready for use.



EARLY INVENTION

Diagrammatic sketch of one of the inventor's developments used in the early stages of wireless telegraphy—the so-called "whisker point" electrolytic detector

Among Fessenden's Inventions

FESSENDEN conceived the idea of the synchronous rotary gap emitting a high musical note, the electrolytic detector, the high-frequency alternator, radio telephony (1906), the heterodyne, systems in microphotography, long playing phonograph records, picture transmission and reception, television without scanning discs or cathode ray tubes, submarine signalling systems and depth finders, turbo-electric and diesel-electric drives for battleships, automatic parking systems for garages, and hundreds of other inventions in varied fields.

The first order for high-frequency alternators was placed by Fessenden with the General Electric Co. and a then young engineer by the name of Alexanderson was assigned to the development of the alternator. Alexanderson so improved his design in later years that he was able to build 200 kw. alternators, and until the advent of the vacuum tube, these alternators proved to be the most reliable method of transatlantic communication.

Transoceanic Radio

Fessenden describes, in a paper before the A.I.E.E., radio telephony between his famous Brant Rock station and Jamaica, N. Y., in the year 1906. On telegraphy, he regularly communicated with Scotland. He is often credited as being the first to transmit radio telephony and telephoto or pictures.

Fessenden is the inventor of the hetrodyne, the principle upon which all modern superhetrodyne broadcast receivers as well as all carrier current systems are based.

He was a great exponent of methods of storing knowledge and he was well versed on microphotography. Several patents have been issued to him covering systems of reproducing pages of a book on a space about the area of a pin head and a method of producing phonograph records that will run 15 minutes on a 1½-inch diameter record.

Television

At the time of his death he was trying to promote a system of television that he guaranteed results with. He used no scanning discs or cathode-ray tubes. This shows his usual independence of recognized methods of attack.

His methods of submarine depth finding are well known and are now used by nearly every Navy in the world. His system operates on the principle that the ship sends out a signal that is reflected back by the ocean bottom or any intervening obstruction. The time interval between the time of sending the signal and the reception of the reflected sound enables the navigator in time of fog or clear weather to plot his course. Variations of this system are used for locating submarines and the location of ore or oil deposits.

He was inventor of the turbo-electric and Diesel-electric drives for battleships.

As head of the Canadian Commission for Generation and Distribution of Electricity generated at Niagara Falls, he laid out this gigantic system.

Several antenna patents were issued to him, such as shooting a stream of water vertically into the air; the wave chute; half-wave antenna where the mast of proper height is the only antenna used, no wires being part of the antenna.

He was greatly interested in archeology and geology. His patents covered such a wide range of subjects that it would take a good-sized book to do justice to all of them.

Within the last few years Fessenden won a settlement of $2,500,000 from the largest communication concerns in the world for infringement of his patents and he also won a case against our government for use of his patents during the War. Hundreds of other patents of this great inventer form the nucleus for many large and important corporations in the radio field.

Radio mourns the recent loss of this great mind whose contributions to science in general and radio in particular will be greatly missed.

Morton W. Sterns.

INVENTED BOOK THAT READS ITSELF

To quote part of the first paragraph of Fessenden's patent taken out in 1920, drawings of which are reproduced below: "My invention relates to methods and apparatus for recording and reproducing language and pictures and the like, and more particularly to recording and reproducing books. . . . Such reproductions are entirely permanent and durable in contradistinction to the present methods of printing on paper"

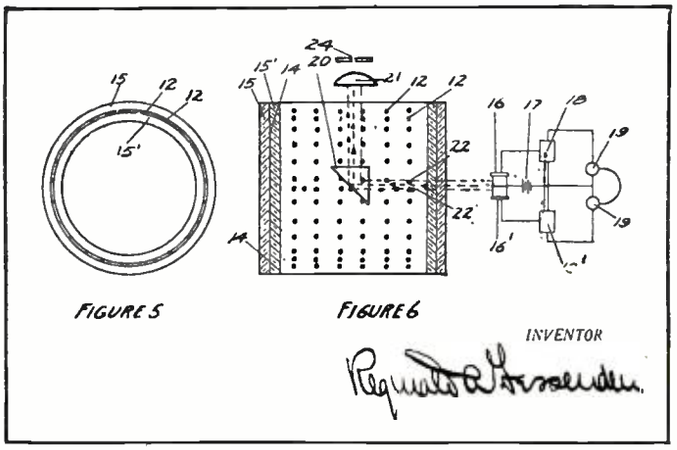


FIGURE 5 FIGURE 6

INVENTOR

Reginald A. Fessenden

Equipment and Technique for

HOME RECORDING

The author, in this series of articles, offers innumerable hints and suggestions concerning proper equipment and best practices for successful home recording. This material is all highly practical, being based on extensive experience in this field

By Lt. Wm. H. Wenstrom

Part One

TECHNICAL hobbies are most interesting when they include some elements of originality and self-expression. Nowhere in the amateur radio-audio field are the opportunities for creative artistry more abundant than in home recording. And in addition, it provides microphone experience of distinct value to anyone who expects to enter the broadcasting or sound-picture industries. Recording demands, at the outset, certain apparatus which must be up to definite standards if satisfactory results are to be obtained. Beyond this irreducible medium, an amateur can elaborate his equipment to any extent that his inclination, ingenuity and purse may allow.

One must have, first of all, a thoroughly good electric phonograph, home or factory-made, which is used for playing the records after they are made. As shown in Figure 1, most of the units in this playing equipment, together with a few additional devices, are used in recording. Let us look first at the various familiar playing units from record to loudspeaker. Next, we can examine the additional equipment used in recording. While the writer's apparatus, homemade where possible, will be described in some detail, it is intended to serve only as a typical example, rather than as a precise model to be followed exactly by experimenters who may well have ideas of their own.

No audio system is better than its worst link. This is particularly true in home recording, because most of the links are used twice—once in recording and once in playing. No link in either process is more important than the record itself.

Many types of records are on the market. The writer has used most of them at one time or another, but one type of record now on the market (with its associated recording and playing needle) is plainly so good that other audio links such as amplifiers and loudspeakers must be excellent indeed to bring out its best qualities. As this type of record definitely fulfils the requirements, the writer uses it exclusively.

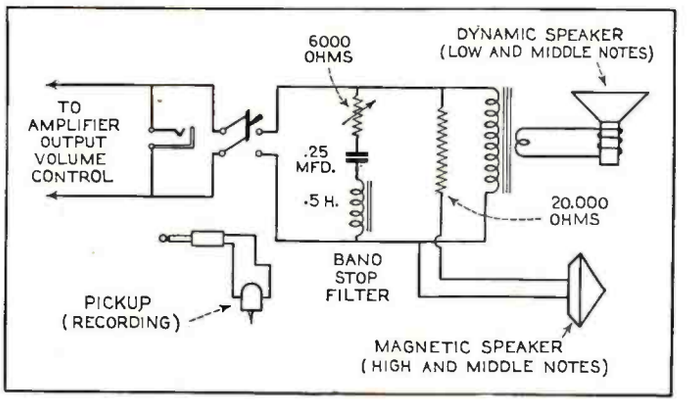
This standard disk is the Victor home recording record blank, available in two sizes through RCA-Victor dealers. At 78 r.p.m. each side of the six-inch disc, which costs 25 cents, plays one and one-quarter minutes; the ten-inch disc costs 50 cents and runs three minutes per side. Both types can also be used on new 33 r.p.m. turntables, greatly extending the time. The record is made of black composition similar to that used in regular records, each side is pregrooved to take the special needle, and the whole is made light and thin enough to be easily mailable if one wishes thus to send a personal message to a friend.

The special Victor home-recording needle is distinguished from regular record needles by its red shank and its rather blunt chromium-plated point. A card containing eight needles, obtainable at stores dealing in the records, costs 25 cents. The useful life of a needle, which should be used for both recording and playing (with this type of record only), is between 6 and 25 records. Recording wears the needle considerably more than playing.

From the playing viewpoint, the next piece of apparatus after the record is the phonograph pick-up. The function of this device is to convert the mechanical vibrations of the needle, occasioned by record-

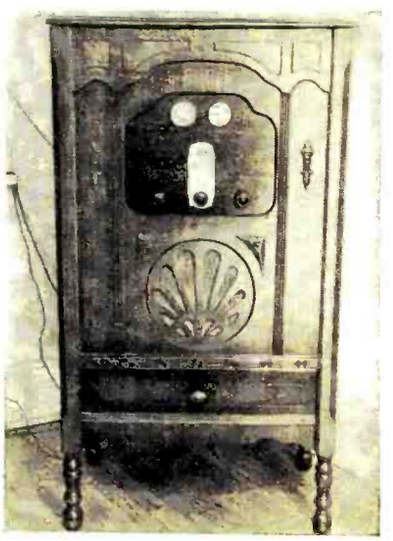
LOUDSPEAKER AND TONE FILTER SYSTEM

Figure 4. The author uses a dual speaker arrangement and special filter system for playing back. In recording the tone filter is not required



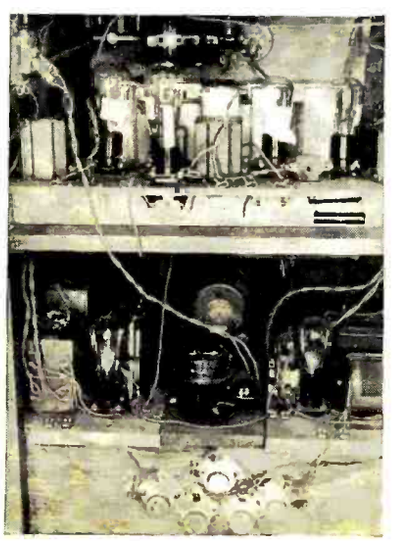
FRONT VIEW

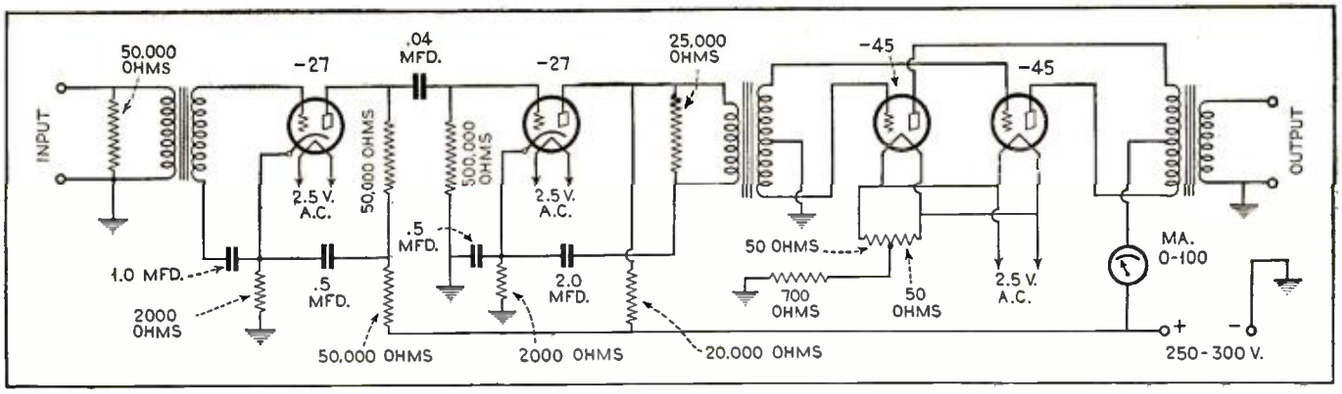
This console houses the radio tuner, phonograph mechanism, and all other equipment. The turntable, switches, jacks, etc., are all accessibly located under the top cover.



REAR VIEW

Above are the phonograph motor, radio tuner and main amplifier. Below: The loudspeaker, band-stop filter and separate power supplies for tuner and amplifier



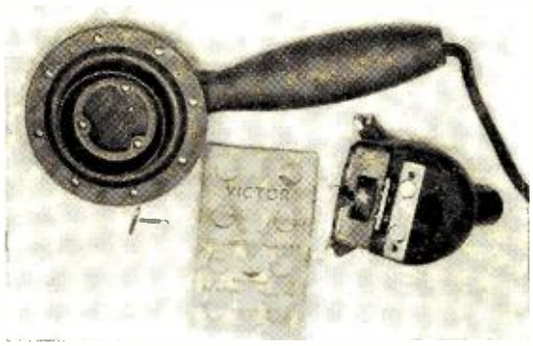


ed irregularities in the record groove, into audio-frequency electric currents which can be suitably amplified. There are many satisfactory makes on the market. The writer has used a Stromberg-Carlson unit for some years. The RCA-Victor unit used in standard commercial radio-phonographs is also excellent and can occasionally be obtained quite cheap ($6.50) from some large mail-order radio houses One can gain a rough idea of the tonal range of a phonograph pick-up by connecting it, together with suitable impedance-matching transformers or resistances, across the loudspeaker of an excellent radio set. If the tone quality of the output is very noticeably impaired, particularly in the low-frequency region, the pick-up is not what it should be. For playing, the effective weight of the pick-up and tone arm should be just sufficient to hold the needle in the groove—to prevent it from jumping grooves, that is—without pressing it down to the point of impairing tone quality. For recording, as will be shown, more pressure is necessary.

The electrical output of the pick-up is fed to the audio amplifier, which should have considerable gain, ample undistorted output capacity (4 to 5 watts on peaks) and excellent tonal range. The writer's "main amplifier," as shown in Figure 2, is a transformer-resistance-push-pull combination, giving somewhat more gain than two transformer stages alone, and somewhat less gain, with better quality and stability, than three transformer stages. In the last stage two type –45 triodes, biased approximately Class A, are used in preference to pentode or Class B combinations in order to avoid harmonic and other distortion. As the amplifier has plenty of gain for playing either phonograph or radio music, resistances are connected across transformer primaries to flatten their frequency characteristics. In addition, short-path bypasses are provided for the audio-frequency currents in the grid and plate circuits of each tube, which thus need not flow around long, interacting external paths. Finally, direct current is excluded from all single-winding transformer primaries with a view toward keeping their operating inductance as high as possible. The result of these precautions is that the tone fidelity is very good indeed. Grid bias for all tubes is secured from the 250-300 volt d.c. plate supply in the usual manner. (*Continued on page* 383)

THE MAIN AMPLIFIER

Figure 2. The three requirements of good quality, ample power output and high gain are provided by this amplifier, which is used by the author

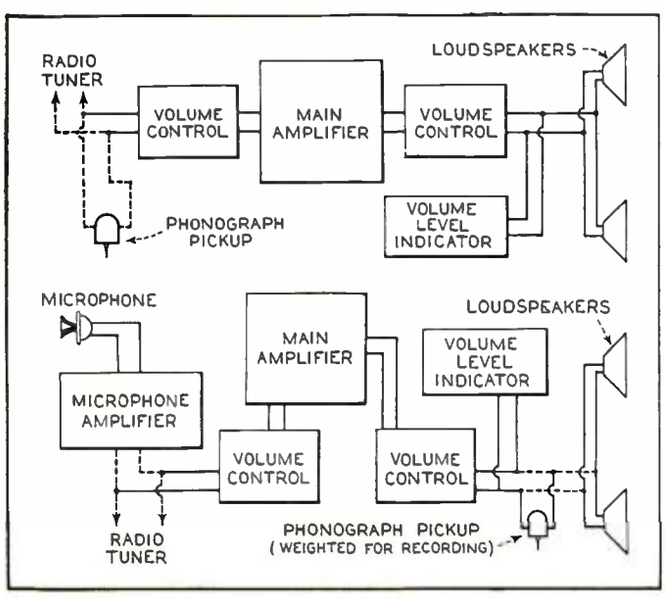


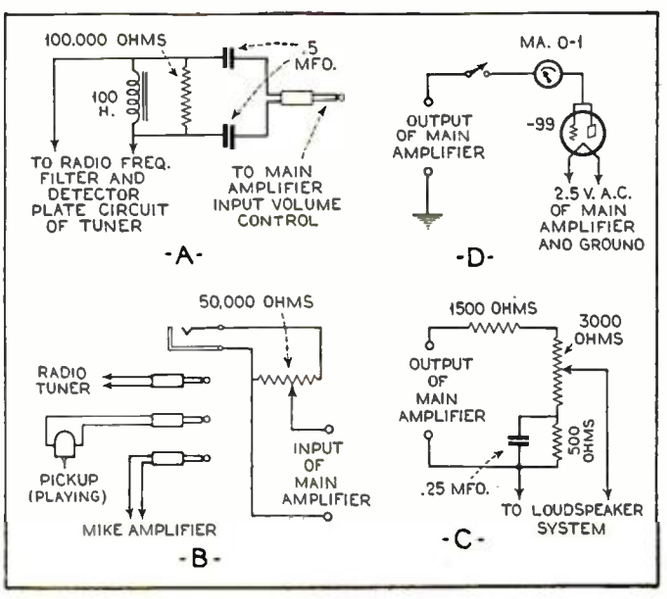
RECORDING ACCESSORIES

The pickup is shown with cover removed. Partly visible beneath it is the metal weight which rests astride the pickup when using it as a cutting head. A hand microphone (R.C.A.-Victor) is shown, and also some needles of the recommended type

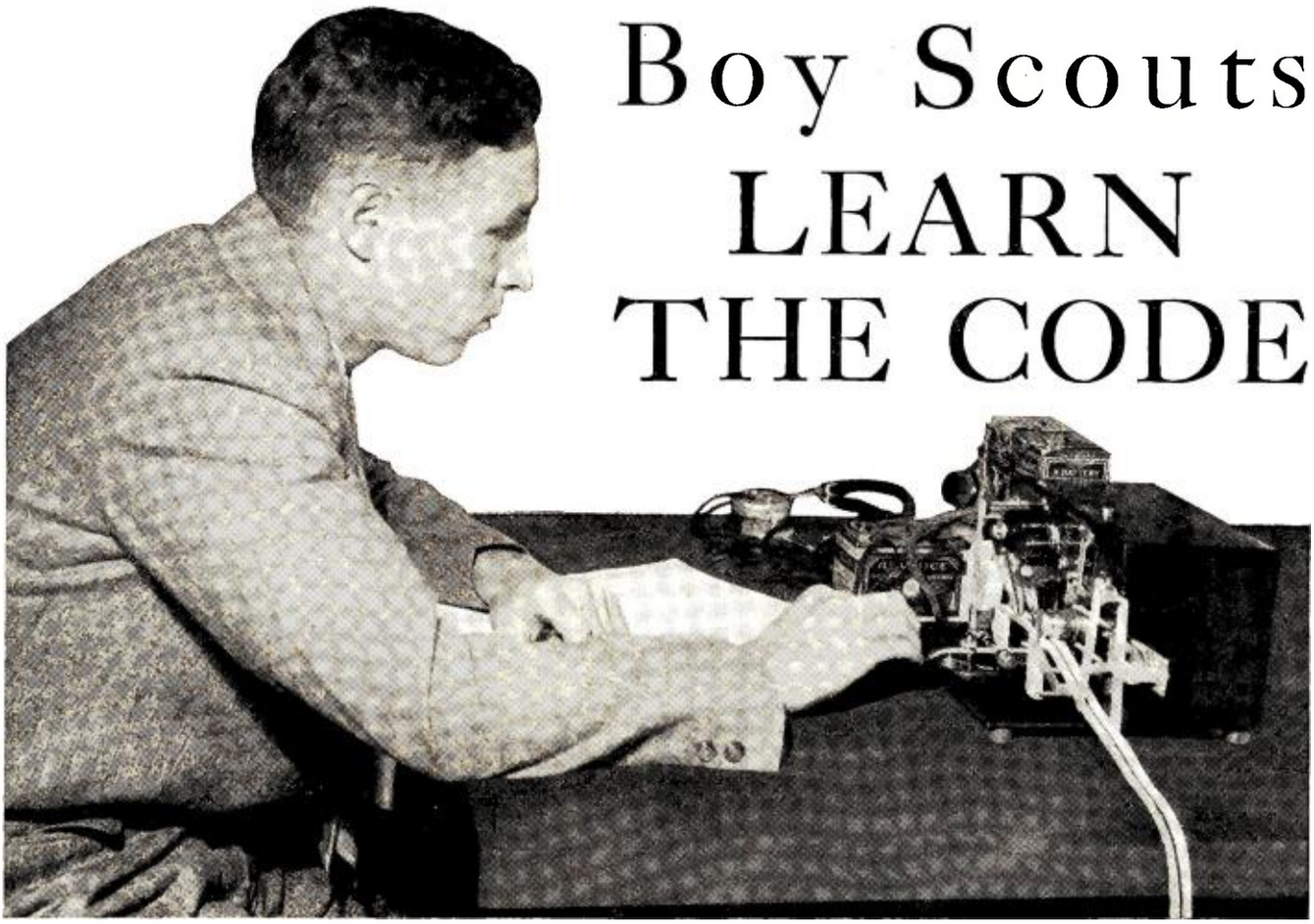
CIRCUITS FOR RECORDING AND PLAY BACK AND DETAILS OF COMPONENTS

Figure 1. (Left) The various units shown in the play back circuit (above) and the recording circuit (below) are discussed in the text. Figure 3. (Right) (a) Shows method of coupling a radio tuner to the main amplifier through the input volume control circuit (b). (c) The tone compensating output volume control which follows the main amplifier. (d) Circuit of the simple volume level indicator



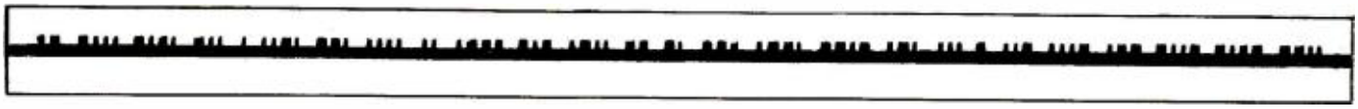


Boy Scouts LEARN THE CODE



THE TAPE RECORDER

The new Master Teleplex and below is a sample tape upon which the aplhabet has been recorded



An electro-mechanical device which enables the beginner to effectively and quickly master the code at home

By Frederick Siemens

THERE are very few young men who at some time during their life have not been fascinated by the mysterious dots and dashes of the telegraph code. And it is far from the mark that only boys are interested in code. Many of our wealthiest men, holding enormously responsible positions, have their own radio shacks where they spend many fascinating hours communicating with ordinary "hams" in all parts of the globe. But it is equally true that every growing boy, and especially the Boy Scout, should learn the code; it may be useful and even save life at some time in the future.

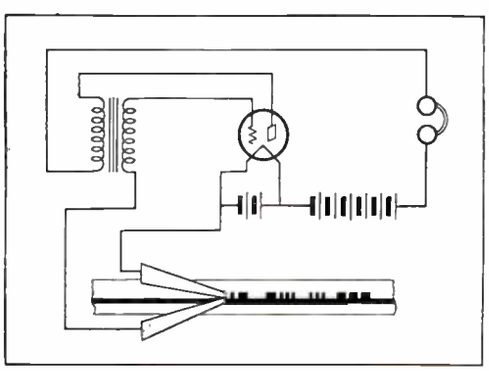
In the beginning, Morse signals were sent over the land-line and recorded by embossing them on a strip of paper. It was purely accidental that the art of receiving the signal by sound was discovered. Some of the old-time operators, after watching the recording for many years, found that they could read the signals by the sound of the electromagnet. That was the beginning of "reading" by sound.

In radio, the sound is somewhat different from the signals over the land-line, since the receiving operator hears a sustained musical tone which has the duration of the dots and dashes. In the land-line system there is a click at the beginning and end of each dot or dash.

Beginners have usually had to learn the code by having an experienced operator send to them. If the teacher happened to be a poor operator—and some of them were—the students had a hard time of it and were greatly handicapped.

THE OSCILLATOR

Figure 1. The hookup is familiar to every amateur. The grid circuit is closed by the inked dots and dashes

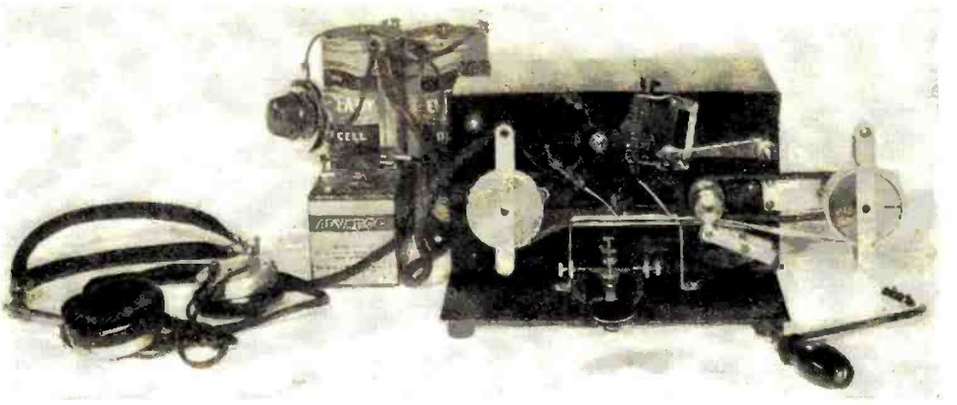


Automatic senders have come into use which served to insure perfect signals and to eliminate the necessity of having an operator present all the time. Yet, although these devices have been of great help, it was practically impossible to do away with hand-sent signals altogether. This made it necessary for students to attend a resident course or to find someone who could send to them.

Some years ago Miller invented the Teleplex, which has become the most popular of the mechanical devices. This instrument still had the disadvantage that one was limited to the tapes which could be bought. The making of tapes required a rather complicated apparatus which is too expensive to be owned by the average student.

Now Miller has invented a new device, which he calls the Master Teleplex. This instrument records the signals on a tape with a pen instead of perforations, and the student can make his own tape as well as run them off with the same instrument.

The Master Teleplex, therefore, gives an unlimited variety of possible tapes, and it can be employed for the learning of sending as well as receiving. It is ideal for learning the code and every Boy Scout troop should own one.



WHAT THE "WORKS" LOOK LIKE

Complete equipment necessary for the recording and reception of code signals

The Master Teleplex contains a spring-driven mechanism which moves a paper tape at uniform speed past a pen. This pen normally rests on the middle of the tape. When the sending key is pressed, the pen is moved sideways by an electromagnet. Before starting the recording of a message, the entire tape is run past the pen so that a single straight line is made at the center of the tape. Then the tape is ready to receive its message. The pen will retrace the previous line, but when the key is presed the signals are formed and the tape looks like that shown on the front cover of this issue.

The spring of the magnet and the distance can be so adjusted that it will follow the highest speeds an operator can send. We are told that a speed of 70 words per minute—delivered by a machine—was recorded perfectly.

Conductive Ink Employed

But now comes the important part of the story. The ink used is a conductive compound. In "playing back," the tape is run under a set of two spring contacts; one of these runs over the steady line in the middle and the other covers the dots and dashes. It is easily seen that a contact is made every time a dot or dash passes under this second spring. When the two contacts are thus connected they close the circuit of an oscillator and the dots and dashes can be heard in the headphones. The diagram of this oscillator is reproduced in Figure 1. The clockwork, key, electromagnet and pen, as well as the oscillator, are included in the unit. The entire instrument is a compact unit made entirely of metal, as can be seen in the illustrations.

The speed of the tap is adjustable within rather wide limits; this enables the operator to run the machine at the desired speed. While receiving, the tape is rolled up on a second reel. Now, in order to use the tape again, it would have to be rewound, but here another novel idea comes in. Another message can be recorded on the same tape by having the pen move sideways toward the other side of the line. Rather than reversing the movement of the pen, the tape is reversed. This means that when once the tape has been used and wound on another reel, it is at once ready for the copying of the second message without rewinding. The same thing can be repeated on the reverse side of the paper, making, in all, four times that the paper can be used for recording.

COPYING RECORDED SIGNALS

The master teleplex reproduces the message exactly as it was sent, but the speed can be adjusted

In practice, mechanically perfect sending is seldom encountered on the air—unfortunately. The student who has learned his copying from mechanically perfect devices is going to encounter difficulties when receiving on the air. This device, however, records signals *as they are actually sent*, and the student will become used to the average type of signal.

Contrary to popular opinion, learning to send is far more difficult than learning to receive. This new device provides an excellent way for the student to test his own sending. Various charts showing good, fair and poor sending are furnished with the new Teleplex so that the student may easily and quickly compare his sending. For the beginner, mechanically perfect records are furnished by the makers of the device, enabling the student to get started in the proper manner. As he advances he can make his own tapes. After the student is able to make readable signals, he submits a specimen to the company, and he will be furnished with the addresses of other students owning the Master Teleplex so that they can exchange their tapes. In this way there is no limit to the variety of exercises available. The student can inspect his own signals by looking at the regularity of the lengths of dots, dashes and spaces or he can run it off and listen to the signals.

Tips on Recording

A few practical pointers on this recording will not be amiss. The ink furnished with the device is a special preparation which contains a metal compound and dries quickly. As you will notice in the picture which illustrates the use of the Master Teleplex when recording, the tape is then left trailing off the table. During the time it takes the paper to advance from the pen to the floor, the ink has dried. The paper cannot be wound on the reel immediately because this would blot the signals.

Ink is fed from an inkwell to the pen by a wick. The height of the inkwell is variable so as to regulate the flow of the ink. Further, the pen arm must be adjusted so as not to strike the magnet too hard, for that would throw the ink from the pen.

Not only beginners, but experienced operators, experimenters and amateurs will find many new uses for the Master Teleplex. A sensitive relay is available which will operate the recorder

(*Cont'd on page 377*)

A New Type of CONDENSER "MIKE" AMPLIFIER

THE ABSORPTION MICROPHONE UNIT

The standard 4½-inch aluminum box shield houses the head amplifier. The microphone mounted on the face is the Argabrite condenser microphone, constructional details on which were given in the April issue

A relatively new type of head amplifier for use with condenser microphones is described here. A single –30 type tube employed in this circuit replaces the two tubes normally used in pre-amplifiers

By Glenn E. West*

THE condenser microphone is considered by many authorities to be the best microphone obtainable. In broadcasting and recording work it has no equal, unless it be the new dynamic microphone. The clear, bell-like response of a condenser microphone can be detected almost instantly by the trained sound engineer. The lack of background noise as compared with the "frying" carbon hiss of the average carbon microphone makes the condenser type far more desirable.

The Absorption Amplifier

The condenser microphone does, however, have certain disadvantages, and some of them are serious. Chief among these disadvantages is the extremely low output. This makes it necessary to use an amplifier right at the microphone head. Such an amplifier is usually called a preamplifier or head amplifier, and consists of two or three resistance-coupled stages. Tubes of the low filament drain type are used, and the whole amplifier is usually housed in a metal cylinder or box which supports the condenser microphone head.

High-voltage B batteries are required to supply the condenser and preamplifier. From 180 to 450 volts d.c. are used on the condenser head and from 90 to 180 volts on the amplifiers, depending upon the type of tubes in use. These batteries must be first quality and free from creepage currents and other defects which might cause noise. A long shielded cable is required to connect the microphone and its preamplifiers to the battery box and output circuits. The upkeep cost of such batteries and amplifiers is a considerable factor, even though the B current drain is low.

The high cost of the condenser microphone has limited its use almost entirely to the broadcast studio and other commercial uses. A few amateurs have boasted of owning condenser microphones and they have been the envy of the whole amateur fraternity. Recently, however, amateurs have learned that a good condenser microphone can be made from the parts of an old magnetic speaker unit. Mr. Argabrite's microphone, described in the April issue of RADIO NEWS (with additional information on page 79 of the August issue), has proved to be so much better than expected that hundreds of amateurs are now making them.

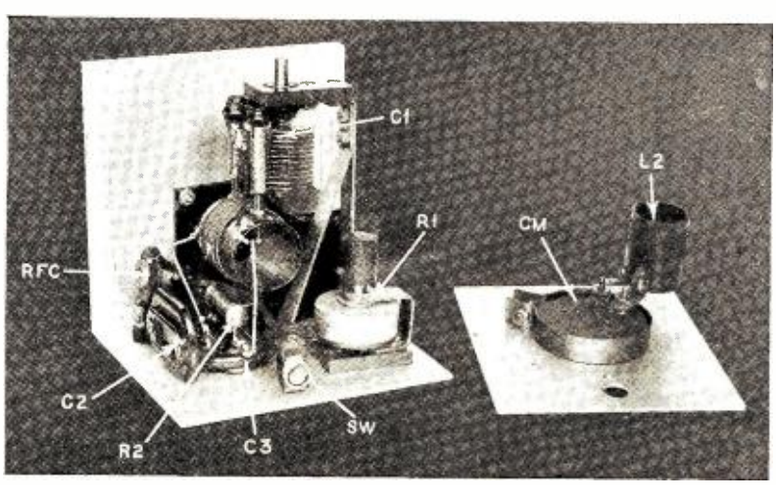
Figure 1 shows a new condenser microphone circuit, which, for want of a better name, has been called the "Absorption Microphone." The arrangement shown here has been in use at station W9EO for two years and has proved to be very satisfactory.

A UX-230 tube is used in a simple Hartley oscillator circuit. The primary of a high-ratio audio transformer is connected in series with the plate supply of this oscillator, while the secondary is connected to the audio output posts and so to the main amplifier. The condenser microphone is connected across the coil L2, which is placed in inductive relation to the oscillator coil L1. The circuit is set into oscillation by closing the filament switch SW. The frequency is then varied by rotating the tuning condenser C1 until the resonant frequency of the circuit L2-CM has been reached. This resonant condition may be detected by placing a pair of headphones across the output posts of the unit and listening for the sharp click which will be heard when resonance is reached. The condenser C1 is then tuned just a trifle to one side of the resonant peak and the microphone is ready for use.

The theory of operation is rather simple. Figure 2 shows a typical resonance curve in which amplitude of current is plotted

THE LAYOUT OF PARTS

The location of the various parts; also the method for mounting the tank tuning condenser (C1), the rheostat (R1) and the coils



* Electrical Eng Dept., Purdue University.

against frequency. When vibrations due to the voice strike the diaphragm of the microphone the natural frequency of this circuit is caused to vary accordingly. The amount of radio-frequency current absorbed or induced in the absorption circuit will vary between the limits x-x¹ marked operating point on the curve. This variation in the amount of energy absorbed or rejected will cause a similar varying plate current to flow through the primary of the audio transformer. The secondary of this transformer will then have an audio-frequency voltage induced across its terminals. This audio energy may be used directly or amplified in the usual manner. The amount of output energy obtained will depend upon the strength of the plate current and the degree to which it is varied by the absorbing circuit.

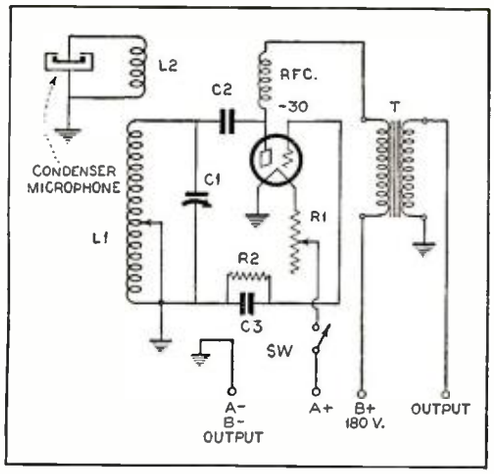


FIGURE 1. THE CIRCUIT DIAGRAM

A variation of this circuit may be obtained by interchanging the condenser microphone with the tuning condenser. No lumped capacitance should then be used across the microphone, as this will seriously reduce its effectiveness. This arrangement places the delicate condenser head across the tank coil, where it is more liable to be damaged by radio-frequency flash-overs. A number of other variations of the circuit have been tried out, but for all-round work the arrangement shown in Figure 1 has been found most satisfactory.

Construction Details

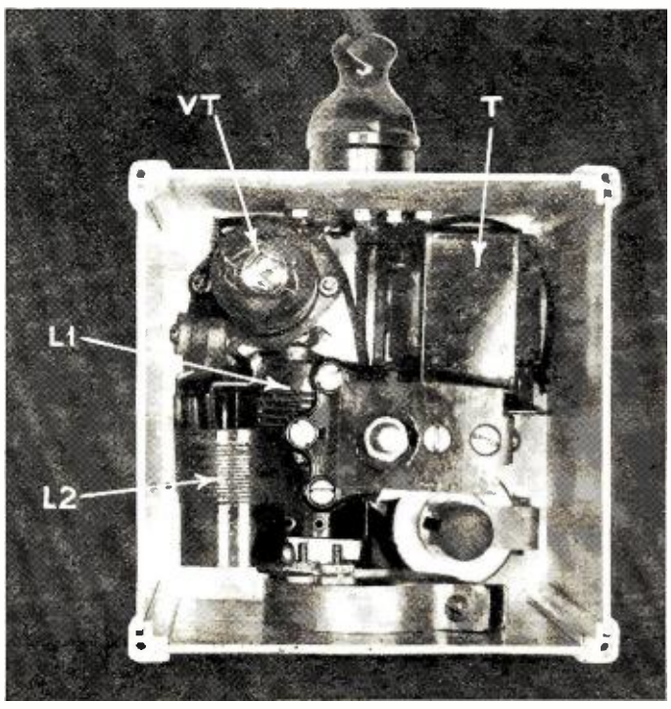
The actual layout and construction of the unit is made clear in the photographs. Most of the parts employed are parts which most constructors will find on hand. Some of these parts are not critical. However, it is recommended that only parts of high quality be employed. This is particularly true of both the variable and fixed condensers and particularly of the r.f. choke coil. This choke must be an effective one, and if the constructor has several short-wave chokes on hand, he will find it well to try them all.

A standard 4½-inch square aluminum box shield is used to house the microphone and oscillator. A large hole should be cut in the front panel to accommodate the microphone. The cutting may be done with a fly cutter or by simply drilling a circle of small holes with a hand-drill. The small coil L2 is mounted directly on the microphone terminals and so arranged that when the microphone is slipped around in the panel the coupling between L1 and L2 will be varied. The tank condenser C1 is a 100 mmfd. variable midget. The shaft of this condenser projects through the aluminum cover, allowing adjustments to be made while the microphone is in use.

The audio transformer used should be of good quality and fairly high ratio. Cheap transformers are often noisy and should be avoided in microphone or audio amplifier circuits. The value of the rheostat employed will depend on the source of voltage supply. If a storage battery is used for the supply the rheostat may be replaced by a fixed resistor. If two dry cells are used for the filament supply an amperite may be used in place of the rheostat, if desired.

THE UNIT WITH COVER REMOVED

The absorption coil (L2) is shown at the lower left, mounted directly on the microphone terminals. To vary the coupling between L1 and L2 it is only necessary to rotate the microphone from the outside of the shield



The plug and socket arrangement is used to connect the shielded cable to the microphone. An ordinary 5-prong socket is mounted in the center of the back panel with the soldering lugs facing in. Connecting leads from the oscillator are soldered to these lugs. A 5-wire shielded cable is used, although one wire is left idle. A 4-wire cable would serve the purpose as well. The cable shield and negative lead should be connected together and grounded. The battery box should also be shielded and grounded.

Only small B batteries need be used, as the drain is only about 5 milliamperes for a UX-230 tube. If greater output is desired, a larger tube may be used with proportionately higher plate voltage. A good B eliminator may be substituted for the B battery, but it should have very little hum. The whole circuit may be a.c. operated, but special precautions must be used to reduce the a.c. hum to an extremely small amount.

When the oscillator is first put into operation, the grounded tap should be moved along coil L1 until strong steady oscillations occur. A current squared galvanometer loosely coupled to the tank coil L1 will indicate when the circuit is oscillating. A plate milliammeter having a range of 0 to 5 or 0 to 10 milliamperes will also be useful in tuning up the oscillator. The feed-back tap should only be moved along the tank coil toward the plate end far enough to obtain strong oscillations consistent with moderate plate current.

Operating Data

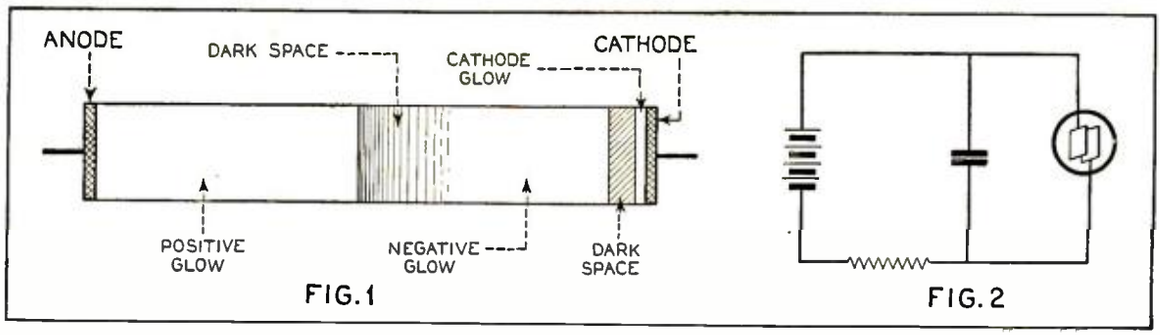
The coil L2 should be coupled loosely to L1. Rotate condenser C1 until a sharp click is heard in the phones connected across the secondary or output posts. Now vary the coupling and adjust C1 until the microphone seems most sensitive. When these adjustments have been made the microphone will be ready for use.

Some precautions in the use of this microphone should be observed. It often happens that noise develops when condenser microphones are first put into service. Noisy batteries may be the cause. Replace the batteries one by one with good new ones. The noise may be due to dust or moisture in the microphone itself. The cure is to take the microphone apart, clean it with carbon tetrachloride and dry thoroughly in a warm but not too hot oven. Before assembling, brush all parts, and especially the back plate, with a soft clean camel's-hair brush. Too much time cannot be spent in locating and removing all causes of noise. In this connection induced currents from power wires and radio-frequency circuits should be carefully guarded against. Complete shielding is the only safe method to follow.

The coupling between L1 and L2 must always be loose. Too close coupling will result in unstable operation. Considerable time should be spent in testing the coupling and condenser settings for best results.

The method of mounting or suspending the entire unit is left to the ingenuity of the builder. The model

(*Continued on page* 379)



NEON TUBE CHARACTERISTICS AND CIRCUIT

The relation between light and dark spaces in neon tube and simple neon tube oscillator circuit

Neon Tube Oscillators

The neon tube may be used in one of the most simple types of oscillator circuits to operate at frequencies between .05 and 95,000 cycles per second. This and an article to follow cover the subject thoroughly

By Dale Pollack

Part One

THE use of the neon tube in its usual rôle, that of an illuminating agent in advertising signs, is well-known. Less well known, however, is the fact that the neon tube possesses the property of producing an intermittent oscillatory current, when connected in the manifestly simple circuit described in this paper. Although the ability of the neon tube to produce an intermittent current was first noted ten or more years ago, it since seems to have almost escaped notice and until recently has been little used. It is the purpose of this paper to present the theory of the oscillating neon tube and to enumerate some of its applications.

The neon tube, in its common form, consists of two electrodes sealed in a glass tube containing a mixture of neon and some other inert gas at low pressure. When the electrodes are connected to a source of current of sufficient potential, the gas in the tube glows with the familiar orange-red color. It is not always observed that the luminous glow is not distributed evenly throughout the gas but is divided into several clearly defined bands. The positions which the various glows and dark spaces would occupy in a gas-filled discharge tube with widely paced electrodes is shown in the diagram, Figure 1.

In 1922 H. St. G. Anson demonstrated before the Physical Society of London[1] the ability of the neon tube to produce an oscillatory current. He found that a neon lamp, when connected in series with a high resistance and in parallel with a capacity as in Figure 2, would flash intermittently (or "oscillate") at a frequency determined by the characteristics of the tube, the applied potential and the values of the condenser and resistor. By properly proportioning the constants of the circuit, as will be shown later, the lamp may be made to oscillate at frequencies varying from one or two per minute to as high as 95,000 per second.

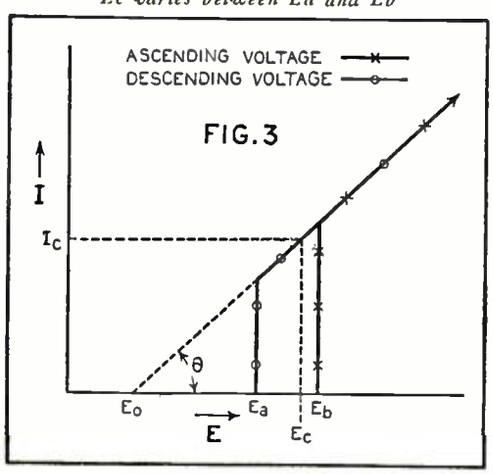
It is not difficult to explain the occurrence of oscillations in a neon tube connected in the fashion indicated. If the voltage applied to the terminals of a neon lamp is gradually increased from zero, it will be found that the lamp will not glow until after a certain voltage has been surpassed. However, once the applied e.m.f. has exceeded this critical value, it may be reduced until another critical voltage, lower than the first, has been passed, before the lamp is extinguished. The upper critical voltage will be referred to as E_b and the lower critical voltage as E_a. These two voltages are not, strictly speaking, constants, for they will vary somewhat until the tube has been operating for a period sufficiently long to stabilize its operation. It has been found that the critical voltages change with temperature variations, due to expansion and contraction of the tube parts and to the effect that temperature has upon the ionization of the gas. The apparent instability mentioned later is, in all probability, of this nature. The presence of an ionizing agent[2] (such as γ-rays from radium) has an effect on the critical voltages, but this phenomenon is not of sufficient importance to warrant extended treatment here.

Figure 3 shows the current, plotted as a function of the voltage, through the theoretical "perfect" neon tube, the curve being given for both ascending and descending voltage. It will be seen that the curve is an uninterrupted straight line, except for the critical voltages. This theoretical curve cannot be obtained from commercial tubes, as the gas in the tube is not always pure, and, in addition, a surface is generally used for the cathode and all the points on it are not equidistant from the anode. At a potential only slightly beyond the critical voltages the glow will not cover the entire cathode, but will occur first at the point nearest the anode, spreading to cover the entire cathode as the voltage is increased. This effect produces irregularities in the curves plotted from commercial tubes. A curve plotted from a small indicating lamp is given in Figure 4 (a). From A to B the curve is fairly straight, in agreement with the theory, but after B its slope decreases sharply. It is at this e.m.f. that the glow ceases to cover the cathode completely. The curve of Figure 3 may be approximated, however, by the use of a neon lamp whose electrodes consist only of the tips of wires, and the graph of such a tube is reproduced in Figure 4 (b).

Now, returning to Figure 3, when the battery potential is applied to the circuit, the e.m.f. built up across the condenser rises, and as soon as it exceeds the upper critical voltage, E_b, the tube ignites. When this

CURRENT-VOLTAGE CURVE OF IDEAL NEON TUBE

When oscillating in a stable condition, the voltage across the terminals of the tube, Ec varies between Ea and Eb



occurs, the tube becomes a much better conductor than when it was dark and the condenser discharges through the lamp. The voltage now drops below the lower ignition voltage, E_a, and the tube extinguishes. The condenser then begins to recharge and the cycle is repeated, resulting in an intermittent oscillatory current across the tube.

The period of oscillation may be deduced mathematically. Let t_1 be the duration of the period during which the lamp is dark and t_2 be the period during which it is glowing; then, to find the total length of one cycle:

(1) $$T = t_1 + t_2$$

The voltage E_c across the terminals of a condenser of C microfarads in series with a resistor of R megohms (Figure 6), at any time, t seconds after a terminal voltage of E volts has been applied, is given by[3]:

(2) $$E_c = E\left(1 - \varepsilon^{-\frac{t}{\sigma}}\right)$$

ε being the base of the natural logarithms, 2.718. . . .

Placing the neon tube in parallel with the condenser, as in the circuit of Figure 2, then t_1 becomes the time it takes for the condenser to charge from the lower critical voltage, E_a, to the upper critical value, E_b; solving (2) for these values gives

(3) $$t_1 = CR \log_\varepsilon \frac{E - E_a}{E - E_b}$$

We now consider the calculation of t_2. When a neon or other gas-filled lamp is operating steadily, there is a potential difference between the cathode and the negative glow[5] (Figure 1). This potential drop is dependent upon the nature of the gas used and the metal of which the electrodes are composed, and is of the order of 50 to 100 volts. If it is assumed that this cathode fall in potential is constant for small changes in the applied e.m.f., then the field throughout the dark portion of the lamp may also be assumed to be constant.[6] If we consider an element of area, ΔA_k, of a plane of total area A perpendicular to the flow of the current, then the portion of current flowing through ΔA_k will be given by the expression:

$$\Delta i_k = n\,e\,(E_c - E_k)\,\Delta A_k$$

where e = charge carried by each ion
n = number of ions
E_k = cathode fall in potential.

Now, if we take the limit of the sum of the currents through all the ΔA's:

$$i = e\,(E_c - E_k) \int_A n\,dA$$

where i is the total current flowing through the lamp.

Let $\int_A n\,dA = An'$

where A is now the area of the cathode glow, and n' is the mean value of n, then

$$i = An'e\,(E_c - E_k)$$

or, letting $An'e = M$. M being a constant termed the "conductance" of the lamp:

(4) $$i = M\,(E_c - E_k)$$

Since $i = \frac{dq}{dt}$, $dq = M\,(E_c - E_k)\,dt$, which is an expression for the quantity of electricity, dq, passing through the tube in dt seconds. During the same period a quantity of electricity flows into the condenser from the battery—

$$dq' = \frac{E - E_c}{R}\,dt$$

Hence the change in the charge on the condenser is:

(5) $$-dQ = \left[M\,(E_c - E_k) - \frac{E - E_c}{R}\right]dt$$

or, solving, E_c varying between E_a and E_b:

$$t_2 = \frac{CR}{MR + 1} \log \frac{E_b - \frac{E + MRE_k}{MR + 1}}{E_a - \frac{E + MRE_k}{MR + 1}}$$

or, if we let $K = \frac{E + MRE_k}{MR + 1}$, then

(6) $$t_2 = \frac{CR}{MR + 1} \log \frac{E_b - K}{E_a - K}$$

and, substituting (2) and (4) in (1):

(7) $$T = CR\left(\log \frac{E - E_a}{E - E_b} + \frac{1}{MR + 1} \log \frac{E_b - K}{E_a - K}\right)$$

which is the expression for the period of one oscillation.

If C is greater than 0.1 mfd., MR is large and eq (7) may be approximated:

$$T = CR \log \frac{E - E_a}{E - E_b} + \frac{C}{M} \log \frac{E_b - E_k - \frac{E}{MR}}{E_a - E_k - \frac{E}{MR}}$$

and, since $\frac{E}{MR}$ is thus small compared with $(E_b - E_k)$ and $(E_a - E_k)$, and also, as $-\log \frac{E_b - E_k}{E_a - E_k}$ is nearly constant with normal variations in capacity, it may be set approximately equal to k; then:

(8) T may be taken to equal $CR \log \frac{E - E_a}{E - E_b} + Ck$

From equations (7) or (8) it is obvious that, within limiting values of R, the period of one complete cycle is very nearly directly proportional to the product (*Continued on page 376*)

CURRENT-VOLTAGE CURVES OF TYPICAL NEON TUBES

(a) The curve of a common type of neon indicating lamp; (b) of a neon tube in which the elements are in the form of points rather than large plane surfaces

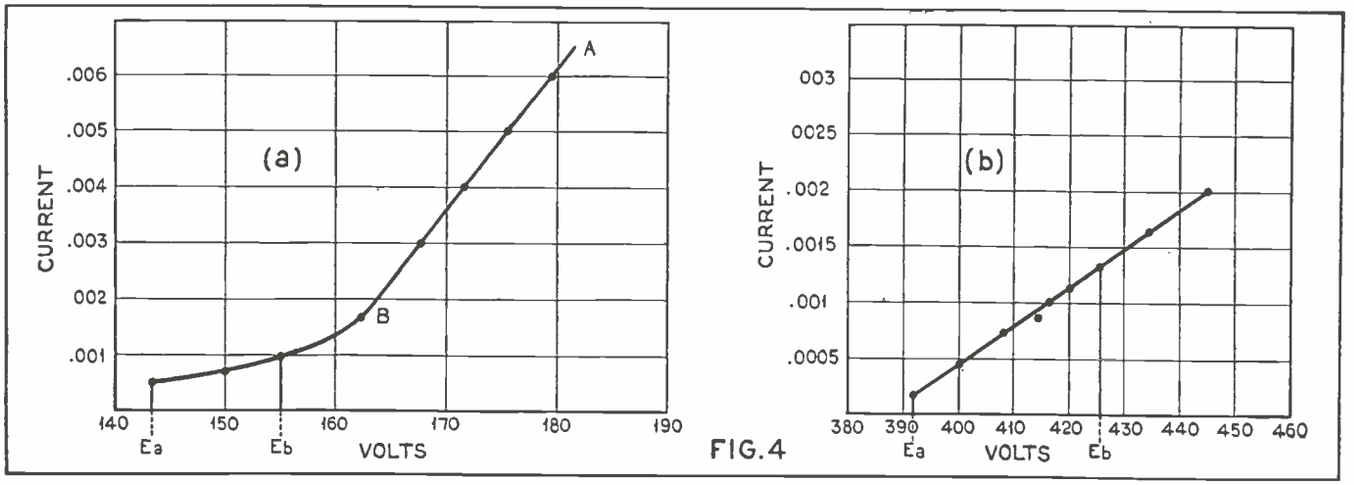
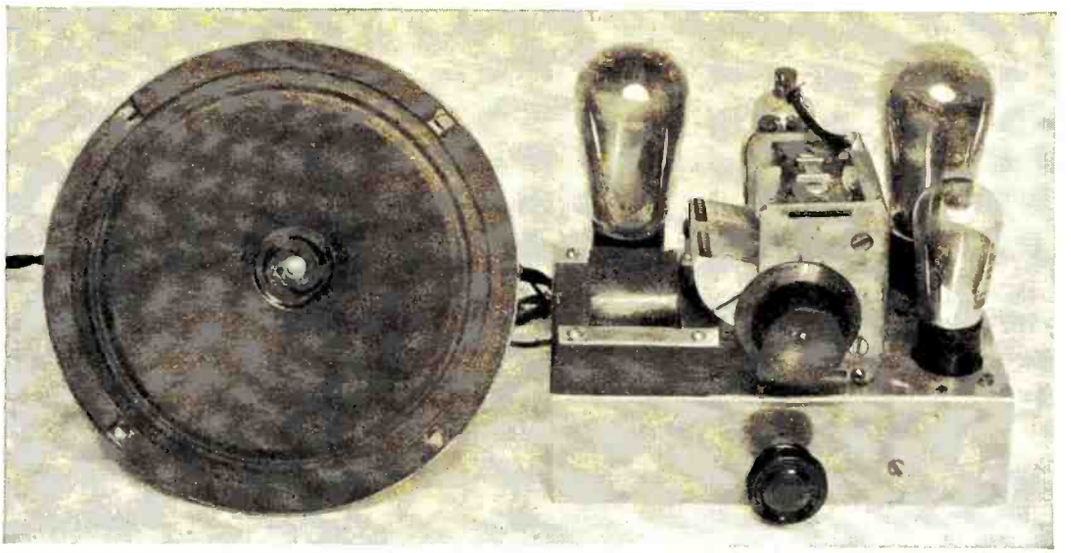


FIG. 4



How to Build

A Real "Midget" Receiver

Here is a receiver so compact and inexpensive that the average home might well afford several for installation in upstairs rooms or other parts of the house not reached by the living room receiver

By Harry Georges

THE justly-deserved popularity of midget receivers is based upon their ability to deliver desired results, at a reasonable price. The high efficiency of these small sets has been attained through important developments in vacuum tubes, circuits and receiver components.

Of these three items, the new tubes are responsible, without a doubt, for most of the progress. After obtaining the new tubes, it is up to the radio engineers to learn how to apply them to the best advantage. Thus, more efficient circuits are evolved. Radio parts manufacturers have contributed to these developments by producing better and more compact components and accessories, designed especially to function with the new tubes and circuits.

The little three tube midget set described in this article employs the latest tubes in a circuit designed to utilize them to the fullest extent. As a result, many components have been eliminated, which were formerly supposed to be essential, and still this little receiver is superior to many of the large size sets of older vintage.

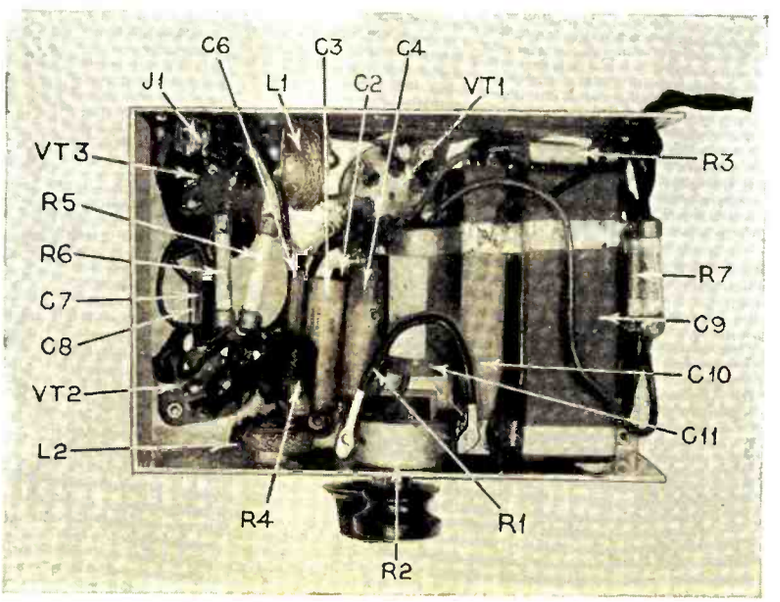
The Lafayette "Modern Midget" is built on a chassis 5 inches by 8 inches by 2 inches high and the over-all height, including tubes, is less than 7 inches. This receiver can be held quite readily in the palm of the hand.

To illustrate the rapid progress in radio receivers a comparison will be made between the new midget and a six tube a.c. receiver which the writer designed and built in 1928. The latter receiver consisted of two stages of tuned radio frequency employing -26 tubes, a tuned detector and a -27 tube and two transformer coupled audio stages. The first audio stage employed a -26 tube, while the output stage used two -71A tubes in push-pull.

This set, which was called the "Supreme A.C. Six," was built on a bakelite sub-panel 26 inches long by 10 inches deep. A 7 by 26 inch panel was used. Due to lack of space, it was necessary to place the power supply on a separate baseboard, 5 inches wide by 14 inches long. The filament transformer alone was 2¾ inches wide, 5 inches long and 4½ inches high. Then there was a bulky power transformer containing the high voltage supply and another huge iron case containing two large audio chokes for the filter system. Even the filter condensers were of enormous size as compared to present practice. The rectifier was a Raytheon BH tube.

THE BOTTOM VIEW

This shows what an experienced builder can accomplish in the way of space saving. The inexperienced builder may prefer to make the chassis larger to allow more room for assembly and wiring



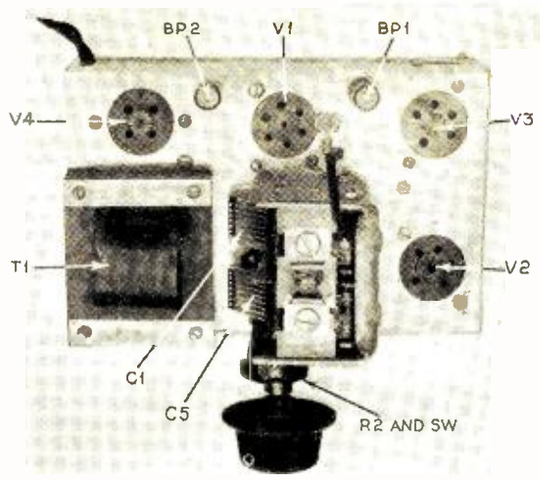
All in all, the "Supreme" was a formidable piece of apparatus and in addition to taking up a lot of room, it cost quite a bit more than $100 to build.

This set, which was built of very good parts, is still in operation and a comparative test was made between it and the "Modern Midget," to determine their relative merits.

The "Modern Midget" uses only three tubes, not counting the -80 full-wave rectifier. There is a stage of tuned r.f. using the new variable mu r.f. pentode (-58 type tube), a tuned detector stage employing the new -56 general purpose tube and a single audio stage using the PZ pentode (-47) power output tube.

The comparative test showed that the midget was very nearly as selective as the larger set, in spite of the fewer tuned circuits in the midget. This was due to improvements in coil design and to the use of more accurate variable condensers. The two-gang Trutest condenser, in addition to being very well designed, is one of the most compact variable condensers obtainable.

As regards sensitivity, the small set equalled the large one, each one bringing in the same list of stations under identical conditions. The use of the -58 tube in the midget set, had the very noticeable effect of holding cross-modulation and modulation distortion to a minimum.



ONLY A HANDFUL

This top view of the chassis shows radio reduced to its simplest form. The receiver employs four tubes, including the rectifier, yet will equal many larger sets in performance

Advantages of New Tubes

So far as detection was concerned, the -56 tube used in the smaller set, showed a decided improvement over the -27. This new tube has a high mutual conductance and a high amplification factor and its possibilities are fully realized in the "Modern Midget".

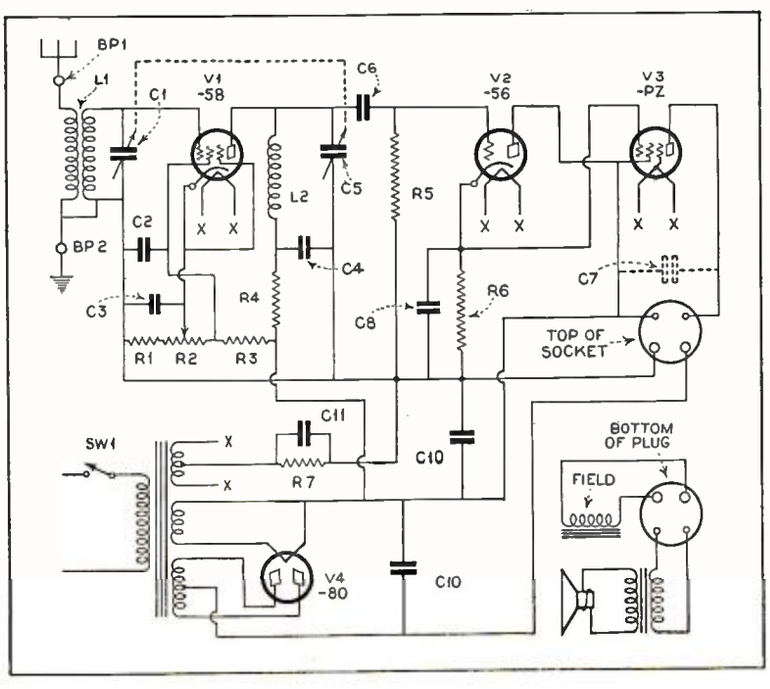
The little midget far surpassed the larger set both in volume and tone quality. This is just what one would expect, in view of the fact that the combined -71a's have an undistorted power output of 1400 milliwatts, as compared to a power output of 2500 milliwatts for the pentode. Incidentally, the -71a tube possesses an amplification factor of 3, while the amplification factor of the PZ is 90.

An examination of the schematic diagram (Figure 1) of the "Modern Midget" immediately discloses the simplicity of the circuit employed. The secondary of the antenna coupler, L1, is tuned by one section C1, of a two-gang variable condenser. The r.f. stage is coupled to the detector by means of a tuned impedance. The conventional grid leak and grid condenser will be noted at R5 and C6 respectively.

An extremely novel form of coupling will be observed between the detector and the power output tube. The cathode of the detector is connected directly to the grid of the PZ tube. This form of coupling, in addition to being highly efficient, eliminates transformers, resistors and condensers and hence is the simplest and cheapest coupling method ever devised.

THE CIRCUIT DIAGRAM

Even the circuit is simplicity personified. The method of coupling the power tube to the detector is of particular interest



Construction

Volume is controlled by means of a tapered potentiometer, R2, in the cathode return circuit of the r.f. tube. This method gives a smooth, even control from a whisper to maximum volume. Resistor R1 provides the minimum resistance necessary to maintain the 3-volt negative grid bias required by the -58 tube. Theoretically, a resistance of from 200 to 400 ohms should suffice. In actual practice, however, it was found that a 1500-ohm resistance at R1 gave more stable operation, reducing the tendency toward undue oscillations.

If R1 is too low, the set will emit regenerative whistles; if too high, the sensitivity and volume will be reduced. It may be desirable to experiment with different resistances at this point until one is found which gives best results for the particular local conditions encountered.

Both the screen-grid and the cathode circuits of the -58 tube are by-passed by .1 mfd. condensers. Other portions of the circuit are also adequately by-passed by small condensers.

One of the features of the "Modern Midget" is the simplified power supply and filter system. A single midget transformer contains the 5-volt filament winding for the -80 tube, the 2½-volt filament windings for the other three tubes, and the high-tension winding for supplying the plates and screen grids.

Instead of the usual iron-core audio chokes, the 2500-ohm field of the dynamic speaker is used to smooth out the rectified current. Dry electrolytic condensers, C9 and C10, by-pass each side of the speaker field winding. This filter system is very efficient, as there is no noticeable hum.

The bias resistor R7 is by-passed by a 10 mfd. dry electrolytic cartridge condenser. Switch S1 is mounted directly upon the volume control, R2, forming an integral part of that unit. Hence there are only two controls on the set, the single-control tuning knob which varies the capacity of the two-gang condenser and the combined switch and volume control.

The dynamic speaker is connected to the set by means of a four-prong plug which fits into a four-prong socket at the rear wall of the chassis. The output transformer on the speaker should have a primary of the correct impedance to match a PZ or -47 output tube. Theoretically, this calls for a 7000-ohm impedance.

The chassis cut from a sheet of 1/16-inch aluminum, 9 inches by 12 inches. The four socket holes for the tubes and the socket hole for the speaker connection are drilled before bending. The hole for the flush-mounting power (*Continued on page* 380)

HIGH QUALITY AMPLIFIER DESIGN FOR A

Heavy Duty P. A. System

This amplifier will operate a large number of dynamic speakers and is therefore well suited to large area coverage, outdoors or in. For hotel or hospital systems it will operate up to 2000 magnetic speakers

By Bernard J. Montyn

Part Two

LAST month we described the pre-amplifier and the voltage amplifier stage of this Kenyon heavy-duty, 50-watt public-address amplifier. In this article we conclude the description with a discussion of the output stage and the speaker connections.

The final stage with its power supply is mounted on the third or bottom panel, which is twice as large as panels 1 and 2.

Two 845 type tubes in a push-pull circuit, as shown in Figure 1, furnish the output power. These are run considerably below their maximum rating in order to insure high quality.

Let us now take up the story where we left off last month. The output transformer of the voltage amplifier on panel 1 has a split and tapped secondary to permit connections to a 500-ohm or a 200-ohm line, or by suitably connecting the secondaries in parallel an output impedance of 125 ohms or 50 ohms can be obtained. In the amplifier described here, all secondaries are connected in series to provide a 500-ohm output.

The input transformer for the power stage has a similarly split and tapped primary. A patch-cord connects this to the voltage amplifier output.

It has been found advisable to insert 85-millihenry chokes in both grid leads to insure complete stability in the 845 circuits. These tubes require a plate voltage of approximately 1000 volts. Their bias is secured by means of the usual resistors, but each tube has its own adjustable bias resistor. Milliammeters in each plate circuit enable the operator to adjust the individual bias voltages for minimum distortion.

The output transformer has four secondaries. They have been designed to permit a great variety of connections which might be required for different speaker combinations. We shall return to the subject of speaker connections later on.

The Power Supply

A diagram of the entire third panel is shown in Figure 1. The line is plugged into the receptacle marked "A.C.-IN." This will automatically turn on the filaments of the power tubes and all the power on panels 1 and 2. If the constructor prefers, he can insert a switch in this circuit. The high voltage is applied through a time-delay device. In this case, a mark-time switch is used. The switch consist of a timepiece which is wound by moving the handle up and down. For every up-and-down movement, the clock is wound and set for 15 seconds. Consequently when the handle is moved up and down, say, four times, the plate supply is connected after one minute. The clock system has certain disadvantages; for instance, if the power line were to fail and then be connected again, everything would be switched on at once. Further, when the amplifier is turned off, the filament and plate supply are turned off simultaneously. There should be a little delay on the filament supply in this case. Therefore, if desired, a time-delay relay system could be employed to advantage. This would give the needed protection in case of breakdown of the power line. The time-delay, however, is not adjustable within such wide limits.

Small differences in line voltage are provided for. The primary of the filament transformer has several taps which are connected to the contact points of a rotary switch. By adjusting the switch, the turns ratio is made correct for the existing line voltage. A voltmeter across the filament of one of the power tubes indicates when the correct adjustment has been reached. All other voltages are then correct.

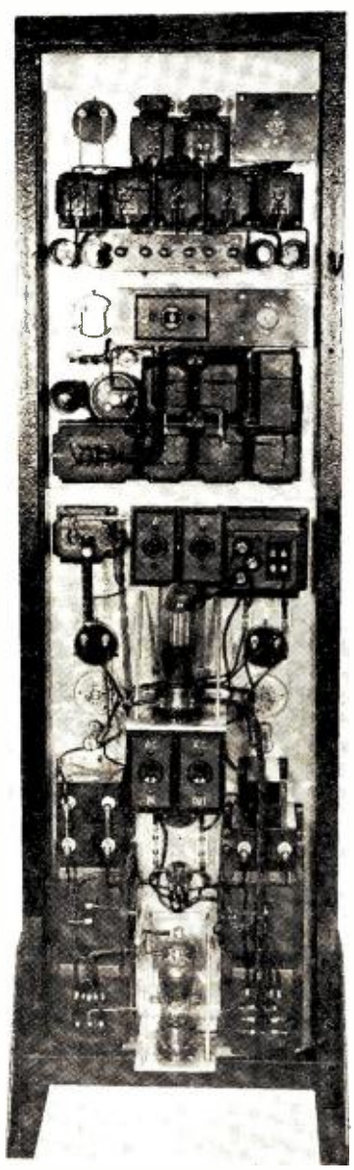
It can be seen in the illustrations that the tubes are mounted on sub-panels behind windows. These windows are made of pyrex and are non-shatterable. This type of construction makes it possible to observe the tubes while they are in operation.

The photographs on this page show clearly how the parts are laid out. It is important to remember that all a.c. wiring should be twisted, and audio lines, too, wherever possible.

Connections between the three panels are made with patch cords having cap type plugs on both ends. These connections have already been mentioned in the text. The picture of the complete amplifier shows the various receptacles employed for that purpose.

THE COMPLETE AMPLIFIER

For clarity, the patch-cords had been removed when this picture was taken



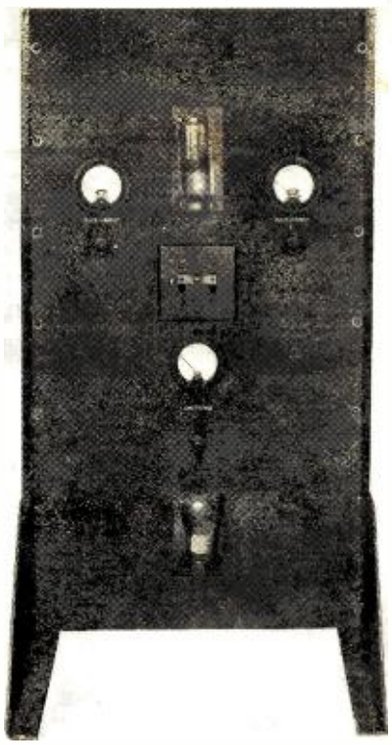
Multiple Speaker Connections

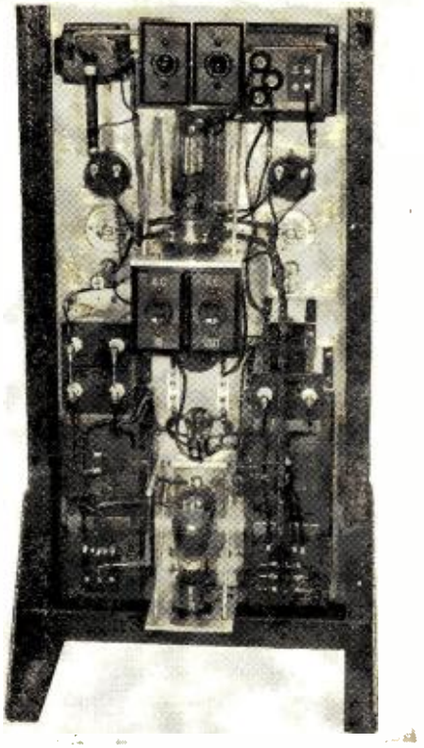
The output transformer has secondaries which will match a 500-ohm line, a 200-ohm line, or—with suitable parallel connections—from 1 to 20 voice coils.

Let us first suppose that a rather large area is to be covered with magnetic speakers. In that case, the 500 or 200-ohm line should run to a central point where a speaker-matching transformer is connected. This

FRONT AND REAR VIEWS OF POWER STAGE

The illustration at the left shows all the controls. Under the two milliammeters are the variable bias resistor control knobs. In the center is the automatic delay switch and below that the filament voltmeter rotary switch can be seen, which serves to adjust the line voltage. (Right) The layout of the parts and construction of the sub-panels are clearly visible





transformer, in turn, might have several secondaries, each designed to feed into a 500 or 200-ohm line, providing several trunk lines, each able to supply a great number of magnetic speakers. The speakers must be connected in parallel or in series-parallel so as to match the source impedance of the individual trunk line.

With a system like this, a strip of ground two miles long has been covered during tests. Wherever a large territory has to be covered, this type of amplifier will supply all the power needed.

The use is not necessarily restricted to outdoor work. For instance, large hotels are now being equipped with centralized radio systems. For such installations the speakers should be connected as outlined above. Generally, the circuit should be so designed that the total impedance remains the same regardless of whether speakers are cut out or not. This will have to be done by compensating resistors or chokes.

The use of dynamic speakers brings some more complications. The output transformer on panel 3 can be arranged to supply from 1 to 20 voice coils. However, then the line cannot be very long and it should consist of rather heavy twisted wires.

Where conditions demand a long line, there is a special Kenyon line-matching transformer that solves the problem. This transformer, type KLS-50, has primaries to match a 200-ohm, 500-ohm, 2000 ohm or 4000-ohm impedance. The secondaries can be so arranged as to match ½-ohm, 1-ohm, 2-ohm, 3½-ohm, 5-ohm, 7-ohm, 15-ohm and 30-ohm loads.

This matching transformer should be placed close to the speakers, and thus any line to the amplifier would be a 200-ohm or 500-ohm line. It is obvious that the voice coil leads should not be too long, for there will be too much loss in them. They should be heavy wires, and the longer they are the heavier they should be.

Another problem is the supply for the fields. Sometimes it is easier to employ speakers with 6-volt fields. They can then be connected in series and should be supplied from a d.c. source or a heavy-duty rectifier of the copper-oxide type. Of course, when 110 volts d.c. is available, speakers with 2500-ohm fields can be connected in parallel. This has the advantage that a defect in one of them will not put the other fields out of commission.

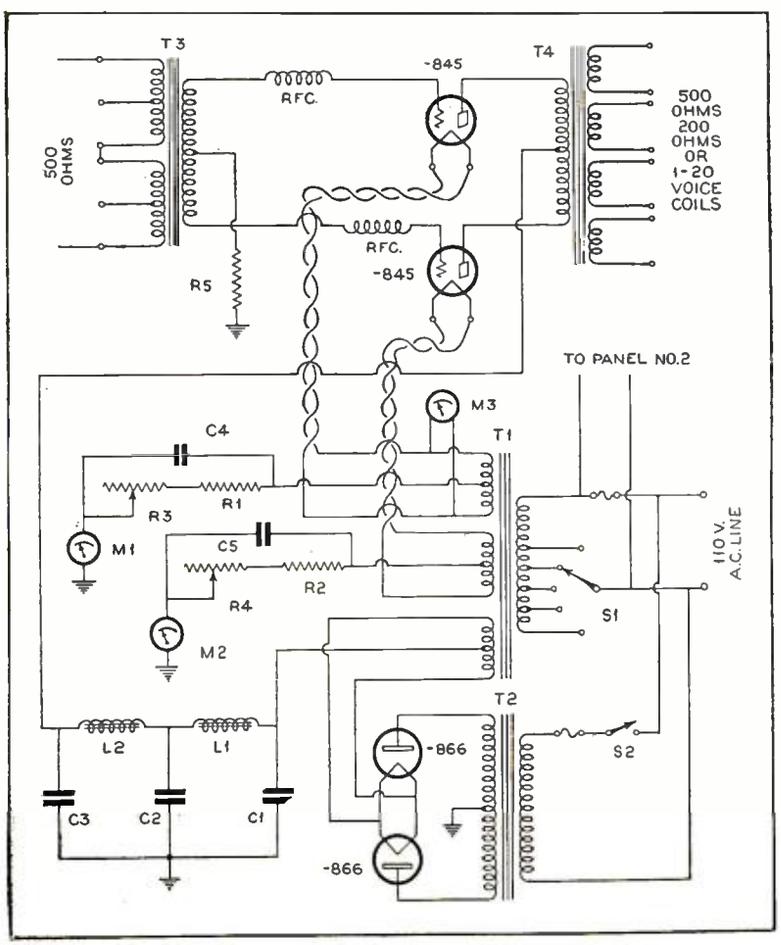


DIAGRAM OF POWER STAGE

Figure 1. The power output stage consists of two 845 type tubes in push-pull. Note the individual bias adjustment

List of Parts

C1—Aerovox filter condenser, ½ mfd., 2500 volts
C2—Aerovox filter condenser, 1 mfd., 2500 volts
C3—Aerovox filter condenser, 2 mfd., 2500 volts
C4, C5—Aerovox by-pass condensers, 2 mfd., 400 volts
L1, L2—Kenyon filter chokes, type KC-30-200
M1, M2—Milliammeters, range 0-100 ma.
M3—Voltmeter, range 0-15 volts
R1, R2—Aerovox vitreous enameled resistors, 1250 ohms, 50 watts
R3, R4—Ward-Leonard adjustats, 1000 ohms
R5—Aerovox 50,000-ohm vitreous enameled resistor, 50-watt rating (*Continued on page* 382)

PRACTICAL ON 3/4 METER

AN OPTICAL WAVE RECEIVER SYSTEM

Figure 8. The B.-K. receiver with an audio frequency amplifier and loud-speaker attached for picking up ¾-meter transmissions

Continuing the with constructional details and reflecting antenna wavelengths

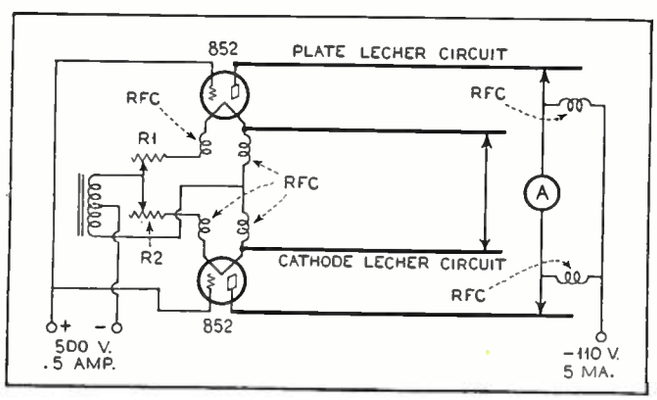
By James

THE optical characteristics of ultra-short-wave radio transmission become pronounced only on wavelengths shorter than 5 meters. While it is justifiable to consider any wavelength shorter than 10 meters in the quasi-optical region by virtue of the fact that communication is usually limited to visual distances, the "shadows" are erratic and transmission and reception can be effected by conventional circuits. A wavelength of 5 meters perhaps marks the borderline where circuit differentiation becomes more than mere modification of the usual arrangements, and Barkhausen-Kurz and Gill-Morell hobnob with our familiar friends, Armstrong and Colpitts. But even at 56 megacycles the superheterodyne (RADIO NEWS for August, 1932) is the most efficient receiver yet developed, the super-regenerator is still very effective, while the tourmaline crystal-controlled transmitter is more reliable than the magnetron oscillator.

However, still farther down, the picture changes more definitely. The old principles are still recognizable, but apparatus, technique and application are entirely new. While it is by no means as hopeless as Dante's Inferno, we may take liberties with the Florentine poet and declare, "Abandon old ideas, all ye who enter here!"

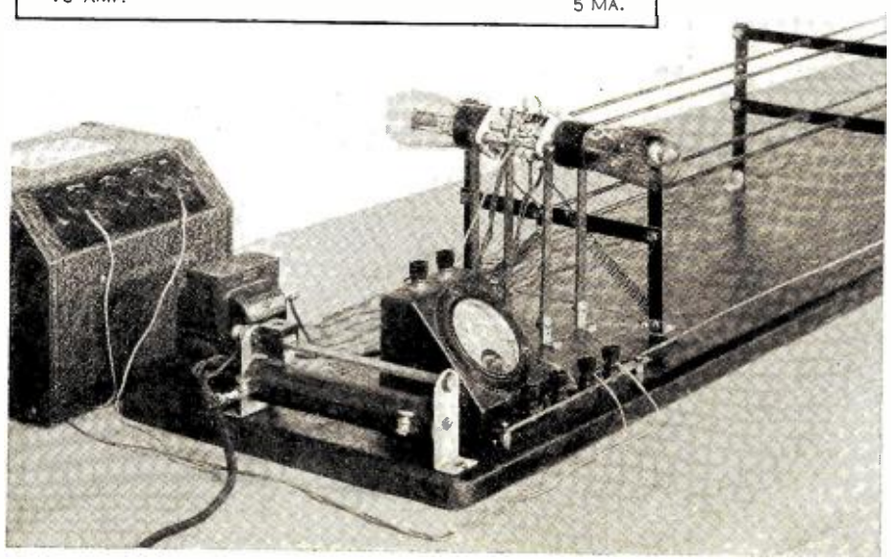
In the "misty mid-region" of centimeters, the phenomena are markedly quasi-optical, and it is suggested that the experimenter review the first two articles (RADIO NEWS, June and July) in this series, which consider the basic principles and characteristics.

As we shall describe a ¾-meter transmitter and receiver in this article, we shall limit ourselves for the present to 75-centimeter considerations, bearing in mind, however, that the optical phenomena predominate more and more as the wavelength is shortened still further. Communication at 75 centimeters is believed to be limited to between points in a direct line of vision with each other. Even small obstacles, such as trees, cast pronounced "shadows." The wavelength is sufficiently short to permit the use of simple parabolic reflectors, at both transmitting and receiving stations, whereby the signals can be concentrated in accordance with the familiar optical law.



CONSTRUCTION DATA

Figure 1, at left, shows circuit diagram of a Kozanowski oscillator. Figure 3, below, experimental Kozanowski oscillator for type -27 tubes



The experimenter who has studied the introductory articles in this series will appreciate that at frequencies above 300 megacycles (300 megacycles equals 300,000,000 cycles per second or a wavelength of 1 meter—just to remind you) the period of the circuit approaches the limitations imposed by the rapidity with which the electrons can circle about in the tube. The velocity of the electron and the geometric spacing of the tube elements, rather than the capacity and inductance of the circuit, may be the deciding factors as to frequency. Such is the case with the Barkhausen-Kurz oscillator, and by varying the accelerating charge on the grid (which, of course, affects the velocity of the electron stream) the wavelength can be controlled over a considerable range, practically independent of the circuit constants. Such a circuit necessarily results in the very unconventional arrangement in which the grid is highly positive and the plate negative.

B-K oscillations can be extended well down in the centimeter region, but are of lesser value for transmitting purposes

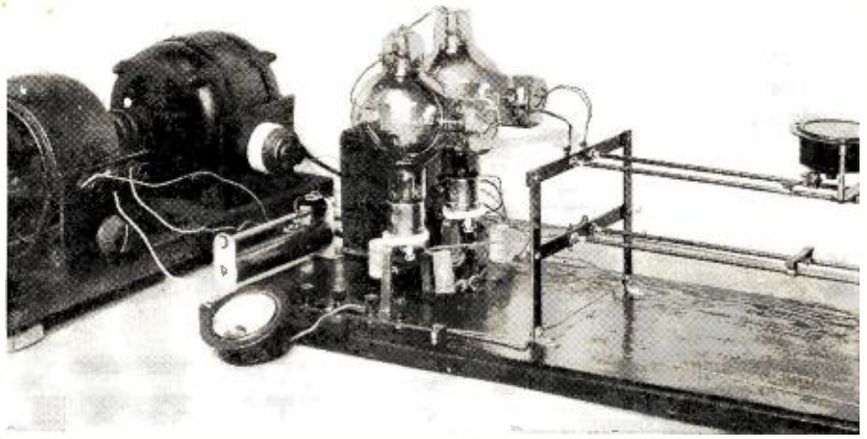
* The National Co.

WORKING DATA

TRANSMISSION

ultra-short-wave series on transmitters, receivers systems for operation on below one meter

Millen*



FINAL EXPERIMENTAL SET-UP FOR 852 TUBES

Figure 2. This transmitter is capable of generating five to six watts of 75 centimeter radiation and is tuned by Lecher wire antennas

below 1 meter, due to low output and lack of stability—the frequency often swinging as much as several megacycles! The lack of stability, however, suggests that the system has possibilities as a receiver, where signal swinging would merely be evidenced as broad tuning. Barkhausen-Kurz oscillators are considered in detail in the June and July articles to which reference has already been made.

It was in an effort to improve the output of the B-K system that Kozanowski developed his oscillator, which departs even farther from the familiar way of things by tuning the plate and filament circuits rather than the plate and grid circuits. Kozanowski's investigation into a modified Barkhausen-Kurz oscillator indicated that the oscillations were the result of the space-charge fluctuating geometrically (not in potential) about the grid. In other words, the vibratory phenomena pivots about the grid, the filament and plate being the high-potential sides of the oscillating system. Such a theory would suggest an improved output with the filament and plate circuits balanced or tuned—an assumption thoroughly justified by further experimentation.

The Kozanowski oscillator circuit used by the author in ¾-meter experiments is shown in Figure 1, while the photograph, Figure 2, provides a clear idea of the mechanical arrangement. The plate and filament circuits are tuned by individual Lecher wire systems. The wavelength at which the oscillator functions is determined by the length of the plate Lecher system. It must not be assumed, however, that we have here merely a modified oscillator operating on the tuned-plate principle. It is, of course, a bona fide electronic oscillator, as is evident by the reversed potentials on grid and plate, and the fact that the wavelength is almost exactly equal to the length of the plate Lecher system as measured from the plates of the tubes to the terminating ammeter, quite independently of concommitant inductance and capacity.

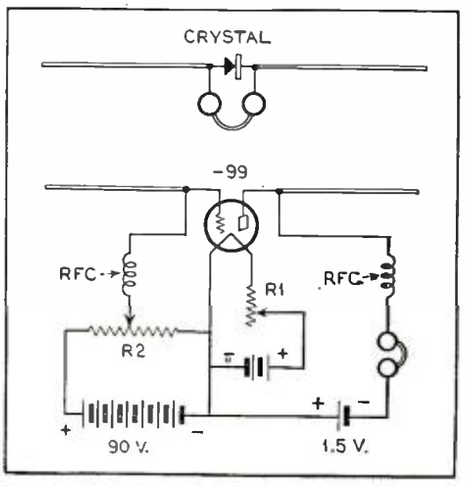
From considerations outlined above, it is evident that the power output can be controlled by varying the length of the cathode Lecher system, which has practically no effect on frequency. The oscillating power generated by the Kozanowski circuit is considerably greater than that obtained by a B-K oscillator. The best output reported from Barkhausen-Kurz circuits at 75 centimeters has been a fraction of a watt, whereas the circuit in Figure 1, employing the tubes and potentials indicated, can be pushed to well over 5 watts, at this wavelength, with good stability.

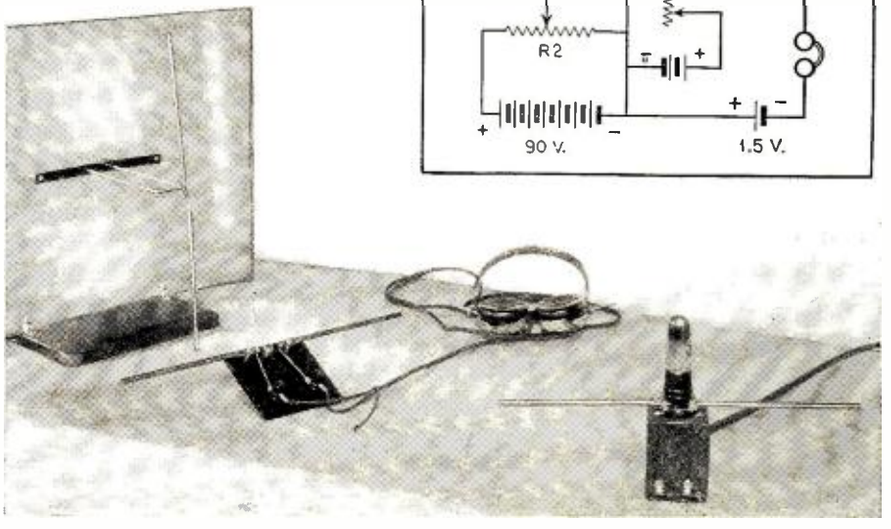
The 852 type tube is admirably suited to oscillations of this character. Original experiments carried on with the type –27 tubes (Figure 3) showed that our old ultra-high-frequency standby will not provide satisfactory results in this circuit. While oscillations were present, they did not exhibit the proper characteristics. The plate circuit showed practically no frequency control, and the length of the cathode circuit had a negligible effect on the power output. Oscillations ceased when a plate potential of more than a few volts negative was applied. The circuit was apparently functioning as a Barkhausen-Kurz oscillator, and increasing the grid potential up to the point where the grid ran white-hot did not improve matters.

However, upon substitution of the type 852 tubes, as shown in Figure 2, the circuit settled down and operated strictly in accordance with Hoyle—or, rather, Kozanowski. It was necessary to apply at least 200 volts to the grids before the power output became sufficiently great to light a small flashlight bulb.

RECEIVER CIRCUITS

Figure 4, below, shows resonating crystal and tube receivers. Figures 6 and 7, at right, show the crystal receiver and the simple tube receiver, respectively





With the accelerating potential increased to 500 volts it was possible to obtain a power output between 5 and 6 watts. With this voltage applied to the grids, the filament circuit of each tube should be adjusted, by means of R1 and R2, to limit the grid current to about 250 milliamperes per tube. Careful matching of tubes is unnecessary when provision is made for this adjustment. The negative plate potential should be about 110 volts. The plate current varies from 5 to 6 milliamperes, while the oscillatory current in the plate Lecher circuit is about 2.5 amperes at no load.

Needless to say, the grids of the tubes become extremely hot, but since the filament emission is not excessive, the life of the tubes should not be materially shortened.

It will be found that the negative plate voltage, for best output, is rather critical, and that as the plate voltage is increased from the optimum value, the power output decreases proportionately. This condition suggests that the circuit is readily amenable to modulation, which can be effected most economically due to the fact that the power required is only about 6 watts. The usual straight-line considerations are involved, and the steady plate voltage should be set midway between the optimum value and the point at which oscillations cease.

Construction Details

The constructional details are well illustrated in the photographs. The Lecher wires are made of ¼-inch copper rods, supported rigidly by isolantite and R-39 insulating material. The filament choke coils consist of 15 turns of No. 12 double-cotton-covered wire, wound with a ¾-inch diameter. The plate-circuit chokes can be the same, or, if more convenient, of 20 turns of No. 18 enameled wire, with a diameter of ½ inch, and stretched, spring fashion, until they are two inches long.

Once the oscillator is functioning satisfactorily, there remains the problem of providing a suitable antenna system and of coupling it to the plate Lecher circuit. The most interesting features of ¾-meter experimentation are, perhaps, the miniature radiating systems and the sharp directional effects which they can be made to produce.

The simplest antenna consists of a 15-inch piece of copper rod (Lecher wire material), one end of which is clipped to the plate Lecher circuit. Any desired amount of coupling can be obtained by clipping the rod antenna at different points along the plate circuit. While a simple radiator of this description will work fairly well, it is definitely inferior in efficiency to the reflector systems shown in Figures 4 and 5. The antenna is a current-fed doublet and is located in the focus of a semi-parabolic reflector. The feeder system is one wavelength long and is inductively coupled to the plate Lecher circuit. The mechanical degree of coupling can be ascertained by reference to Figure 5. A reflector of this type will concentrate the radiation in a fairly sharp beam which will be many times more powerful than that emanating from an open antenna system.

Antennas and Feeders

A later version of the reflector, which gave improved results, was similar to the above described arrangement with the exception that the feeder system, three-quarters of a wavelength long, was clipped directly to the Lecher system. It is probable that this voltage-feed method is to be preferred, as it is rather difficult to obtain satisfactory inductive coupling to the Lecher circuit because of its shape.

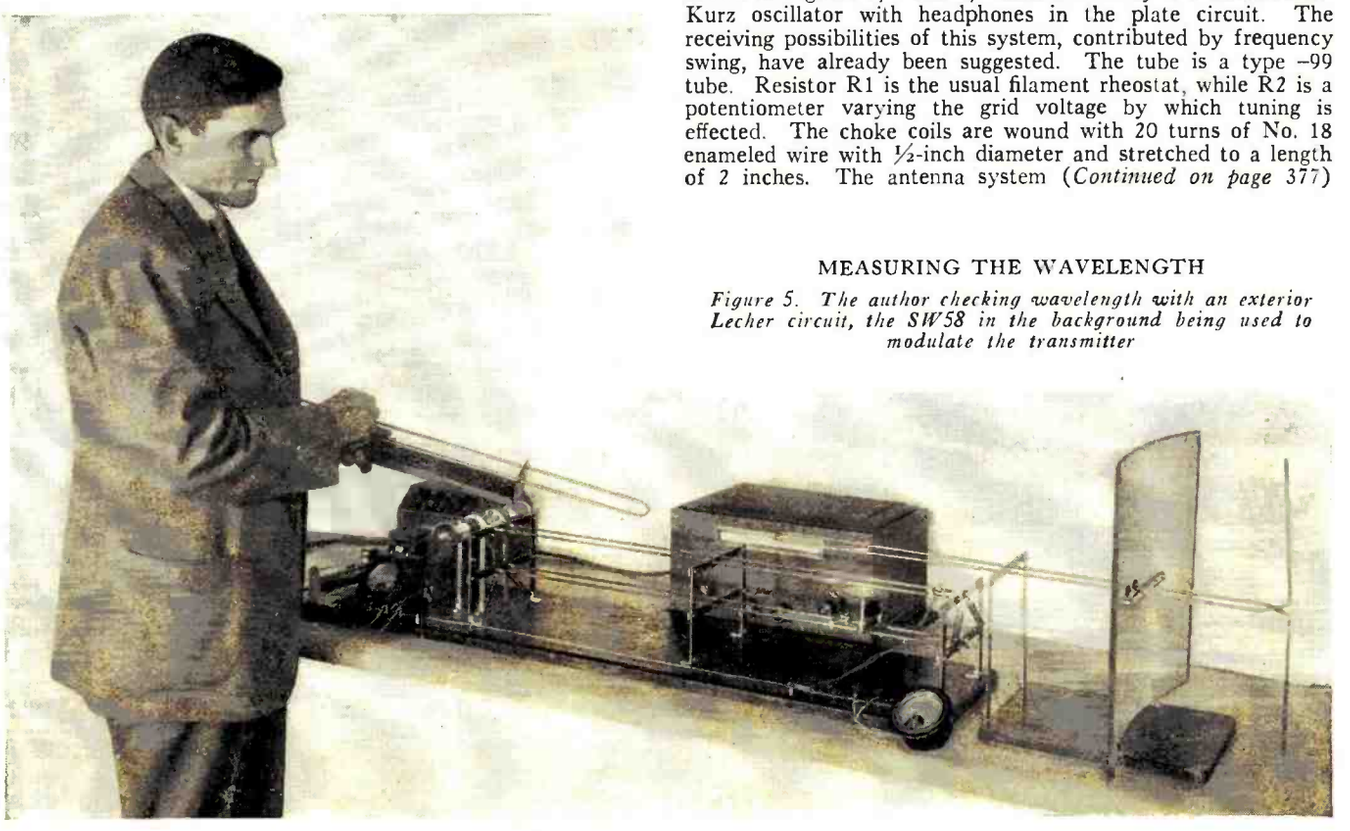
The wavelength of the radiated wave may be measured on an independent Lecher system if desired, as shown in Figure 5. The slide may be either a sensitive microammeter, a small flashlight bulb (when relatively high powers are being radiated) or a simple short-circuiting bar, resonance being indicated in the latter case by a variation in the plate Lecher oscillatory current. However, checking in this way is hardly essential, because, as already explained, the radiated wavelength is equal (with negligible error) to the measured distance between where the Lecher wires connect to the plates (within the tubes) and the terminating bridge.

Before extensive experiments can be carried out, it is essential to have some form of receiver. The simplest is the crystal unit diagrammed in Figure 6 and photographed in Figure 4. This consists of an iron pyrite crystal detector connected between two 7-inch lengths of rod—the overall length approximating 15 inches or ½ wavelength at 75 centimeters. The headphones are connected directly across the detector.

This arrangement, while insensitive, is extremely useful in checking modulation, the directional effects of different radiators, etc., due to the fact that its low sensitivity permits its use in the immediate field of the transmitter. An interesting phenomenon will be observed in a preliminary search with this receiver. When the antenna rods of the receiver are parallel with those of the transmitter, the received signal will be strong; at right angles the signal cannot be heard—demonstrating the sharply polarized nature of the radiated wave.

Receiver Equipment

A receiver more practical for communication purposes is shown in Figures 7, 8 and 4, which essentially is a Barkhausen-Kurz oscillator with headphones in the plate circuit. The receiving possibilities of this system, contributed by frequency swing, have already been suggested. The tube is a type –99 tube. Resistor R1 is the usual filament rheostat, while R2 is a potentiometer varying the grid voltage by which tuning is effected. The choke coils are wound with 20 turns of No. 18 enameled wire with ½-inch diameter and stretched to a length of 2 inches. The antenna system (*Continued on page* 377)



MEASURING THE WAVELENGTH

Figure 5. The author checking wavelength with an exterior Lecher circuit, the SW58 in the background being used to modulate the transmitter

Radio Call Book Section

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

Consolidated Short-Wave Station List

By Wavelength, Frequency, Call, Location and Time

Wavelength Meters	Frequency Kc	Call Letters	Location	Service and Schedule
5.80	51,724	RW61	Moscow, U. S. S. R.	Broadcast
7.05	42,530	.....	Berlin, Germany	Exp. Tue., Thurs. 11:30 A.M. 1:30 P.M.
9.68	31,000	W8XI	Pittsburgh, Pa.	Phone.
10.79	27,800	W6XD	Palo Alto, Cal.	Phone.
11.55	25,960	G5SW	Chelmsford, Eng.	Exp.
11.67	25,700	W2XBC	New Brunswick, N. J.	Phone.
12.37	24,380	VE9GW	Bowmanville, Ont. Can.	Phone.
12.48	24,000	W6XQ	San Mateo, Cal.	Phone.
13.92	21,540	W8XK	Saxonburg, Pa.	Phone. 6:30-11 A.M.
14.01	21,420	W2XDJ	Deal, N. J.	Phone.
14.01	21,420	WKK	Lawrenceville, N. J.	Phone. to LSN; 8 A.M.-4 P.M.
14.18	21,160	LSM	Buenos Aires, Argentine	Phone. to Europe; before noon
14.25	21,060	WKA	Lawrenceville, N. J.	Phone. to England; 8 A.M.-4 P.M.
14.27	21,020	LSN	Buenos Aires, Argentine	Phone. to WLO; 8 A.M.-4 P.M.
14.27	21,020	OKI	Podebrady, Chechoslovakia	Phone.
14.49	20,700	LSY	Buenos Aires, Argentine	Phone. 1-2 P.M. irregular
14.50	20,680	LSX	Buenos Aires, Argentine	Phone. to U. S.
14.50	20,690	LSN	Buenos Aires, Argentine	Phone. to Europe; after 10:30 P.M
14.53	20,640	.....	Paris, T. S. F., France	Phone. to Saigon
14.59	20,560	PMB	Malabar, Bandoeng, Java	Phone. to PCK; 3:10 A.M.-4:40 A.M.; 8-9:20 P.M.
14.62	20,500	W9XF	Chicago, Ill	Phone.
14.72	20,380	GBA	Rugby, England	Phone. to ships and LSN; irregular
14.97	20,040	OPL	Leopoldville, Belgian Congo	Phone. to Brussels; mornings
15.04	19,947	DIH	Nauen, Germany	Phone.
15.08	19,900	LSG	Buenos Aires, Argentine	Phone. to FTM; 10:30 A.M.-3:30 P.M.
15.10	19,850	WMI	Deal, N. J.	Phone.
15.12	19,840	FTD	Paris, France	Phone.
15.14	19,820	WKN	Lawrenceville, N. J.	Phone. to England; 8 A.M.-4 P.M.
15.21	19,720	EAQ	Madrid, Spain	Phone. to S. A.; 11 A.M.-2 P.M. 4 P.M.
15.24	19,680	CEC	Santiago, Chile	Phone. to Argentine; 6 P.M.
15.45	19,420	FRO-FRE	Paris, France	Phone.
15.50	19,355	FTM	Paris, France	Phone. to LSG; 10 A.M.-2 P.M.
15.51	19,350	.....	Nancy, France	Phone 4-5 P.M.
15.57	19,260	PPU	Rio de Janeiro, Brazil	Phone. to FTM; 10:30 A.M.-3:30 P.M.
15.58	19,240	DFA	Nauen, Germany	Phone. to XDA; 10 A.M.-2 P.M. irregular
15.60	19,220	WNC	Lawrenceville, N. J.	Phone. to England; 8 A.M.-4 P.M.
15.62	19,200	ORG	Brussels, Belgium	Tests 11-11:30 A.M.
15.77	19,020	WKW-W2XBJ	Rocky Point, N. Y.	Tests, mornings
15.82	18,960	LSR	Buenos Aires, Argentine	Phone. to Chili; 11 A.M. and 4 P.M.
15.90	18,890	ZSS	Klipheuvel, So. Africa	Phone. to GAA; 3-8 A.M.
15.94	18,820	PLE	Malabar, Bandoeng, Java	Phone. to PCK; 5:40-10:40 Tu., Fri.
16.06	18,680	OCI	Lima, Peru	Tests with HJY; 2 P.M.
16.11	18,620	GBU	Rugby, England	Phone. to WMI; 6 A.M.-2 P.M.
16.15	18,580	GBJ	Bodmin, England	Phone. to Montreal
16.27	18,440	HJY	Bogota, Colombia	Phone. to Chile and Argentine; 6 P.M.
16.32	18,382	FRS	Saigon, Indo-China	Phone. 1-3 P.M. Sundays
16.35	18,350	ZLW	Wellington, New Zealand	Phone. VK2ME, irregular
16.36	18,340	WLA	Lawrenceville, N. J.	Transatlantic phone.; 8 A.M.-4 P.M.
16.38	18,310	GBS	Rugby, England	Phone. to WND; 6 A.M.-2 P.M.
16.39	18,295	YVQ	Maracay, Venezuela	Tests with Spain and Germany; 2 P.M., 3 P.M., 4 P.M.
16.43	18,250	FTO-FTE	Paris, France	Phone. to FZR; 5-9 A.M.
16.50	18,180	CGA	Drummondville, Quebec	Phone. to England
16.53	18,145	PMC	Tjimindi Bandoeng, Java	Phone. to PCV; 3:10-9:20 A.M.
16.48	18,200	GBW	Rugby, England	Phone. to WNC
16.57	18,100	W9XAA	Chicago, Illinois	Tests mornings
16.57	18,100	GBK	Bodmin, England	Phone. to CGA; 6 A.M.-2 P.M.
16.65	18,020	KQJ	Bolinas, California	Tests
16.81	17,850	PLF	Malabar Bandoeng, Java	Phone.
16.80	17,860	W2XAO	New Brunswick, N. J.	Phone.
16.82	17,795	PCV	Kootwijk, Holland	Phone to Java 6-9 A.M.
16.37	17,780	W8XK	Saxonburg, Pa.	Exp.
16.87	17,780	W3XAL	Bound Brook, N. J.	Broadcast 7 A.M.-3 P.M. weekdays
16.88	17,775	PHO	Huizen, Holland	Broadcast, 7-9 A.M. daily exc. Tues.
16.88	17,775	PHI	Huizen, Holland	Phone. to Java
17.02	17,630	PMW	Malabar, Bandoeng, Java	Broadcast
17.05	17,040	.....	S. S. Conteraggo	Phone., sometimes broadcast 6-8 A.M., 11 A.M.-1 P.M.
17.05	17,040	WSBN	S. S. Leviathan	Phone.
17.05	17,040	GFWV	S. S. Majestic	Phone.
17.05	17,040	GLSQ	S. S. Olympic	Phone.
17.05	17,040	GDLJ	S. S. Homeric	Phone.
17.05	17,040	GMJQ	S. S. Belgenland	Phone.
17.05	17,040	GTSD	S. S. Monarch of Bermuda	Phone.
17.05	17,040	GKFY	S. S. Minnetonka	Phone.
17.05	17,040	GMBJ	S. S. Empress of Britain	Phone.
17.24	17,400	JIAA	Tokio, Japan	Phone. to Australia
17.34	17,300	VE9BY	London, Ont. Can	Broadcast irregular
17.34	17,300	W8XL	Dayton, Ohio	Exp.
17.34	17,300	W6XAJ	Oakland, Cal.	Exp.
17.34	17,300	W2XCU	Ampere, N. J.	Exp.
17.34	17,300	W9XL	Anoka, Minn.	Exp.
17.52	17,120	WOO	Deal, N. J.	Transatlantic phone.
17.52	17,120	W2XDO	Ocean Gate, N. J.	Exp.
17.56	17,080	GBC	Rugby, England	Phone.
18.00	16,665	DAN	Norddeich, Germany	Tests with ships, irregular
18.37	16,330	VLK-VK2ME	Sydney, Australia	Broadcast; 3-6 A.M.
18.40	16,305	PCL	Kootwijk, Holland	Phone. to Bandoeng from 7 A.M.
18.40	16,270	WLO	Lawrenceville, N. J.	Phone. to England
18.44	16,270	WLK	Lawrenceville, N. J.	Phone. to England
18.48	16,233	FZR	Saigon, Indo-China	Phone.
18.59	16,140	GBX	Rugby, England	Phone. to VK2ME 4-11 P.M.
18.68	16,060	NSS	Annapolis, Md.	11:55 to noon (time signal)
18.71	16,030	KKP	Kauhuku, Hawaii	Phone. to KWO; 2-7 P.M.
18.81	15,950	PLG	Tjimindi, Bandoeng, Java	Phone. afternoons
18.89	15,880	FTK	Paris, France	Phone. to FZS; 9-10 A.M.
19.04	15,760	JIAA	Tokio, Japan	Tests up to 10 A.M.
19.53	15,355	KWU	Dixon, Calif.	Phone. to Hawaii, 2-7 P.M.
19.53	15,355	KWO	Dixon, Calif.	Phone. to Hawaii, 2-7 P.M.
19.55	15,340	W2XAD	Schenectady, N. Y.	Broadcast; 3-6 P.M. daily—1-6 P.M., Sat., Sun.
19.61	15,300	OXY	Lyngby, Denmark	Exp.
19.61	15,300	OXO-OXZ	Copenhagen, Denmark	Broadcast
19.61	15,300	.....	Tandjong Priok, Batavia, Java	Broadcast
19.61	15,300	W6XAL	Westminster, Calif	Phone.
19.68	15,245	.....	Paris, France	Broadcast; 7-10 A.M.
19.72	15,210	W8XK	Saxonburg, Pa.	Broadcast; 6:30 A.M.-4 P.M. daily
19.74	15,200	DJB	Koenigswusterhausen, Ger.	Broadcast; 8 A.M.-noon
19.74	15,200	JIAA	Tokio, Japan	Broadcast, irregular
19.84	15,120	HVJ	Vatican City, Italy	Broadcast; 5-5:15 A.M., daily
20.00	15,000	T14NRH	Heredia, Costa Rica	Sat., Sun., Mon.-11 A.M.-noon. 4-5 P.M.
20.00	15,000	CM6XJ	Central Tuinucu, Cuba	Broadcast, irregular
20.23	14,830	WKU-W2XBJ	Rocky Point, N. Y.	Tests daytime
20.43	14,690	PSD	Rio de Janeiro, Brazil	Tests with LSN near 6 P.M.
20.50	14,630	XDA	Mexico City, Mexico	Broadcast; 2:30-3 P.M.
20.51	14,620	XDA	Mexico City, Mexico	Tests with XAM; 2:30-3 P.M.
20.56	14,590	WMN	Lawrenceville, N. J.	Phone to England daylight
20.64	14,535	HBJ	Geneva, Switzerland	Tests
20.65	14,530	LSN	Buenos Aires, Argentine	Phone. to England; daylight
20.70	14,480	W8XK	Saxonburg, Pa	Phone.
20.73	14,470	WNC	Lawrenceville, N. J.	Phone. to England; daylight
20.78	14,440	GBW	Rugby, England	Phone. to WNC; 6 A.M.-6 P.M.
20.80	14,425	VPD	Suva, Fiji Islands	Phone.
20.95	14,310	G2NM	Sonning-on-Thames, England	Broadcast; 1:30 P.M., Sun.
21.52	13,940	YOI	Bucharest, Roumania	Broadcast; 2-5 P.M., Wed., Sat.
21.62	13,870	WIY	Rocky Point, N. Y.	Tests, irregular
21.72	13,811	SUZ	Abu Zabal, Cairo, Egypt	Phone. to GBC, daily up to 3:30 P.M.
21.77	13,780	KKW	Bolinas, Calif.	Tests
21.90	13,699	KKZ	Bolinas, Calif.	Tests, irregular
22.26	13,480	WAJ	Rocky Point, N. Y.	Tests
22.40	13,390	WND	Lawrenceville, N. J.	Transatlantic phone.
22.52	13,320	GBC	Rugby, England	Phone. CGA and ships afternoons
22.58	13,285	CGA	Drummondville, Can.	Phone. GBC; 8 A.M. to 2 P.M.
22.68	13,230	.....	S. S. Conteraggo	Phone., sometimes broadcast; 6-8 A.M.-11 A.M. to 1 P.M.
22.68	13,230	GFWV	S. S. Majestic	Phone.
22.68	13,230	GLSQ	S. S. Olympic	Phone.
22.68	13,230	GMJQ	S. S. Belgenland	Phone.
22.68	13,230	GDLJ	S. S. Homeric	Phone.
22.68	13,230	WSBN	S. S. Leviathan	Phone.
22.68	13,230	GTSD	S. S. Monarch of Bermuda	Phone.
22.68	13,230	GKFY	S. S. Minnetonka	Phone.
22.68	13,230	GMBJ	S. S. Empress of Britain	Phone.
22.94	13,080	JIAA	Tokio, Japan	Tests, irregular
23.06	13,010	FZG	Saigon, French Indo-China	Broadcast
23.35	12,850	W2XO	Schenectady, N. Y.	Broadcast; 9 P.M. Mon.-3 A.M. Tu., Antipodal program; 12-5 P.M., Tu., Thu., Sat.
23.35	12,850	W9XL	Anoka, Minn.	Broadcast
23.35	12,850	W2XCU	Ampere, N. J.	Exp.
23.36	12,840	WOO	Ocean Gate, N. J.	Phone. to ships irregular
23.40	12,830	.....	Rabat, Morocco	Phone. to Ste. Assise; 7:30-9 A.M., Sun., 5-7 A.M., daily
23.45	12,795	IAC	Coltana, Italy	Tests
23.47	12,780	GBC	Rugby, England	Phone.
24.00	12,500	CT3AQ	Funchal, Madeira	Broadcast; 4-6:30 P.M., Tu., Thurs., 10:30-noon Sun.
24.02	12,490	DAN	Norddeich, Germany	Phone. to ships, noon—3 P.M.; 4-9 A.M.
24.40	12,295	ZLT	Wellington, New Zealand	Phone. to VK2ME; 3-8 A.M.
24.40	12,295	PLM	Bandoeng, Java	Phone. VK2ME; 6:30 A.M.
24.41	12,290	GBU	Rugby, England	Phone. to WMI; 2-7 P.M.
24.47	12,260	FTN	Paris, France	Phone. Buenos Aires, Indo-China Java, U. S. A., 9 A.M.-1 P.M. and other hour
24.46	12,265	PLM	Bandoeng, Java	Phone. 7:45 A.M.
24.69	12,150	GBS	Rugby, England	Transatlantic phone. to Deal, N. J., WND, 2-7 P.M.
24.67	12,160	FQO-FQE	Paris, France	Phone.

(Continued next month)

Broadcasting Stations in North America

(Exclusive of the United States)

Alphabetically by Call Letters, Location, Frequency and Power, Including Frequencies from 550 to 1500 Kilocycles

Canada

Call	Location	Kilocycles	Watts
CFAC	Calgary, Canada	690	500
CFBA	St. John, N. B.	890	500
CFCA	Toronto, Ont.	840	500
CFCF	Montreal, Quebec	1031	500
CFCH	North Bay, Ont.	930	100
CFCL	Toronto, Ont.	580	500
CFCN	Calgary, Alta.	985	10000
CFCO	Chatham, Ont.	1210	100
CFCT	Victoria, B. C.	630	50
CFCY	Charlottetown, Prince Edward	580	500
CFJC	Kamloops, B. C.	1120	15
CFLC	Prescott, Ont.	930	50
CFNB	Fredericton, N. B.	1210	50
CFQC	Saskatoon, Sask.	910	500
CFRB	Toronto, Ont.	690	4000
CFRC	Kingston, Ont.	930	250
CHCK	Charlottetown, Prince Edward	1010	100
CHGS	Summerside, Prince Edward	1120	100
CHLS	Vancouver, B. C.	730	50
CHMA	Edmonton, Alberta	580	250
CHML	Hamilton, Ont.	880	50
CHMS	Halifax, N. S.	930	500
CHRC	Quebec	645	100
CHWC	Regina, Sask.	960	500
CHWK	Chilliwack, B. C.	665	100
CHYC	Montreal, Quebec	730	500
CJBR	Regina, Sask.	960	500
CJCA	Edmonton, Oliver, Alta.	930	500
CJCB	Sydney, N. S.	880	50
CJCJ	Calgary, Alta.	690	500
CJGS	London, Ont.	910	500
CJGX	Yorkton, Sask.	630	500
CJOC	Lethbridge, Alta.	1120	100
CJOR	Vancouver, B. C.	1210	500
CJRM	Moose Jaw, Sask.	665	600
CJRW	Fleming, Sask.	665	500
CJSC	Toronto, Ont.	840	5000
CKAC	Montreal, Que.	730	5000
CKCD	Vancouver, B. C.	730	50
CKCI	Quebec	645	100
CKCK	Regina, Sask.	960	500
CKCL	Toronto, Ont.	580	500
CKCO	Ottawa, Ont.	890	100
CKCR	Waterloo, Ont.	645	50
CKCV	Quebec	880	50
CKFC	Vancouver, B. C.	730	50
CKGW	Toronto, Ont.	840	5000
CKIC	Wolfeville, N. S.	1010	50
CKLC	Red Deer, Alta.	840	1000
CKMC	Cobalt, Ont.	1210	100
CKMO	Vancouver, B. C.	730	100
CKNC	Toronto, Ont.	580	500
CKOC	Hamilton, Ont.	880	50
CKOV	Kelowna, B. C.	1200	100
CKPC	Preston, Ont.	1210	50
CKPR	Ft. Williams, Ont.	890	50
CKUA	Edmonton, Alta.	580	500
CKWX	Vancouver, B. C.	730	100
CKY	Winnipeg, Man.	780	5000
CKX	Brandon, Man.	540	500
CNRA	Moncton, N. B.	630	500
CNRD	Red Deer, Alta.	840	1000
CNRH	Halifax, N. S.	930	500
CNRL	London, Ont.	910	500
CNRM	Montreal, Que.	730	5000
CNRO	Ottawa, Ont.	600	500
CNRQ	Quebec	880	50
CNRR	Regina, Sask.	960	500
CNRS	Saskatoon, Sask.	910	500
CNRT	Toronto, Ont.	840	500
CNRV	Vancouver, B. C.	1030	500
CNRW	Winnipeg, Man.	780	5000
CNRX	Toronto, Ont.	690	4000
CPRY	Toronto, Ont.	840	5000
VE1OAB	Moose Jaw, Sask.	1425	25
VE1OAK	Stratford, Ont.	1200	10
VE1OAY	Kelowna, B. C.	1200	15
VE1OBI	Prince Albert, Sask.	1200	25
VE1OBP	Wingham, Ont.	1200	15
VE1OBQ	Brantford, Ont.	1200	15
VE1OBU	Concord, Sask.	1200	15
VE1OCB	Liverpool, N. C.	1200	15
VOGT	Bell Island, N. F.	890	
VONA	St. Johns, N. F.	950	
VOWR	St. Johns, N. F.	675	
VOX	St. Johns, N. F.	1400	
VO8RA	St. Johns, N. F.	950	

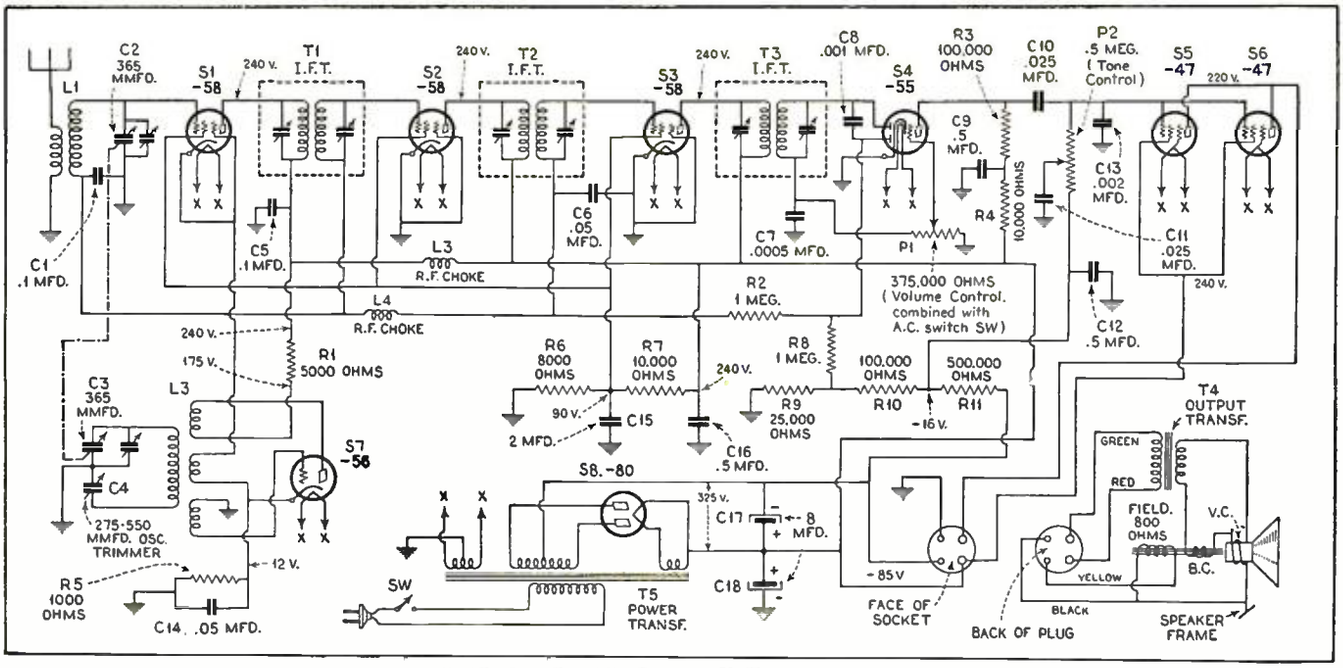
Cuba

Call	Location	Kilocycles	Watts
CMAB	Pinar del Rio	1249	20
CMAC	Pinar del Rio	1375	30
CMBC	Havana	965	150
CMBD	Havana	965	150
CMBG	Havana	1070	150
CMBI	Havana	1405	30
CMBL	Havana	1500	20
CMBN	Havana	1405	30
CMBS	Havana	790	150
CMBT	Havana	790	150
CMBW	Marianao	1010	150
CMBY	Havana	1225	150
CMBZ	Havana	1010	150
CMC	Havana	840	500
CMCA	Havana	1225	150
CMCB	Havana	1070	150
CMCD	Havana	925	25
CMCF	Havana	890	250
CMCG	Guanaoacoa	1345	30
CMCH	Havana	1405	50
CMCJ	Havana	620	250
CMCM	Marianao	1405	15
CMCN	Marianao	925	250
CMCO	Marianao	660	250
CMCQ	Havana	1150	600
CMCR	Havana	1345	150
CMCU	Havana	1285	150
CMCW	Havana	1345	15
CMDC	Marianao	660	500
CMGA	Colon	834	100
CMGB	Matanzas	1205	7½
CMGD	Matanzas	1140	5
CMGE	Cardenas	1375	30
CMGF	Matanzas	977	50
CMGH	Matanzas	1370	150
CMHC	Tuinucu	790	100
CMHD	Caibarien	950	250
CMHI	Santa Clara	1110	15
CMHJ	Cienfuegos	645	40
CMJC	Camaguey	1382	15
CMJE	Camaguey	856	20
CMJF	Camaguey	930	50
CMK	Havana	730	3150
CMKC	Santiago de Cuba	1034	150
CMQ	Havana	1150	250
CMW	Havana	588	1400
CMX	Havana	890	500

Mexico

Call	Location	Kilocycles	Watts
XEA	Guadalajara	1000	100
XEB	Mexico	1030	1000
XEC	Toluca	1000	50
XED	Reynosa	965	1000
XEE	Oaxaca	1000	100
XEFA	Mexico	1250	250
XEFB	Monterey	1270	50
XEFC	Merida	1050	10
XEFD	Tia Juana	1020	300
XEFE	Nuevo Laredo	1000	100
XEFI	Chihuahua	1000	100
XEFS	Queretero	1000	40
XEG	Mexico	1360	100
XEH	Monterey	1132	1000
XEI	Morelia	1000	100
XFJ	Ciudad Juarez	1000	100
XEK	Mexico	990	100
XEL	Saltillo	1000	100
XEM	Mexico	1300	250
XEN	Mexico	711	1000
XEO	Mexico	940	5000
XEP	Nuevo Laredo	1400	200
XEQ	Ciudad Juarez	750	5000
XER	Vera Cruz	1000	100
XES	Tampico	890	500
XET	Monterey	690	500
XETA	Mexico	1140	500
XETB	Torreon	1380	125
XETC	Jalapa	1000	100
XETF	Vera Cruz	630	500
XETG	Torreon	1000	100
XETQ	Mexico	1230	100
XEV	Puebla	1000	100
XEW	Hacienda de Coapa, Mex.	910	5000
XEX	Mexico	1210	500
XEY	Merida	1000	100
XEZ	Mexico	780	500
XFC	Aguascalientes	805	350
XFG	Mexico	638	2000
XFH	Mexico		250
XFI	Mexico	818	1000
XFX	Mexico	860	500

THE END



THE SCHEMATIC CIRCUIT DIAGRAM

Figure 3. The -55 second detector serves a triple function as second detector, a.v.c., and first audio tube. The filter system as described in the text is of particular interest

Tube Saving "Super" Design

New tubes plus careful design make it possible to produce this full-size console-type receiver to sell in the midget price class, although it provides the modern refinements

By McMurdo Silver*

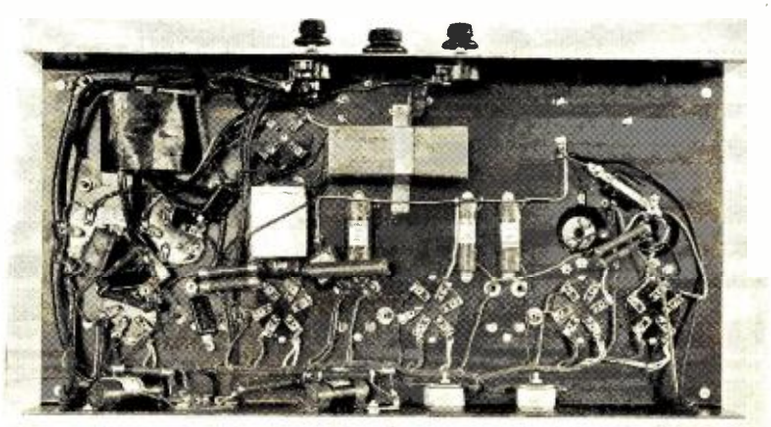
IN the October, 1932, issue of RADIO NEWS the writer illustrated and described a six-tube superheterodyne essentially of the midget type as an illustration of what could be done by careful engineering to bring down the price of a thoroughly good radio receiver to the then depression price levels. No sooner had this design been completed and prepared for production than it began to look as though Old Man Depression was starting to move on, and as it became apparent that John Public would raise his ante from $35.00 to $39.00 to $49.00 or $50.00 for a better radio, work was started to see just how much value could be given to him for the latter price.

The result is illustrated and diagramed herewith—a broadcast superheterodyne having only eight tubes, but actually a ten-tube set since ten separate and distinct tube functions are provided in it, this by virtue of the now increasingly popular -55 tube, the duo-diode-triode, the different elements of which act as second detector, a.v.c. tube and first audio stage.

This new set, built to retail for less than fifty dollars in a full-sized console, complete with a kit of standard tubes, is somewhat of a revelation, since it offers many characteristics found today in competitive commercial broadcast receivers selling at from two to three times its price. Its sensitivity ranges from one to two microvolts absolute, from 550 to 1500 kc.; its selectivity is absolute 10 kc.; its fidelity flat to five decibels from 40 to 4000 cycles; its undistorted power output is from five to six watts, and it has a.v.c. and a 10½-inch dynamic speaker—all this definitely proves that all engineers do not deserve the customary appellation of "one who can do half as much at twice the cost."

ASSEMBLY VIEW

Figure 2. The "below deck" assembly, where all "hot" leads are kept short to limit the shielding requirements

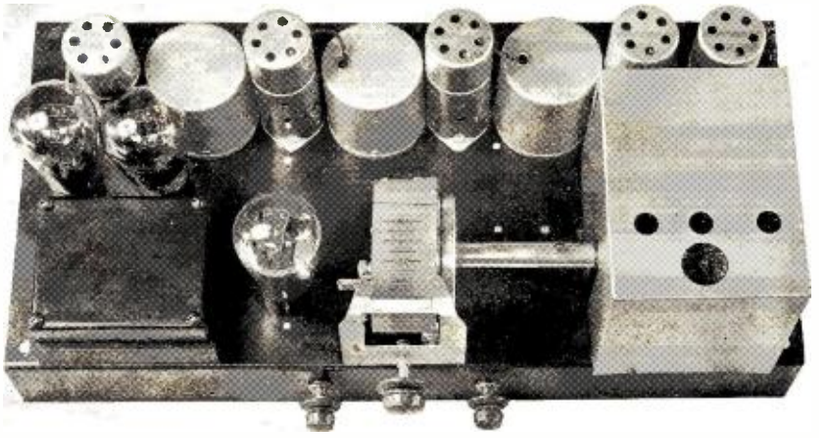


The receiver is illustrated in Figures 1 and 2, with its circuit in Figure 3 and its selectivity and a.v.c. curves in Figures 4 and 5. No sensitivity or fidelity curves are given, as it is felt that their general nature is familiar to all readers, and it seems foolish to give space to a sensitivity curve, for instance, which is merely a straight line between 1 microvolt at 550 kc. and 2 microvolts at 1500 kc., absolute. Likewise, a fidelity curve down 3 db. at 40

* President, Silver-Marshall, Inc.

cycles, flat from 70 to 1500 cycles, and then sloping off gradually to 7 db. down at 4000 cycles is not particularly original to readers of any of the writer's previous articles.

The selectivity curve of Figure 4 is quite interesting, however, for while it is only 30 kc. broad at 10,000 times down, or sharp enough for good 10 kc. selectivity, is just over 10 kc. wide at two times down, which accounts for the excellent high frequency response obtained with practically no circuit or speaker compensation whatsoever.



THE EIGHT-TUBE CHASSIS

Figure 1. This new receiver is simple, compact and presentable. It is available in a full-size console with 10½-inch dynamic speaker

The a.v.c. curve of Figure 5 tells a quite interesting story of the real efficiency of the new –55 tube, for it shows that practically maximum volume (to the ear) is reached at 30 microvolts absolute input, and that it is held constant from there on up for stronger signals. The maximum output is limited to 5.4 watts, ample for home entertainment, yet low enough to hold the harmonic distortion of the two –47 output pentodes well down and to absolutely eliminate blasting as strong local stations are tuned in.

The Power Stage

Looking at Figure 1, the tubes are, right to left rear, the –56 oscillator, –58 first detector, two –58 i.f. stages, and the –55 diode second detector, diode a.v.c. and triode first audio tube. In front of the –55 are the two –47 pentodes and to their right the –80 rectifier.

The reasons for the choice of –47 output pentodes instead of the preferable –45 Class A prime output stage are purely economic—competitive sets use –47's, and while their quality is not quite as good as –45's, it is simply impossible to stand the cost of the Class A prime output stage in a set built to sell complete for such a low price. But the excellent diode second detector takes much of the curse off the pentodes, and the overall tone quality will be quite pleasing to any and all who have not listened critically to a Class A prime amplifier. Likewise, an –80 rectifier is used instead of an –82, since it is more economical and does just as good a job at the power output required by this receiver.

From Figure 2 the simplicity of the chassis assembly is clearly evident and really needs no comment. except to call attention to the very short i.f. plate leads—less than half an inch from sockets to i.f. transformers. This in a large measure accounts for the really beautiful stability of the circuit at high sensitivities with the absolute minimum of circuit isolation. Note also the absence of chassis ends—just one point illustrative of the elimination of all unnecessary refinements to get the cost down.

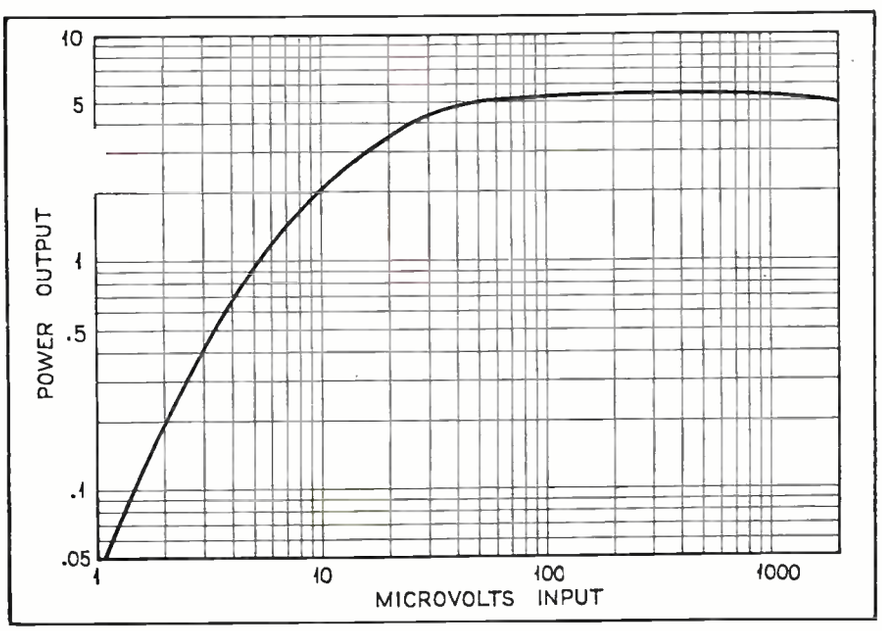
Circuit Analysis

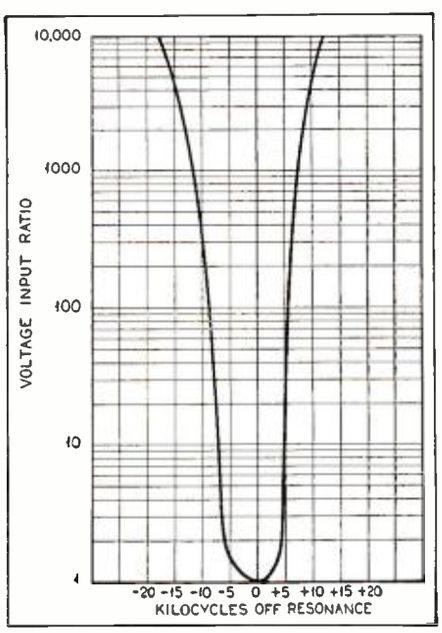
The circuit of Figure 3 is quite familiar up to the second detector (see August, 1932, issue for details). The use of 465 kc. as the intermediate frequency, as in all Silver-Marshall superheterodynes, permits the use of but one tuned r.f. input circuit, with consequent gain in signal-to-noise ratio, yet with complete absence of image-frequency interference.

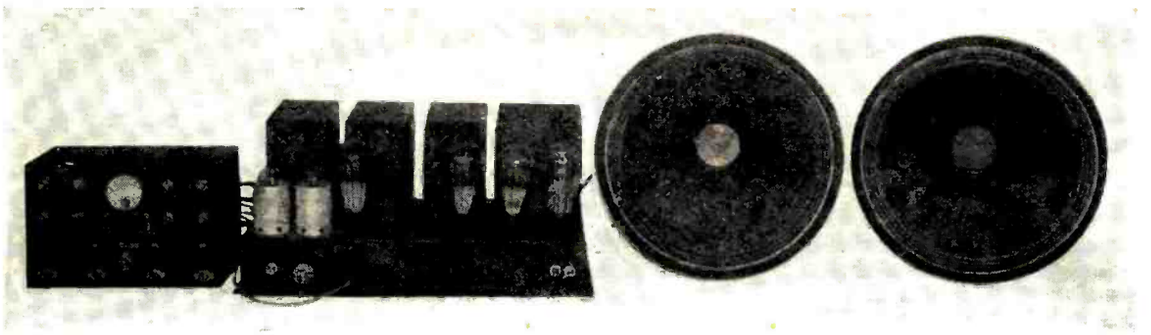
The –55 tube has one anode used as second detector, the rectified a.f. voltage appearing across P1, from the arm of which it is fed to the –55 triode grid for audio amplification. P1 is the volume control. The second diode anode is coupled to the detector anode by C8, and develops a rectified voltage across R8, which with audio modulation filtered out, is used for automatic volume control to vary the biases of the first detector and two i.f. tubes, with their (*Continued on page* 378)

OUTPUT REGULATION CHARACTERISTIC AND SELECTIVITY CURVE

Figure 5 (left). As shown here, any input exceeding approximately 30 microvolts (absolute) produces a constant output at the speaker. Figure 4 (right). The steep walls result in a highly desirable degree of selectivity; at the same time extreme attenuation of the higher audio frequencies is avoided because of the relatively blunt "top"







A COMPLETE P. A. SET-UP

The Class B amplifier is shown here with a universal control box at the left. Two heavy duty auditorium type dynamics or equivalent are required to handle the 20-26 watt output of the amplifier

A New Heavy Duty

CLASS B AMPLIFIER

The introduction of the –46 and –83 type tubes makes Class B amplifiers worthy of the attention of Sound Installation Men. Here is a new amplifier of this type which offers several important advantages

By Leon Littman*

CLASS B power amplification for public-address work is rapidly gaining in favor with the sound-installation engineer, radio dealer, serviceman and radio experimenter. This has been largely brought about with the advent of the new –46 type vacuum tube especially designed for Class B amplifiers.

Heretofore sound-reproducing systems delivering 25 watts power output employed Class A amplification, necessitating the use of four –50 type power tubes and four –81 type rectifier tubes. The Class B amplifier with three –46 type tubes and a single –83 type rectifier is capable of providing this power and offers a striking saving in tube cost with lower operating power consumption as another important advantage.

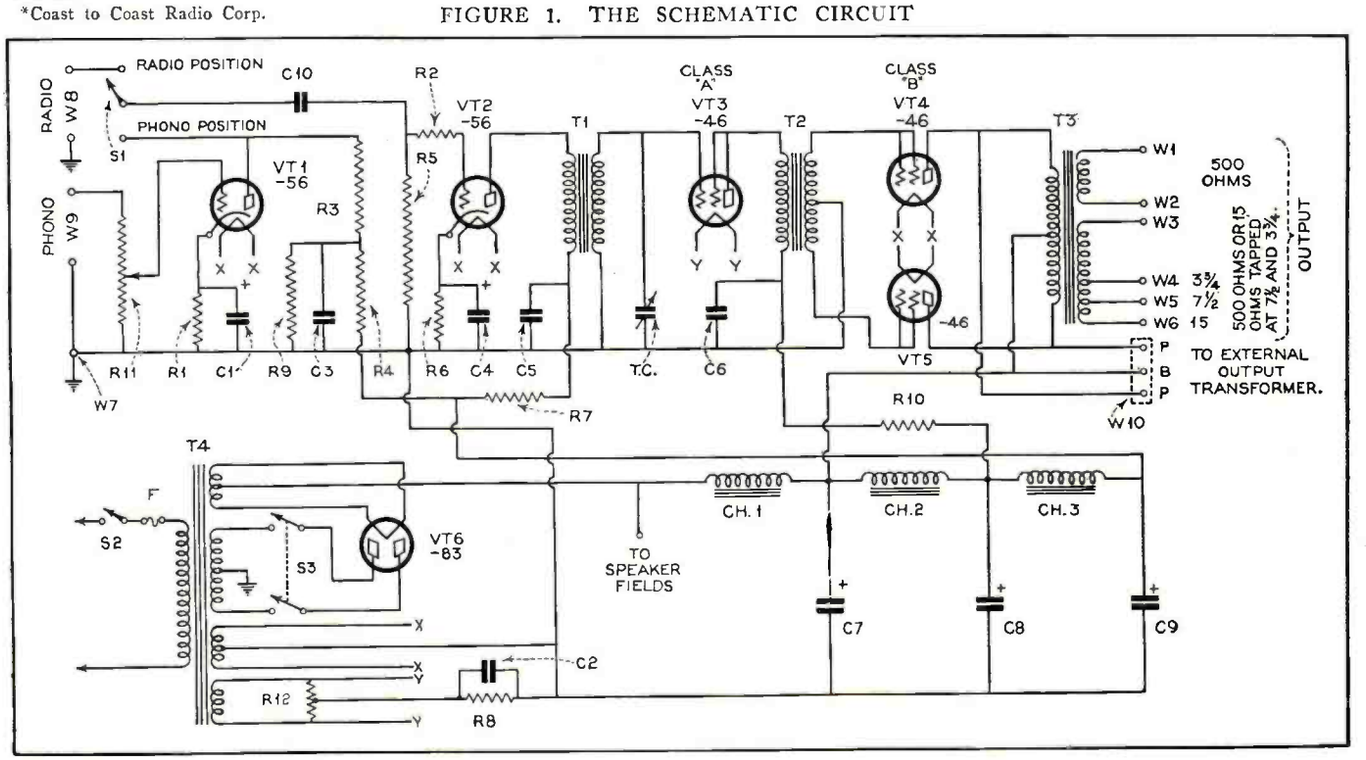
The vacuum tubes for the Class A amplifier in the above comparison list at approximately $45.60, and the tubes required for the Class B unit total $6.20, effecting a saving in tubes alone of $39.40.

The minimum power consumption of a 25-watt Class A amplifier is about 250 watts, while this Class B amplifier consumes 95 watts at full load and 50 watts at no load. The answer to sound-truck installation is found in Class B circuits as the serious drawback to this type of address system has been high wattage consumption.

This article deals with the construction of our four-stage Class B power amplifier designed to provide from 20 to 26 watts of undistorted output power. The amplifier utilizes

*Coast to Coast Radio Corp.

FIGURE 1. THE SCHEMATIC CIRCUIT

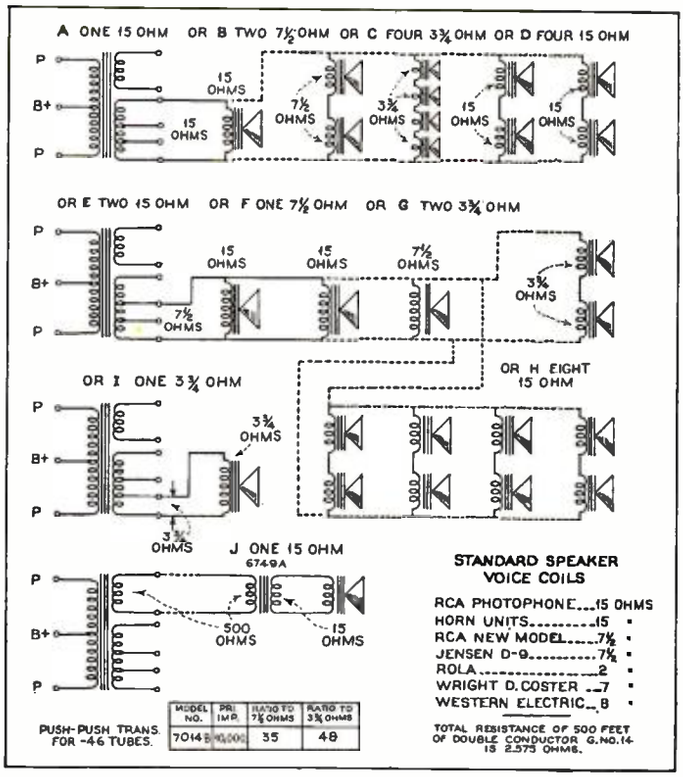


two –56 type tubes, three –46 type and one –83 type rectifier. It is equipped with efficient volume and tone controls and input jacks for connections to microphone, electrical phonograph pick-up and radio tuner.

Circuit Data

By referring to the wiring diagrams in Figure 1 it will be seen that the switch S1 couples the radio tuner to the grid of the –56 tube in the second stage. The resultant amplification would be entirely too great if the tuner was coupled to the first tube. The first stage is employed as a preamplifier circuit for the comparatively weak microphone and and phonograph pick-up impulses.

The output of the first –56 type tube is resistance-coupled to a –56 tube which in turn is coupled to a Class A –46 input or driver tube. This third audio-frequency stage is needed to supply the relatively high grid swing to the two –46 Class B push-push output tubes, through the specially designed step-down transformer, T2.



OUTPUT CONNECTIONS

Figure 2. The output transformer provides great flexibility in speaker arrangement. Here are shown various speaker combinations, together with a table of voice coil impedance values for various popular speakers

The enormous audio-frequency voltage peaks from these –46 Class B tubes are fed through the output transformer T3, which has an output load impedance of 10,000 ohms.

Connections are brought out from the plates of the –46 output tubes and from the high side of the B supply to the triple terminal mounting W10. An external output (10,000 ohms impedance) transformer of a single dynamic speaker can be properly matched at this point.

The output transformer T3 has a secondary winding of 500 ohms for coupling to a line transformer such as type 6749A when the speaker is used 30 or more feet from the amplifier. It is also equipped with a 15-ohm winding tapped at 7½ and 3¾ ohms. These tapped windings provide accommodations for various voice coil values and for multi-speaker systems. For example, a speaker with a 15-ohm voice coil connects across the 15-ohm winding, or this winding also matches two 7.5-ohm voice coils in series, or four 3.75-ohm voice coils in series. Numerous combinations for coupling voice coils of different ohmage are shown in Figure 2.

Care must always be taken that there is a load connected to the output of the amplifier, as the high voltage might otherwise cause a breakdown.

The power supply utilizes the new –83 rectifier tube, which is capable of delivering a continuous direct current of 250 ma. at 500 volts. The output of the tube feeds into a three-stage choke input filter. The power transformer, T4, is so designed that its closed magnetic path is relatively short, it has good voltage regulation and the d.c. resistance of its high-voltage winding is very low. It is imperative that the choke coil Ch.1 have an inductance of at least 10 henries at 200 ma. and its d.c. resistance should be 100 ohms or less.

As the amplifier consumes about 120 ma., there is a current of 130 milliamperes available at 450 volts for field excitation of 1 to 8 dynamic type speakers.

The diagram in Figure 3 shows the methods and coupling connections employed for supplying field excitation of 1 to 4 dynamic speakers with 1000-ohm field windings drawing 110 ma. each, or one to eight 2500-ohm field windings drawing 45 ma. each.

Construction

As to the physical construction of the amplifier, the reader can check the schematic wiring diagram with the parts list and the photograph shown herewith. The underneath view of the chassis with the corresponding symbols as contained in the parts list will show the placement for practically all the small parts.

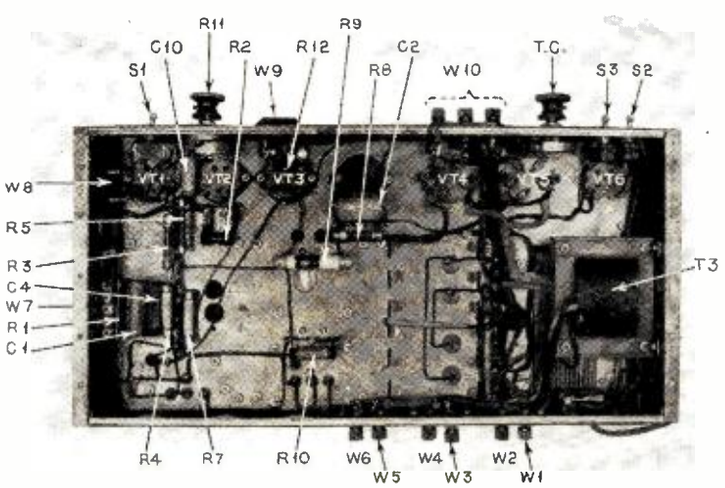
Facing the front of the amplifier, reading from left to right, the shield cans enclose the following parts: The first can contains the triple 4 mfd. filter block, C3, C5 and C6, and the audio-frequency transformer, T1. The second can houses the triple 8 mfd. filter block, C7, C8 and C9, and the input transformer, T2. In the third shield can are the choke coils, Ch.1, Ch.2 and Ch.3. The large can to the extreme right encloses the power transformer, T4.

This amplifier is available in three ways, namely, (1) completely assembled, wired and laboratory tested ready for use; (2) completely assembled but not wired; and (3) as an unassembled kit.

The amplifier measures only 9 inches wide by 9 inches high by 17¾ inches long.

UNDER THE CHASSIS

The parts are marked here with the same symbols used in the list of parts at the end of the article

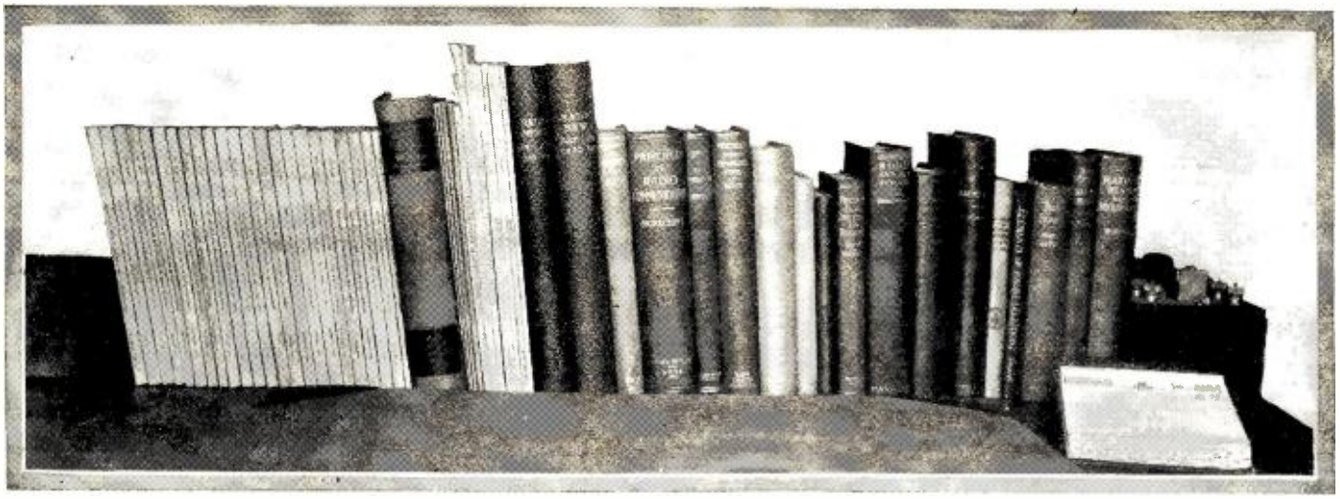


To insure the stability of the amplifier and to obtain the proper gain, it is necessary that all ground connections be well made and joined together with low-resistance connections. Care should be taken, for instance, that the first tube and the filter system have a very low common ground path. It is further absolutely necessary that the input and output circuits of the amplifier be kept away from each other and that they be electrically shielded from each other.

All filament and high-voltage a.c. leads should be twisted together.

(*Cont'd on page* 383)

*Chief Eng., Coast to Coast Radio Corp.



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

Electronics, by Ralph Gorton Hudson; John Wiley & Sons, 1932. This book is a non-mathematical treatise on the electron and the proton. At the present time, nearly all phenomena in physics and chemistry are explained by the electron theory. It is the aim of this book to acquaint the reader with the electron and its properties without going into any extensive mathematical treatment.

The beginning deals with the electron and the proton, their size, velocity, mass, etc., and how these quantities have been measured. Then the structure of different atoms is discussed and finally one comes to the properties of fluids, gases and solids. In later chapters the reader can gain an understanding of electricity, the difference between insulators and conductors, how fast the electrons move, etc. Photo-electric effects and the vacuum tube are treated in the latter part of the book.

The text is written especially for those who have only an elementary knowledge of physics and electricity. It should be of special interest to students of radio because it contains information which usually is not found in the textbook on radio communication.

Radiovisie—Zijn Wezen en Mogelijkheden, by J. G. R. van Dyck; N. V. Viro, Antwerp, Belgium. 1932. (Radiovision—Its Being and Possibilities.) This is No. 1 of a series of books under the general title "Klank en Beeld" (Sound and Image). Its purpose to explain the development of television in a non-technical way to all who read the Dutch or Flemish language. The booklet contains a discussion on the ear and the eye and then goes over to explain the operation of various systems of television, now in use in Europe and in America. An unusual part of the book is the chapter on future possibilities. The author has made a study of the sound of a transmitted picture and the image seen in the televisor when sound is received by it. He suggests that these figures have a definite relation to the transmitted music and should become of interest to authors and composers in order to improve their art.

Perpetual Trouble Shooter's Manual, Volume II, by John F. Rider; Radio Treatise Co. 1932. Volume 2 is a continuation of the well-known Volume I. While Volume 1 contained the diagrams of receivers made during the period from 1919 to October, 1931, Volume 2 contains the newer models, appearing from October, 1931, to May, 1932. It is expected that an additional volume will appear every 6 months, thus making new information available.

In this new volume Mr. Rider has introduced the information necessary for the resistance measurements. The book now contains much additional information besides diagrams. All resistance and condenser values are indicated. In many cases there is a list of the resistance measured between socket contacts, as well as the normal voltage readings. The information on some receivers amounts to an instruction book. Picture diagrams appear for instructions for certain adjustments. The resistance of the coils, chokes and transformers is also indicated. The first part of the book contains a section devoted to the best way of using the available material and what test equipment to employ. Apart from its value for the serviceman, the book deserves to be studied by the engineer and experimenter. Where all values of the components are indicated, benefit can be derived from the study of the most successful designs.

Servicing Receivers by Means of Resistance Measurement, by John F. Rider; Radio Treatise Co. 1932. This addition to Mr. Rider's bookshelf is a plea for a change of service procedure. The present voltage methods are not sufficiently reliable and they do not lead to the location of the trouble without additional resistance measurements, he says. Further, the present analyzer makes it impossible to locate defects if there is no power available. The entire testing procedure can be made more reliable and certain if the serviceman will make a systematic test of the condition of each part and the wiring. The greater part of the book is devoted to a discussion of how this may be done. Mr. Rider reasons that all parts were originally of the right value and placed correctly. Resistors have to be checked for their values, coils and transformer windings for shorts, opens or short-circuited turns, condensers for opens or shorts. Since the condenser-capacity was originally correct there is no capacity measurement necessary.

This system requires a diagram of the receiver, with all values marked on it, but it is claimed that they will be available.

There are chapters on the laws of parallel resistances and how each circuit in a radio receiver can be interpreted as a resistance-network. Examples are given of measurements on both a.c. and d.c. receivers. It is not claimed that resistance measurement will locate *all* defects in a receiver; some, which do not influence the resistance of the circuits must be treated as before.

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

Problems in Selective Reception, by M. V. Callendar. A comparison, from the theoretical standpoint, of the various methods of attaining the highest degree of selectivity required by present broadcasting conditions. An investigation of the distortions introduced by receivers employing such methods is included.

Band-pass and simple-sharply tuned circuits with audio correction are compared on the basis of their ability to deal with the direct and also the heterodyne interference from unwanted neighboring stations.

Linear Distortions in Broadcast Receivers and Their Compensation by Low-Frequency

Equalization Devices, by Arthur Clausing and Wolfgang Kautter. A study of the manner in which high-selectivity characteristics and detector and audio-frequency amplifier action may cause distortion in radio receivers and the means which can be employed to counterbalance such effects and obtain faithful reproduction.

An Estimate of the Frequency Distribution of Atmospheric Noise, by R. K. Potter. A study of the relation between atmospheric noise-intensity and frequency estimated upon the basis of noise-measurement data covering the frequency range between 15 and 60 kilocycles, and 2 and 20 megacycles.

Review of Articles in the Journal of the Acoustical Society of America for July, 1932

Resonance in Small Rooms, by Vern O. Knudsen. A detailed study of reverberation and resonance effects in small rooms and their effect on sound-absorption and sound-transmission tests.

Acoustics of Broadcasting and Recording Studios, by G. T. Stanton and F. C. Schmid. A discussion of the importance of properly balancing damping and reflection and reverberation effects in broadcast and recording studios to produce realism, by the use of suitable sound-absorbing and reflecting surfaces in rooms of suitable size for the type of program being transmitted or recorded.

Extract of Two Articles in Bell Laboratories Record for September, 1932

Airport Radio Transmitter, by W. M. Knott. Circuit and details of the Western Electric 10-A radio transmitter designed especially for airport use for transmitting weather, flying, landing and other information by speech to airplanes in flight. It is designed to deliver 10 watts to the antenna and has a normal range of 40 to 50 miles.

A Radio Transmitter for the Itinerant Flyer, by J. B. Bishop. An article giving the circuit and description of the Western Electric 11-A Radio Transmitter designed for use in planes having a limited load-carrying capacity. The unit described weighs scarcely 18 pounds and occupies little more than three-quarters of a cubic foot of space. It has a range of from 30 to 40 miles.

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.

4. A 15 To 200-Meter Comet "Pro" Superheterodyne. A folder which gives the outstanding features of the Hammarlund-Roberts high-frequency superheterodyne designed especially for commercial operators for laboratory, newspaper, police, airport and steamship use.

5. A 1932 Variable and Fixed Resistor Catalog. Complete specifications on the Electrad line of volume controls, voltage dividers, replacement resistors, fixed and adjustable resistors, public address systems, amplifiers and valuable data on volume control circuits are contained in this 10-page book.

9. A 1932 Fixed Resistor Catalog. This 16-page catalog gives complete specifications on the International line of metallized, wire-wound and precision wire-wound resistors,

Review of Contemporary Periodical Literature

Telephone Transmission Measurements, by Arthur E. Thiessen. General Radio Experimenter, August, 1932. An explanation of the manner in which transmission losses over telephone lines are measured by the use of simple and inexpensive instruments.

Shall We Widen the Broadcasting Band? Electronics, September, 1932. A discussion of the various factors which will be considered at the International Radio Conference at Madrid in determining whether or not the broadcast band of frequencies should be widened and what changes are desirable in the present allocation of wave bands for different types of services.

New Forms of Short-Wave Tubes, by I. E. Mouromtseff, G. R. Kilgore and H. V. Noble. Electronics, September, 1932. This paper gives a discussion of the various important factors which enter into the design of suitable tubes for the ultra-short-wave applications that have been developed during the past few years in American radio.

Electronic Devices in A Testing Laboratory, by Dr. Clayton H. Sharp. Electronics, September, 1932. This article describes the wide variety of tests which have been made possible or which have been simplified by the use of electronic apparatus.

Thirty-Three Watts Per Dollar From A Type -52 Tube, by Charles D. Perrine. QST, September, 1932. This article describes in detail, the circuits and factors which must be taken into consideration to obtain the maximum output and efficiency with safety, of which the type -52 tube is capable of delivering.

Tube Types Tabulated, QST, September, 1932. A complete list of all receiving, transmitting and rectifier tubes now available, with brief descriptions of their applications, filament voltage and type of tube.

Watch Replacement Parts This Year, by R. N. Swanson. Radio Retailing, September, 1932. Because of the tendency to "make the old set do" this article points out that much repairing and replacement of parts will be in order during this coming season.

New Velocity Microphone Promises Revolutionary Broadcast Advances. Radio Engineering, September, 1932. This article gives a complete description of the new "velocity" microphone which is claimed to reproduce sound with a fidelity never before possible, by responding uniformly to the audible range of sound from zero to 14,000 cycles and over. The microphone, it is claimed, has positive directional characteristics which increase its effectiveness for broadcast and recording work.

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How to Get Copies of Articles Abstracted in This Department

The abstracts of articles featured in this department are intended to serve as a guide to the most interesting and instructive material appearing in contemporary magazines. These magazines may be consulted at most of the larger public libraries, or copies of the issues containing the articles may be ordered direct from the publishers.

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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 International gives complete information on how to overcome motor-generator, ignition-coil, interrupter and spark-plug noises in automobile installations.

11. A 1932 Receiver and Transmitter Condenser Catalog. This 4-page folder gives complete specifications and list prices on the Flechtheim line of both high and low-voltage, fixed, paper condensers for by-pass and filter use in transmitting and receiving equipment.

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

13. Electric Phonograph Pickups and Recorders. A series of folders on Pacent Phonovox reproducing units designed to meet the requirements of high quality reproduction from records, for home, broadcast station and talking movie installations and a recording unit for both making and reproducing records electrically through the amplifiers of standard receivers.

16. RMA Standard Resistor Color Code Chart. A handy Lynch post-card-size color-code chart 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.

18. A Baptism of Fire. This interesting 16-page booklet describes, in non-technical language, the materials and processes used in making fixed resistors. Specifications and list prices of the entire line of Centralab fixed and variable resistors, volume controls, rheostats and potentiometers are also included.

19. Making Auto Radio Sets and Farm Sets All-Electric. This circular gives complete specifications and description of the features of the Carter Genemotor which is designed to eliminate "B" batteries in connection with automobile, aviation, farm, portable and other similar sets. A dynamotor unit, operating from the storage battery, and consuming less current than a parking light is employed.

21. Exact Duplicate Replacement Transformers. This folder gives complete information, with receiver name and model numbers, on a complete line of Stancor replacement transformers, chokes, audio transformers and output transformers. The units listed are exact duplicates, electrically and mechanically, of the originally-installed transformers used in many popular sets now in use. It is a handy guide for the serviceman in replacing defective units.

22. Standard Resistor Stock List. A 6-page folder giving complete specifications and list prices of the complete line of Ohmite fixed, semi-variable, meter-multiplier, transmitting, voltage divider and power pack resistors, non-inductive resistors, slide-wire rheostat-potentiometers and power rheostats.

23. Replacement Resistor Bulletin. This folder gives a complete list of Ohmite Red Devil replacement resistor units designed to withstand high temperatures and also gives complete listings and data on a new type of vitreous-enamel, semi-variable resistors that are ideally suited for use as replacement voltage dividers.

(*Continued on page 382*)

December, 1932
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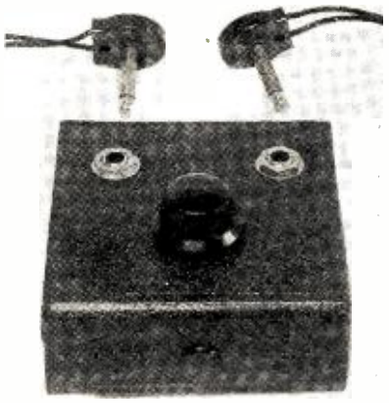
Export Products

Control Box

Description — A neat-appearing leather-covered volume-control box adaptable to numerous input and output circuits. The box, measuring only 3½ inches square by 1½ inches high, includes a volume control potentiometer and two single-circuit open jacks into which the flat type phone plugs are inserted. The manufacturer can supply

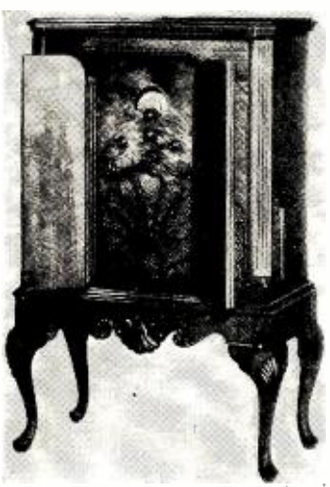


information showing the application of this control box to provide connections and individual volume control for extra speakers or headphones in conjunction with any standard radio receiver. Especially useful where hard-of-hearing persons desire to listen to the radio with headphones, without interfering with the operation of the loudspeaker.

Maker—William H. Broderick, 40 East 49th St., New York City.

Console Receiver

Description — This Sparton thirteen-tube receiver, model 28, with new principles in acoustical reproduction design, employs three speakers mounted in the arc of a circle to provide 155 square inches of sound-reproducing speaker surface. It is a superheterodyne circuit, and it is equipped with the new Sparton Duolinear second detector using two tubes in a full-wave linear detec-



tor circuit, automatic volume control and a tone and static control. The receiver chassis and the three speakers are housed in an attractive Queen Anne style console cabinet. This same manufacturer introduces five new console sets and a new motor-car radio receiver.

Maker—The Sparks-Withington Co., Jackson, Mich.

With the Experimenters

An Easily Made Microphone Stand, Vernier Dial Construction, An Efficient Antenna, Solution for Altering Blueprints, A Tape-Line Antenna, Multiple Antenna Support

Conducted by

S. Gordon Taylor

An Easily Made Microphone Stand

It is quite easy to make a serviceable floor stand for a microphone in an hour's time and for a cash outlay of only one dollar.

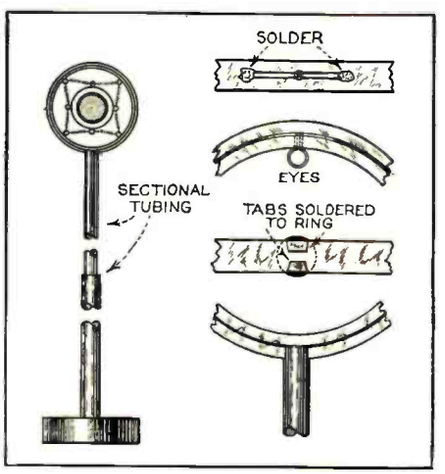
The bill of material is as follows:

1 pair of six-inch metal embroidery rings	$ .10
1 telescopic closet rod	.25
8 microphone springs	.35
5 lb. plaster of Paris	.30
1 ft. of bare wire, No. 14 to No. 18 B. & S.	
	$1.00

A round metal box, about 8 inches in diameter, and 2 inches or 3 inches deep, such as a 2 or 3 pound candy box will be necessary for use as a base. The closet rod mentioned above was purchased at an F. & W. Grand 5, 10 and 25c store. It consists of two three-foot tubes, one of which slides into the other, and was originally intended to be fastened horizontally in a closet, and to have coat hangers hung upon it. However, it serves admirably as the telescopic upright of our mike stand, since by its use the mike can be raised or lowered at will.

The first thing to do is to remove the cork from around the inner embroidery ring, and discard it. Now punch four small holes in the ring, 90° apart. Make a loop of a small piece of wire, and insert it in one of the holes. Pull the ends through until a loop about ¼-inch in diameter is left inside the ring and then flatten the ends and solder them to the outer surface of the ring, as per sketch. Repeat this process at each of the three remaining holes.

Now remove the round end-piece from the inner member of the sliding closet rod by carefully bending up the two metal tabs which hold it on. Place the outside embroidery ring on the end of the rod,



preferably with the spring toward the top, and fold down the metal tabs over the ring so as to hold it upright. Solder should be applied here to strengthen the joint.

Next stand the outer half of the closet rod in the center of the round metal box. Mix the plaster of paris with water until it assumes the consistency of mortar, and pour it in the box.

While this mixture is hardening to form the base of the mike stand, fasten the springs to the wire loops on the inner embroidery ring, and suspend the mike on them in the conventional manner. The inner ring may now be slipped into the outer one, and the spring of the latter will hold the two rings firmly together. When the plaster is thoroughly hard, the inner half of the closet rod is slid into the other half, and your microphone stand is ready for business.

SAMUEL M. LOVENSTEIN,
Philadelphia, Pa.

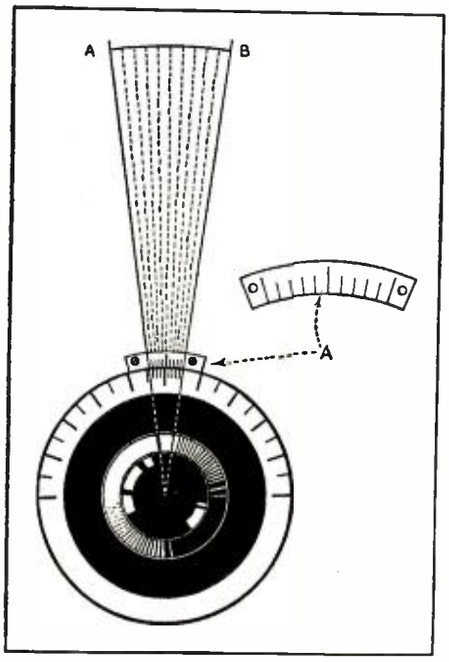
Vernier Dial Construction

Many radio receivers require vernier dials for accuracy in reading. These are often expensive and many experimenters must do without them. With very little effort and practically no expense one can make a vernier scale for many ordinary dials so that readings can be accurately made to a tenth of a scale division. This means that an 180 degree dial with its regular 100 divisions is made into one of ten times as many divisions or 1000.

All that is required is an old piece of bakelite. The device consists simply of a little scale of ten divisions as shown at "A" in the accompanying diagram. This is bolted just above the dial, as shown. These ten divisions correspond in length to nine on the dial. Thus our problem simply consists of dividing the length of nine dial units into ten equal spaces.

As the space on the vernier scale is small, direct and accurate division is impossible. The sketch shows how it can be done easily and accurately. Draw a circle the same size as the dial. Then draw one line from the center through any division on the dial.

A second one is drawn from the center through the division that is nine units from the first. These lines are extended for about six inches and an arc AB drawn. This long arc can easily be divided into ten equal parts with a small divider. These points are then connected with the center giving the accurate divisions on the little piece next to the dial rim. The little piece can be cut out and holes drilled so it can be fastened to the panel. If the bakelite is small it can be held in place with tacks and the drawing made on paper. The lines can be scratched in immediately with some sharp-pointed instrument. The scratches are



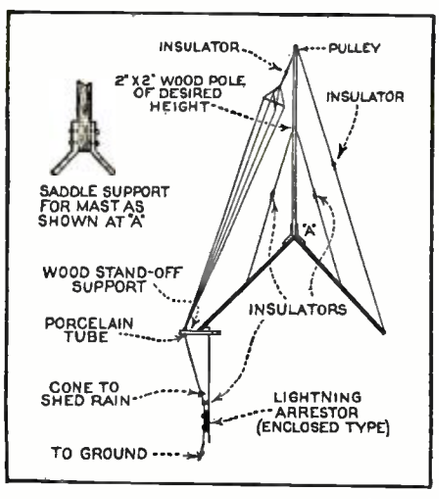
then filled with chalk or white wax crayon. Care should be taken to have the surface of the vernier scale on a plane with the calibrated surface of the dial so no error will occur due to parallax.

This scale will provide accurate readings from zero to 92 on the dial but not accurately above that. If the last few divisions are absolutely necessary a scale twice as long can be made and the last readings made on the part left of center.

ALONZO WIERENGA,
Holland, Mich.

An Efficient Antenna

After trying about everything in the way of antennas, I now use one of the following description. It is non-directional, up in the clear and at right angles to neighboring wires, works well on the shorter wave-



lengths and has good signal pickup on the 550 kc. end of the dial.

It is patterned after the cage antenna but is hung in a vertical or nearly vertical position with the greatest effective signal pickup at the top of the antenna. That is where other noises (static excepted) are of the weakest value and least likely to get in.

Being shorter than the straight-away-antenna, it is more selective. I like also the non-directional feature.

It can be made neat looking, and if enameled copper wire is used in the antenna, galvanized wire for guys, and a 2 inch by 2 inch mast, ten to twenty feet long and painted well, it will also be durable and continue to be neat in its appearance.

FRANK J. FAULKNER,
Bingham City, Utah.

Solution for Altering Blueprints

After a drawing of a radio circuit has been completed and a blueprint made of it, it is often desirable and even necessary to make changes in the blueprint. Changes and additions can be made very easily and neatly in the blueprint by using an ordinary pen and a solution made by dissolving enough bicarbonate of soda (baking soda) in warm water to form a saturate solution. The baking soda solution has the property of bleaching the blue part of the blueprint white; so any writing that is done on the print with this solution will appear the same as that originally impressed on it by the ink drawing. In fact, if the work is done carefully, it is hard to determine which is the original work and which was added after the blueprint was completed. Knowledge of a kind like this may save the trouble of remaking a blueprint.

CHARLES FELSTEAD,
Los Angeles, Calif.

Multiple Antenna Support

Finding a place to fasten the end of an aerial often presents a problem. Frequently there is one location to which a number of

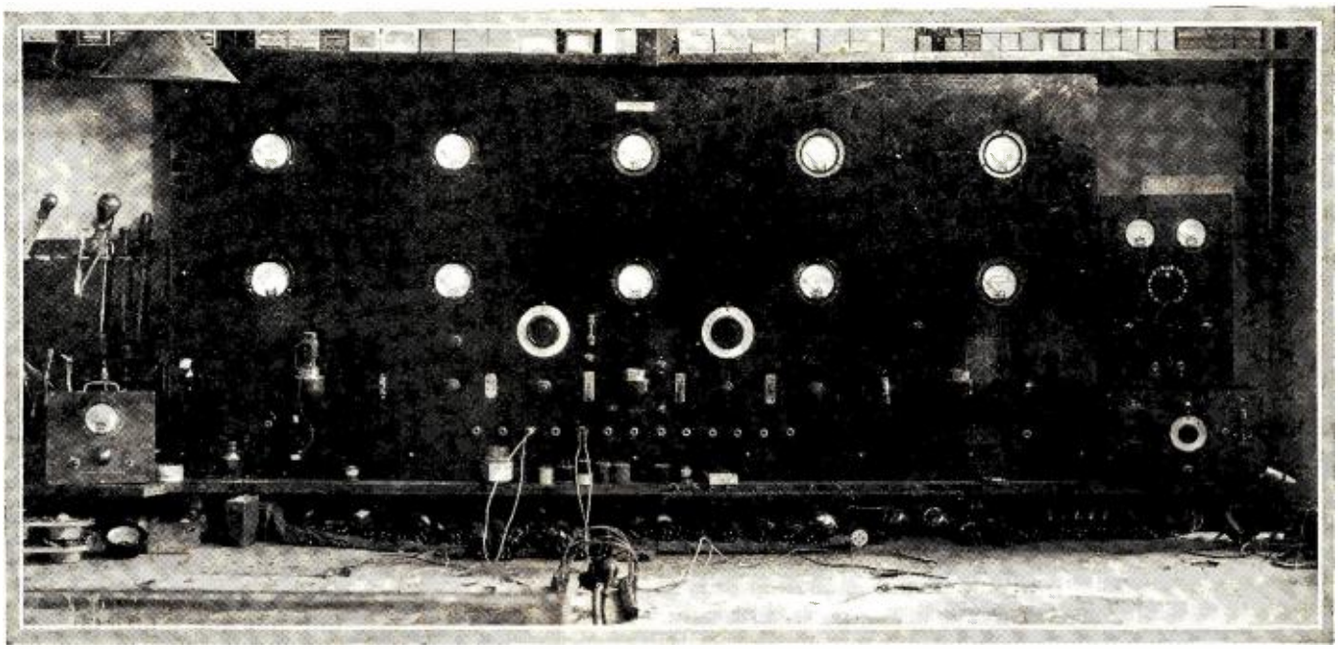
lines from surrounding houses must be fastened if the aerial is to be put up to give any results at all. Securing a number of line ends at one point is for the most part a friendly community affair, readily agreed to by the first "claim staker" if the lines are fastened neatly and without too much trouble. An old auto steering wheel can many times be used as shown. Firmly and rigidly secured with a large bolt or screw in the center, the forks afford a convenient and ready means of neatly attaching four lines from different directions. Saves putting up additional fastenings.

FRANK W. BENTLEY, JR.,
Missouri Valley, Iowa.

A Tape Line Aerial

An ordinary steel measuring tape, such as used by surveyors, makes a very handy and compact aerial to take along with a portable set on camping trips, or when traveling. The better grade of measuring tapes come

(*Continued on page* 382)



The Service Bench

A Universal Set Analyzer—A Texas Service Shop—All in the Day's Work—Philco Service Experience—Open Blocking Condensers, Faulty By-pass and Coupling Condensers, Low Sensitivity, Philco Tubes—Substitutes for Crosley Dynacone Speakers

Conducted by
Zeh Bouck

THE radio test set described was designed and built by Eddie Scribner, joint proprietor of Scribner Brothers Radio and Electrical Shop, Schoharie, New York. It was designed with the requirements of the rural serviceman particularly in mind, which encompass the following considerations: extreme portability; sufficiently elaborate for shop purposes; universality in reference to all types of tubes, a.c., dry-cell, storage-battery and automobile types; universality in reference to the voltage and current measurements required by the correct operation of these tubes; simplicity; continuity and resistance measurements; ruggedness; and economy of construction.

It will be recognized that these requirements are by no means peculiar to the rural serviceman, and that any test set meeting them may be recommended for general servicing.

The number of meters used is a compromise between the requirements of the outfit and the stipulations of simplicity, ruggedness and economy. The consensus is that all considerations are most effectively satisfied with two meters—a d.c. Weston model 301, 0–1 milliampere, and an a.c. Weston model 476 voltmeter. The resistor shunts and voltage multipliers used in conjunction with tbese meters were purchased from the manufacturer. The d.c. meter is used for continuity, resistance, current and voltage measurements, direct-reading scales being made up following calibration. The values of series resistors, for voltage multiplication, are given on the diagram, Figure 1. However, as the values of the current shunt resistors, R_1, will vary with the resistance of the meter available, these values are best calculated for the individual case, or, better yet, ordered from the meter manufacturer as the correct shunts to increase the meter range to 2.5, 25 and 100 milliamperes.

If the resistance of the meter is accurately known, the correct value of the shunt resistor for any desired increase in current range can be figured from the formula—

$$R_x = \frac{R_m}{F-1}$$

—where R_x is the value of the shunt resistor, R_m the resistance of the meter, and F the factor by which it is desired to increase the meter range. If it is wished to double the current capacity, F equals 2, and R_x equals the meter resistance.

This example indicates a safe method of measuring the meter resistance if it is not known. Connect the meter in series with

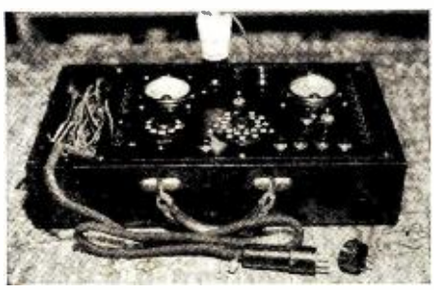


FIGURE 2

a variable resistor and a low potential source—the voltage of which can be accurately determined. The voltage should be such as to provide almost full scale deflection with the resistance cut out. Use short leads for the connections. The resistance is gradually cut in until the meter reading indicates exactly half the original current. The value of the resistance cut in will then be equal to the resistance of the meter (providing the voltage has not varied), and can be measured on a bridge or by an accurate low-resistance ohmmeter. (It is possible, of course, to measure the resistance of the meter directly on a bridge, providing the current passed through it does not exceed the safe capacity of the instrument.)

If there is any doubt concerning the correct shunt resistors, the manufacturer will supply them for any meter if the instrument is sent along with the order.

The resistors R_2 and R_3, employed in conjunction with the a.c. voltmeter, are regularly supplied with this instrument. The scales are properly calibrated for 4, 8, 16, 200 and 1000 volts. The meter is of the double-winding type, providing two meters in one, having natural 4 and 100-volt ranges. Resistor R_3 provides voltage multiplication to 8 and 16 volts on the low potential winding, while R_2 performs a similar multiplication to 200 and 1000 volts on the remaining winding. In using the 100-volt scale, the 1000-volt graduations are divided by 10.

Control Switches

The main selector switch, S_1, is a Weston, double-pole, 23-point switch, and controls all direct-current readings, either directly to tubes in the test set socket or through the continuity, d.c. voltage and d.c. current binding posts. The individual functions of the different contact pairs, as closed, are indicated in Figure 1.

The a.c. selector switch, S_2, is a 9-point, double-pole switch, also manufactured by Weston. Provision is made in this switch for the voltage multiplier. The wire is broken, thus providing a double meter contact-bar on the side of the meter switch next to the panel.

The grid test switches are single-pole, double-throw push-button made by Yax-

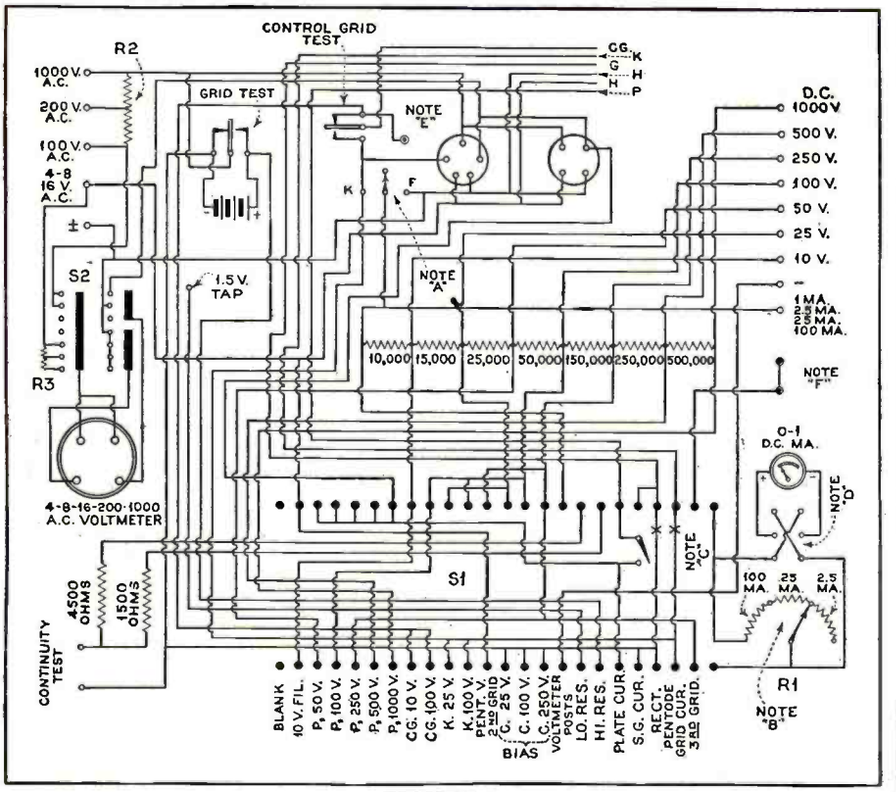


FIGURE 1

ley. The K and F switch (note A) is a Cutler-Hammer toggle switch, single-pole, double-throw, with an "off" position. This switch provides an "on and off' switch as well as switching from cathode to filament when making voltage readings on 4 or 5-prong tubes depending on whether they are of the filament or heater types. The milliammeter range switch is also a Cutler-Hammer, having three "on" and one "off" positions (note B). The push-buttons for the milliampere readings (note C), marked "X" on the diagram, normally short-circuit the meter—that is they permit readings when the buttons are depressed. The reversing switch (note D) performs the usual and essential function.

The pin-jacks are of the standard black Weston type. One pin-jack (note E) provides the control grid connection. The two other pin-jacks (note F) are connected together. When testing 57s or 58s, an adapter is inserted in the 5-prong socket on the tester, and the loose-wire terminal is plugged into one of the pin-jacks. Another adapter is used on the radio set plug. This adapter has a long wire which is inserted

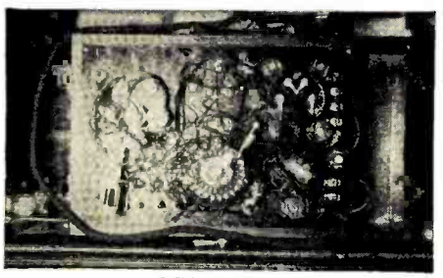


FIGURE 3

in the remaining pin-jack. With the switch in the proper position, voltages are read on the 250-volt scale. However, when this third grid is connected to the cathode, a more accurate reading will be obtained on the K-25 readings.

Adapters

Standard 4 and 5-prong sockets are used in the set tester proper. The adapters as well as the test plug are made by Naald. A 4-pin, 5-hole adapter is used on the plug to test 4-prong tubes. The regular 4-contact socket is used for the tube. A special 6-prong, 5-hole adapter with a long lead is attached to the plug, is employed in testing 57s and 58s. An adapter with 5 prongs and 6 holes is provided on the test set, with an extra, shorter lead. These two leads fit into the pin-jacks as explained under note F.

Other adapters are used to test UV-199's and WD11 tubes which are still met with in rural servicing.

Continuity and other exterior tests are made with the usual leads and test prods. The 1½-volt tap for continuity reading is taken from the built-in battery. Two resistance ranges from 0 to 50,000 ohms and to 150 thousand ohms are calibrated and marked off on the meter.

Front and rear views of the completed test set are shown in Figures 2 and 3.

THIS MONTH'S SERVICE BENCH

The test bench shown in the Heading is one of two in the radio store and shop operated by the Southwest Radio Service at Dallas, Texas. Mr. S. A. Greever, General Manager, writes:

"These benches were designed and built to suit our particular needs. We service all makes and types of radio receivers, speakers and power units and cannot therefore standardize our test equipment as those who have only one or two makes or models to contend with.

"At the right of the board is a vacuum-tube voltmeter—below an r.f. modulated oscillator. At left is a calibrated ohmmeter and continuity checker.

"In addition to repairing we carry a complete line of parts for replacements in repair work and for general sale. Contrary to the experience of many other dealers, *we find there is still a nice volume of business in parts*, and expect to continue our efforts

(*Continued on page* 381)

Question Box

PHYSICS and science instructors will find these review questions and the "quiz" questions below useful as reading assignments for their classes. For other readers the questions provide an interesting pastime and permit a check on the reader's grasp of the material presented in the various articles in this issue.

The "Review Questions" cover material in this month's installment of the Radio Physics Course. The "General Quiz" questions are based on other articles in this issue as follows: Reginald Aubrey Fessenden, Condenser "Mike" Amplifier, Neon Tube Oscillators, On ¾ Meter Transmission, P. A. in the Teaching of Surgery.

Review Questions

1. *Show the circuit for a group of 6 type –30 two-volt tube filaments connected for operation from a 6-volt battery, without rheostats or other means for reducing the battery voltage.*
2. *Draw the filament circuit you would use if you desired to operate 6 type –30 tubes from a 32-volt lighting system. Indicate the resistor value required in series.*
3. *Name four ways of producing e.m.f.*
4. *What is the difference between the terms "battery" and "cell"?*
5. *Explain why the available terminal voltage of a battery is lower than the total e.m.f. developed therein.*
6. *What occurs in the process known as "ionization"?*
7. *Explain the difference between an atom and an ion.*

General Quiz on This Issue

1. *Name four of Fessenden's outstanding achievements.*
2. *Explain the principle employed in the "absorption" amplifier.*
3. *What are the advantages of this type amplifier over the ordinary resistance coupled amplifiers, for use with condenser microphones?*
4. *Over what frequency range will a neon tube oscillator function? Explain the functioning of this oscillator.*
5. *What is the principle of the Kozanowski oscillator and how does it differ from the Barkhausen-Kurz oscillator?*
6. *What primary advantage does this type of oscillator offer over the B.-K. type for transmitters operating at one meter wavelengths or less?*
7. *Describe one of the most recent applications of microphones and amplifiers in surgery.*

Student's Radio

LESSON THIRTEEN

By Alfred A.

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

CIRCUITS may consist of several devices so connected that some of them are in parallel with each other, and others are in series with each other and the parallel combination. Connections of this kind are referred to as *series-parallel* circuits, since they are a combination of series and parallel circuits. A circuit of this kind is shown in (A) of Figure 1. Here the filaments of three 201-A vacuum tubes, A, B and C (each having a resistance of 20 ohms) are connected in parallel with each other. A resistance F of 1 ohm is connected in series with the group. The filaments of two other tubes D and E are connected in parallel with each other. A resistance G of 12 ohms is in series with them. This second group is in parallel with the first group across the battery.

The total resistance of the entire circuit can be found by reducing each series-parallel combination to an equivalent single resistance.

The combined resistance of the resistances A, B and C is found from

$$\frac{1}{R}=\frac{1}{20}+\frac{1}{20}+\frac{1}{20} \text{ or } R = 6.67 \text{ ohms}$$

As this is in series with resistance F, the total resistance of this group is $R = 6.67 + 1 = 7.67$ ohms. Therefore this group is equivalent to, and could be considered as, a single resistance of 7.67 ohms connected across the circuit as shown in (B) of Figure 1.

Likewise the combined resistance of resistances D and E is found from

$$\frac{1}{R}=\frac{1}{20}+\frac{1}{20} \text{ or } R = 10 \text{ ohms}$$

As this is in series with resistance G, the total resistance of this group is $R = 10 + 2 = 12$ ohms. Therefore this group could be considered as a single resistance of 12 ohms connected across the circuit as shown at B.

Therefore the combined resistance of the entire circuit (from B of Figure 1) is

$$\frac{1}{R}=\frac{1}{7.67}+\frac{1}{12} \text{ or } R = 4.5 \text{ ohms}$$

The total current drawn from the 6-volt source of e.m.f. is then

$$I=\frac{E}{R}=\frac{6}{4.5}=1.3 \text{ amperes}$$

The individual voltage across each filament, or the current through it, could be calculated from these values by applying Ohm's law.

Series-parallel circuits are encountered in the plate circuits of modern a.c. tube electric receivers where the plate circuits of all the tubes in the receiver are in parallel with each other across the source of B voltage supply, but each individual complete plate circuit consists of several resistances in series. Such circuits may be very complicated when considered as a whole, but when they are split up and attacked as above they may be solved very simply by the formulas for series and parallel circuits. The scheme of substituting equivalent single resistances in the computations for series-parallel connected resistors, makes this work simple.

Combination of Resistances

Resistances are sometimes purposely connected in series, parallel, or series-parallel in order to obtain odd resistance values or current-carrying capacities which are not obtainable commercially in single resistances. For instance, suppose a resistance of ½ ohm with a current-carrying capacity of 4 amperes is required for the filament circuit of a radio receiver. We will assume that ½-ohm resistors with a current-carrying capacity of 4 amperes are not readily available, but that 1-ohm resistors having a carrying capacity of say 2 amperes can be obtained. By simply connecting two of these in parallel as in (A) of Figure 2, a joint resistance of ½ ohm is obtained, and since each resistor can safely carry 2 amperes, the combination of the two in parallel can handle the 4 amperes.

As another simple illustration of connec-

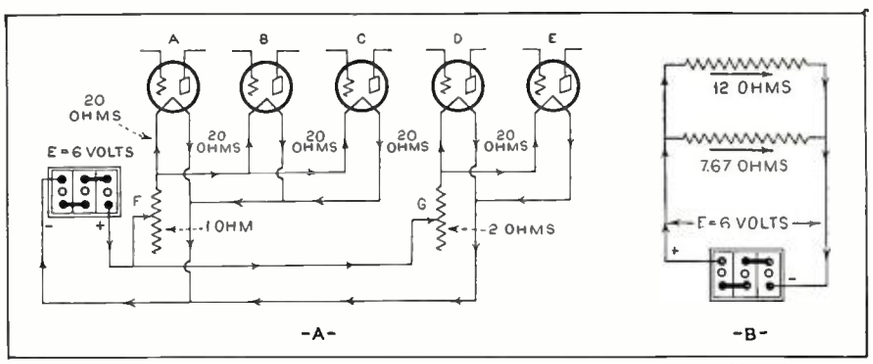


Figure 1. Series-parallel circuit. The circuit at (a) can be considered to be equivalent electrically to the simple circuit at (B)

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

Physics *Course*

SOURCES OF E.M.F.

Ghirardi*

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

tion of resistors to obtain some desired value, let us suppose that we require a resistance of 1620 ohms for some purpose. Now resistors are not made in standard sizes of 1620 ohms. But standard resistors of 1000, 600 and 20 ohms are available. By connecting one each of these in series as shown in (B) of Figure 2, a total resistance of 1620 ohms can be obtained.

Sources of E.M.F.

We have found in our study of electricity that electrons can be made to drift or flow in a definite direction through any conductor (current flow) by the application of an external electrical force which we call *electromotive* force. The e.m.f. is really the force which keeps the electrons moving in a definite direction around the circuit. It is sometimes called *electron-moving* force. Electromotive force may be produced or generated in a number of different ways, among which are the following:

1. By friction between two bodies, and electrostatic induction.

2. By chemical action as in the dry cell or storage cell.

3. By electromagnetic induction, such as produced in a dynamo when conductors are moved across a magnetic field.

4. By thermo-electric action produced by the contact of two dissimilar materials and the application of heat at the junction. The e.m.f. produced in this way is often called thermo-electromotive force.

The first and fourth methods are not used commercially. The third method is used for

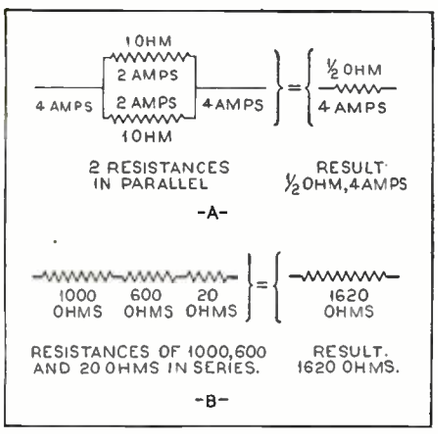


Figure 2. How standard size resistors may be combined to obtain odd values of resistance

producing e.m.f. on a large scale for commercial electric light and power supply. This method will be studied later. The second method finds use where no electric light service is available, as in the case of rural districts. This method will be studied first. We will confine ourselves to the use of chemical changes occurring in primary and storage cells for its production.

Cells, Batteries

A cell is usually considered to be a single unit in which electrical energy is produced by chemical action. A *battery* is a combination of two or more cells, either in series or in parallel, for the purpose of obtaining either more e.m.f. or more current than a single cell will provide. Thus an ordinary 6-volt storage *battery* consists of three 2-volt *cells* connected in series to give 6 volts.

The terms e.m.f., potential difference, fall of potential and voltage are often used interchangeably by the layman. It is perhaps better to reserve the term e.m.f. to denote

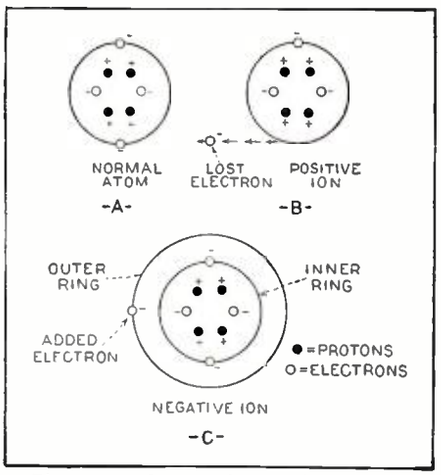


Figure 3. A normal atom has as many electrons as protons. A positive ion has one less electron than protons. A negative ion has one more electron

the *total* electrical pressure actually *developed* by the source, whether it be a dry cell, storage battery, electric dynamo, thermo-couple, etc., no matter how it may be caused. As we will find out later, all generators of electric energy have some internal resistance of their own. When current is being delivered there is a fall or drop of potential in the generator due to this resistance. The result is that the voltage actually available at the terminals when current is being supplied is less than the e.m.f. generated, by an amount equal to the internal $I \times R$ drop in the generator. This resulting voltage actually available at the terminals is called the terminal voltage or p.d.

The Ion

Electrons or negative charges of electricity may be added to or removed from normal atoms in several ways. If by some means an electron is removed from an atom as shown in B of Figure 3, the balance between the strength of the total positive charge of the nucleus or protons and the total negative charge of the electrons in the atom no longer exists, and the positive charge

(*Continued on page* 373)

Backstage in

Personal interviews with broadcast artists and executives

By
Samuel Kaufman

GENE CARROLL AND GLEN ROWELL

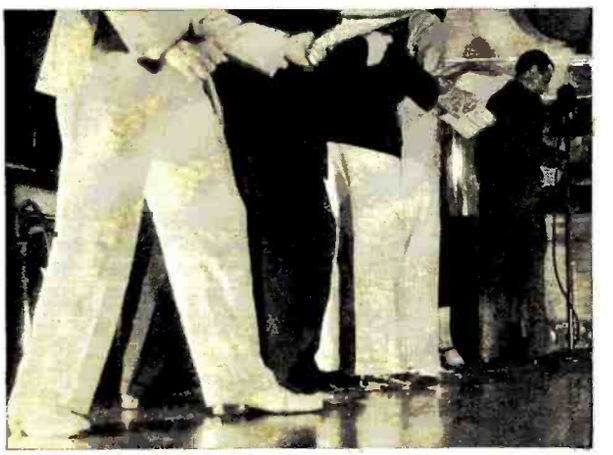
GENE CARROLL and Glenn Rowell, the "Gene and Glenn" of the Quaker Early Birds program heard over the NBC, have proven so popular in Cleveland, where their broadcasts orginate through the facilities of Station WTAM, that 245,000 citizens of the Ohio city signed a petition 875 feet long requesting the NBC to keep the noted broadcast team in Cleveland. The petition was the result of an announcement that the early morning NBC feature would be broadcast from Chicago instead of Cleveland. Such a move would have prevented the continuance of additional local broadcasts of the team in Cleveland which have won wide popularity. The lengthy petition was prepared with the assistance of the Police and Fire Departments of Cleveland and nearby towns. The scroll was presented to John F. Royal, a vice-president of NBC, while on a visit to the Ohio city. Royal was formerly manager of Station WTAM. A committee headed by distinguished citizens made the presentation. The team of Gene and Glenn was organized in Cleveland three years ago and broadcast over WTAM for about a year before a sponsor placed them on the NBC hookup. Even if the team does go to Chicago, its neighbor Clevelanders will still hear the chain program through the local outlet, but stand to lose the additional local broadcasts to which they have become accustomed.

JESSICA DRAGONETTE

AFTER her first extensive vacation in five years, Jessica Dragonette, noted radio soprano, was recently welcomed back to the NBC by her numerous followers from coast to coast. As in the three previous years, Miss Dragonette is again featured on the Cities Service programs Friday nights. The new series also features Rosario Bourdon's Orchestra and the Cavaliers Quartet. During this season's Cities Service programs, Miss Dragonette is featuring a generous measure of light opera selections.

THE popular "March of Time" feature heard over the CBS on Fridays utilizes a cast of fifty players to re-enact the chief news developments each week. The scripts of this novel program are prepared by Thomas Everitt and the presentations are directed by Donald Stauffer. Howard Barlow's orchestra supplies musical backgrounds to the dramatizations. During the recent campaign, many political incidents were re-enacted on the programs. The role of President Hoover was filled by Ted di Corsia while Governor Roosevelt's part was assumed by William Adams. Six to eight of the week's chief news events are re-enacted on each program. Stauffer, the director of the broadcasts, explained that the purpose of the program is to re-enact happenings of interest before the microphone with a view to impressing upon the listeners some of the traits of the personalities whose names are in the headlines. The series' popularity proves that listeners like programs that are instructive as well as entertaining.

THE MARCH



Broadcasting

Chatty bits of news on what is happening before the microphone

"MYRT AND MARGE"

DESPITE the large number of family acts on the stage there are very few family teams in radio. "Myrt and Marge," the CBS series of back-stage life, is unusual in the fact that it stars a mother and her daughter. Myrtle Vail began her stage career at the age of fifteen as a chorus girl. She fell in love with George Damerel, the star, and married him. A daughter, Donna, was born who was destined to later be the "Marge" of the popular network program. The Damerels, for several years, toured the well-known vaudeville circuits as "Damerel and Vail." Although they did their best to keep Donna's interest away from the footlights their daughter declared her strong intentions to go on the stage and the act became "Damerel, Vail and Co." and included Donna. Two years later, the family quit the stage and bought a chicken farm. The Damerels went into local real estate as a sideline. When real estate values tumbled, Myrt, remembering all of the tragic and comic happenings behind the footlights, created the "Myrt and Marge" skit. She got some sample scripts before P. K. Wrigley and these led to the five-time-a-week series sponsored by the William Wrigley, Jr., Company.

RAYMOND KNIGHT, the famous Ambrose J. Weems of the "Station KUKU" program, has shown radio listeners his versatility by his creation of the new "Wheatenaville" sketches heard daily, excepting Friday and Saturday, over the NBC. We don't mean that there is no humor in the new programs. There is plenty of it, but it is of more subtle variety than the slapstick "Station KUKU" feature. Knight takes three different roles in the "Wheatenaville" program. Included in the cast are two children—Bobby Jordan and Vivian Block—who were selected for the important parts after an intensive search for juvenile talent especially suited for the script. Knight, as author and star of the five-day-a-week program, showed that wisecracks and puns are but by-products to his versatile make-up. Knight's first object in life was to become a lawyer. He attended the Boston University law school and was admitted to the Massachusetts bar of which he is still a member. He practiced law for two years but developed a strong inclination for dramatics. He left his law office and went back to college. He first went to Harvard to enter the famous "47 Workshop" of Professor Pierce Baker and then switched to Yale when his tutor joined the faculty there. In 1927, Knight won the Drama League prize for his one-act play "Strings."

RAY KNIGHT AND ALICE DAVENPORT

OF TIME

AFTER several months absence from the air, the 70-piece symphony orchestra of the Roxy Theatre, New York City, recently resumed its weekly schedule of Sunday night broadcasts over the CBS. The present conductor is David Ross, not he of CBS fame.

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

A Console Receiver

Description — The new "Bi-Acoustic" twelve-tube superheterodyne receiver, model R-78, embodying a new circuit design and featuring new developments in both the receiver and cabinet construction, is said to provide twice the power and tone range of the ordinary receiver. The most important features of this receiver are: advanced automatic tone compensator, tone equalizers, dual automatic volume control, an improved loudspeaker, micro tone control and class B audio amplification which is said to have an output of over 10 watts. The following tubes are utilized: two –46 type, four –58 type, five –56 type and one –82 mercury-vapor rectifier tube. The receiver chassis is mounted on rubber and is installed in a walnut and maple-veneered six-leg console cabinet measuring 43 inches high by 48¼ inches wide by 14 inches deep.

Maker—RCA-Victor Co., Inc., Camden, N. J.

A Compact Radio Receiver

Description—The new line of Philco receivers includes eleven different models in five, seven, nine and eleven-tube circuits. The new type of vacuum tubes, such as the –44 and –42, are employed in these receivers. The illustration shows the Model 52C Compact receiver. This tiny five-tube set measures only 10⅜ inches in height by 16 inches in length and is suitable for installation in the bookcase or for placement on the mantel or table stand.

Maker—Philadelphia Storage Battery Company, Philadelphia, Pa.

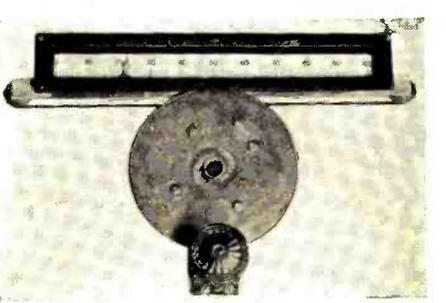
Portable Tube Checker

Description—This model H-33 tube checking instrument can test all types of a.c. and battery-operated vacuum tubes, the –80 and –81 type rectifier tubes, and has provisions for testing the new 2.5 and 6.3-volt series of 6 and 7-prong type vacuum tubes. It operates entirely from 110-volt, 60-cycle a.c. line supply. Direct current for testing the tubes is obtained through the use of rectifiers. The instrument can also check paper type condensers and either dry or wet electrolytic type condensers. It is also possible to check the value of resistors up to two million ohms. There is an operating and calibrated chart furnished with each checker.

Maker—The Franklin Radio Corp., Dayton, Ohio.

Full-Vision Dial

Description — This full-vision type dial with linear scale uses the National velvet-vernier mechanism, which accounts for its smooth operation. The scale is seven inches in length, permitting easy and accurate scale reading. The escutcheons can be supplied in either silver or antique bronze. The dial scales are available in the following types: Style VKC, clockwise, 100-0, 180 degrees; style VKCC, counter-clockwise, 0-100, 180 degrees; style VKE, counter-clockwise, 0-100, 270 degrees.



Maker—National Company, Inc., Malden, Mass.

Oscillograph Apparatus

Description—The oscillograph equipment shown in the above illustration comprise the following units. On the extreme right is the model No. 309 sweep circuit, especially de-

signed for use with cathode-ray tubes. It has a variable frequency range between 10 and 10,000 cycles per second. The wave shape is independent of both frequency and output voltage. This sweep circuit employs a special Thyratron type tube which is charged at a constant current by a special tungsten filament current regulator tube. The unit contains a built-in power supply operating from the 110-volt, 60-cycle a.c. lines. The center instrument is

the model No. 710 adjustable cathode-ray tube holder designed for the Wireless Egert No. 209 cathode-ray tube. This holder is also applicable to the Allen B. Dumont and the Globe Television Company's 3½-inch cathode-ray tube. The inside diameter of this holder is 3½ inches and it is 16 inches in length. To the extreme left is the model No. 709 power unit to supply all the A and B operating voltages and an adjustable modulating voltage to vary the focus of the beam on the face of the tube.

Maker—Wireless Egert Engineering, Inc., 179 Varick St., New York, N. Y.

An Attractive Mantel Type Receiver

Description—The model R-8 midget superheterodyne receiver is equipped with automatic volume control and micro-tone control. It employs the following tubes: three

–27 type, two –35 type, one –24 type, one –47 pentode type and one –80 type rectifier tube. The receiver chassis is mounted on rubber and it is enclosed in a walnut-finished cabinet measuring 18 15/16 inches high by 14 inches wide by 10 19/32 inches deep.

Maker—RCA-Victor Co., Camden, N. J.

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

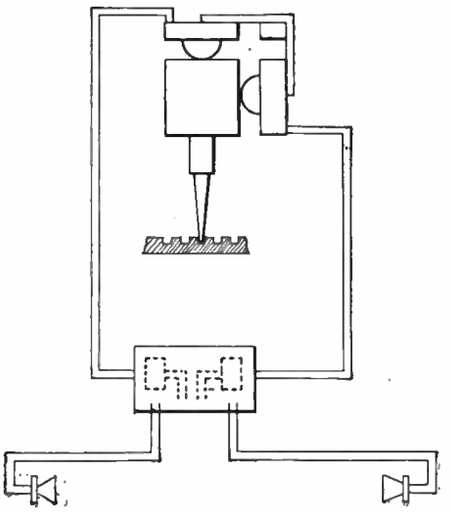
By Ben J. Chromy*

1,855,151. ELECTRICAL PHONOGRAPH PICK-UP AND APPARATUS. W. BARTLETT JONES, Chicago, Ill. Filed Jan. 25, 1930, Serial No. 423,351. Renewed Jan. 9, 1932. 15 Claims.

11. A duplex wave form record having independent coordinated vibrations therein, one vertically and one horizontally, and electrical pick-up devices for each record having a common stylus.

1,855,150. REPRODUCTION OF SOUND. W. BARTLETT JONES, Chicago, Ill. Filed Oct. 10, 1928. Serial No. 311,488. 13 Claims.

1. A duplex sound record combining in one track two independent and separable



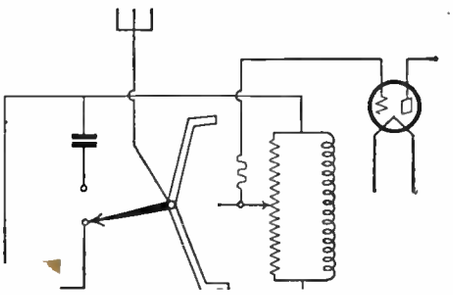
records of the same sounds picked up at different loci, one for the right ear, and one for the left ear.

1,859,678. ELECTRON DISCHARGE DEVICE. IRVING NACHUMSOHN, Chicago, Ill. Filed Dec. 29, 1926. Serial No. 157,744. 3 Claims.

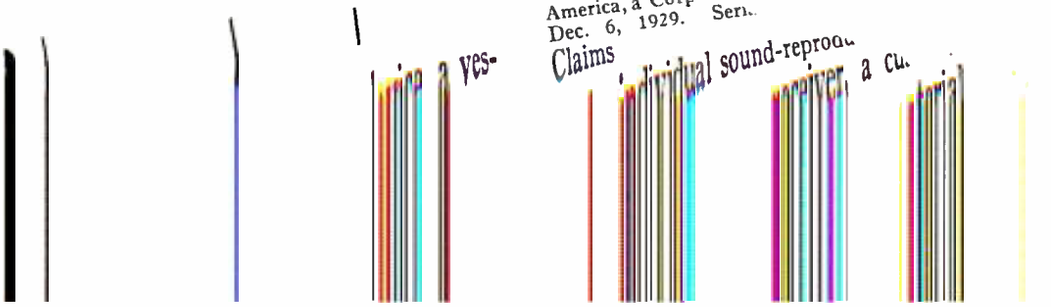
ments, said anode and spacing means comprising an enclosure for said heater and thermoelectric elements, whereby heat generated in said enclosure will affect the hot junctures of said thermoelectric element and generate a current therein, and a plurality of cold junctures of said thermoelectric element disposed externally of said enclosure and within said vessel.

1,865,271. RADIORECEIVER. HORACE E. OSMUN, HARRY W. RUBINSTEIN, and ERWIN R. STOEKLE, Milwaukee, Wis., assignors to Central Radio Laboratories, Milwaukee, Wis., a Corporation of Wisconsin. Filed Oct. 17, 1930. Serial No. 489,272. 11 Claims.

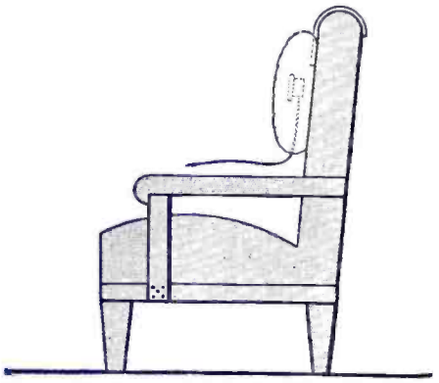
1. A radio receiver having means cooperable with the antenna for varying the volume of the signal impressed on the receiver, a local-distance switch regulating the action of said means and operable in one position to put the receiver in a condition of maximum sensitivity for distance reception and in another position to put the receiver in condition of minimum sensitivity for local reception, a manually operable volume control device for effecting smooth and accurate regulation of the volume whether the receiver is in a condition for maximum or minimum sensitivity, and interengaging means between the manually operable volume control device and the local-distance switch whereby when the manually operable device is moved to its maximum volume position it will automatically throw the local-distance switch into distance reception po-



...only 5 feet, 11
...d store expanded to
... size, or 10 feet in width,
...oom for a counter and shelves
...er wall. The new store is 22 feet
wide and should permit room for business
expansion.



sides thereof, the sound waves from said telephone receiver being transmitted through



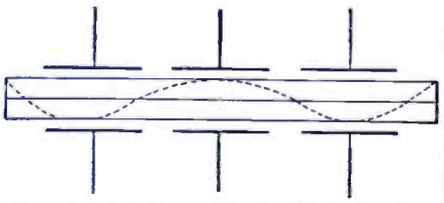
the cushioning material of said cushion-like member.

1,859,679. VACUUM TUBE AND METHOD OF TREATING THEREOF. IRVING NACHUMSOHN, Chicago, Ill. Filed Mar. 28, 1928. Serial No. 265,391. 1 Claim.

In the manufacture of vacuum tubes having a filament wire and an equipotential cathode disposed therearound, means for conducting a current through the cathode for heat treating said cathode, the said means embodying lead wires attached to the longitudinally opposed ends of said cathode, one of said lead wires being more easily fusible than the other of said wires.

1,860,529. ELECTROMECHANICAL SYSTEM. WALTER G. CADY, Middletown, Conn., assignor to Radio Corporation of America, a Corporation of Delaware. Original application filed Aug. 1, 1925, Serial No. 47,483. Divided and this application filed Apr. 12, 1930. Serial No. 443,685. 5 Claims.

1. An electromechanical vibrator comprising two vibrator elements secured together to vibrate as a unit, the elements being adapted to become deformed oppositely un-



der the action of an electric field, and a plurality of pairs of coatings applied to the vibrator and adapted to be energized with alternating current.

1,863,372. MULTI-ELECTRODE TUBE OSCILLATOR CIRCUITS. JAMISON R. HARRISON, Middletown, Conn., assignor to Wired Radio, Inc., New York, N. Y., a Corporation of Delaware. Filed July 31, 1928. Serial No. 296,586. 6 Claims.

1. In an electron tube generator, in combination, an electron tube having filament, space-charge grid, control grid, shielding grid, and plate electrodes, a source of potential connected to said filament, sources of potential for supplying potentials positive with respect to said filament to said space-charge grid, shielding grid, and plate electrodes, said shielding grid being maintained at a greater positive potential with respect to said filament than said space-charge grid, and said plate being maintained at a greater positive potential with respect to said filament than said shielding and grid, an input circuit connecting said control grid to said filament, an output circuit connecting said plate to said filament, and means for coupling said input and output circuits, whereby the electron stream between said filament and said plate is maintained and controlled.

?QRD?

A column devoted to the commercial operator and his activities

Conducted by GY

OUT in the streets the snow flickers and falls quietly—cold blasts of air go through clothing—brrrrr! On HQ circuits the atmosphere is filled with plenty hooey: Hlo thr—hw r u— hope yr freezing —nice dwn hr—warm—went bathing last night—yeh, well, I'd rather go swimming than ice skating anyway—wl, so long, hope u swelter—righto—ge.

If we gadgets think we have a monopoly on putting QRM through the ether, we are mistaken. The latest stunt is to put a person's heartbeats on the air. Here's for a transmitter in each and every home to see if the sweet woman still loves us whilst we "go down to the sea in ships." But will we know from which port the heartbeats come, eh?

Hear ye, all ye faithful: Uncle Sammy's mailboy brings greetings from Mervyn R. Rathbone, the kingpin of the American Radio Telegraphists Ass'n., informing us that not only does he like this colyum (tks OM), but also will aid with articles and other interesting information. His first bit of news is that English ops employed by the Marconi Company are paid whether or not they are on a ship. Sometimes an op stays on the beach for as long as three months on full pay. Now, don't be going English, gang.

Shuffling through the deck of mail, here's a few excerpts: Red Geale (GL) flash from the Orient, short-circuited his plans to go home and see how the mortgage was going. It's still there—on the roof—so Red's looking for a soft billet with the Airways. Here's how, Red: write to Dept. of Commerce for an application and you will be rated according to your experience.

Tsk, Tsk. "Boy, break out the towel." Vidrine (JL), who brass-pounded his way to a billet on the *S.S. Kishacoquillas,* is weeping the blues. An aunt dies—leaves him a pot of gold—he buys a house and lot—takes his femme out—biff, bang, boom—no more dough. He is now looking for another berth where he can rest and think over what he should have done with the lucre. Best wishes, OM; we live and learn, what?

The spirit of the month is "for all things (good or bad) we duly give thanks." Let's see . . . what must we be thankful for? A good hearty appetite? Some one who still remembers us (especially the guy to whom we still owe that fiver)? That there is a RADIO NEWS magazine which is giving Free a book of "23 Lessons in Radio"? (Sh—get in touch with me and I'll tell you the se-crut!) Anyway, gang, find something for which to be thankful—this holiday only comes around once a year—so cheerio and happy holiday—73's—GY.

Listeners' Survey

(*Continued from page 333*)

pleads "for only sixty seconds." Among the persons interviewed in this survey, few were opposed to granting sponsors a reasonable amount of time in which to tell of their products. Their opposition was toward the methods used. If an advertiser who pays for time on the air in which to tell the public about a good product would sincerely, interestingly and expeditely present the essential facts, the indications are that he would gain the confidence and respect of the folks in the armchairs who are, by and large, a reasonable lot.

Proceeding from the general discussion of the mistaken practices of radio advertisers to specific presentation of facts obtained from radio listeners, some of the more interesting data are here presented. Those sponsors who depend upon fan mail to guide them may find something to interest them in the following: Each person interviewed was asked when he bought his first radio set. The table in Figure 2 shows the age (in terms of radio ownership) of the audience covered in this survey, by income classes. It will be observed that the bulk of the lower income class (those with an annual income of less than $1000 a year) is a comparatively new addition to the the radio audience. In these charts, Class A listeners have incomes of over $5000; Class B, incomes from approximately $3000 to $5000; Class C, incomes from $1000 to $3000; Class D, incomes under $1000. The extent of influence this new element has exerted on the quality of radio entertainment is indicated in the analysis of fan mail shown in Figure 3.

The survey shows that the radio audience of today is a discriminating audience is indicated by the methods used in selecting radio programs as shown in Figure 4.

An alternative to devising a program of universal appeal, advisable in the instance of products adapted only to the needs of certain localities—such as farm machinery—is open through the use of electrical transcriptions on various selected stations reaching the special markets. The attitude of the listeners interviewed by the survey toward electrical transcriptions is indicated in the chart in Figure 5.

Some advertisers, in their desire to achieve a popular program, seem ot lose sight of the importance of effectiveness, translated into terms of recognition of sponsorship and incentives to buy.

The findings of this survey show that the programs most often mentioned as programs regularly tuned in are not always high on recognition of sponsorship and sales for the products advertised. Most all of us have met salesmen who were likable, entertaining chaps but not very efficient salesmen because they lacked that most necessary sales aid—the ability to use the clincher. Some radio programs are like those salesmen, as indicated by the following observations:

1. Advertisers who engage outstanding personalities, well known on their own account, often find themselves and their products overshadowed by the stars on their programs.

2. Programs which vary their routine, either in time of broadcast or talent engaged, confuse their listeners so that recognition of sponsorship is diminished.

3. Advertisers who engage artists previously identified with other commercial programs take a risk because listeners are inclined to associate an artist with his first program.

4. Children's programs, directed to interest children themselves rather than their parents, obtain a higher percentage of rec-

(*Continued on page 373*)

Radio Physics Course

(*Continued from page 365*)

of the excess proton left in the atom predominates. This unbalanced electrical state of an atom due to the removal of one or more of its electrons changes the atom to an *ion*. The process of accomplishing this result is known as *ionization*. As the excess electrical charge remaining on the ion is positive, this ion is known as a *positive ion*. The electron which has been removed from the atom becomes a *free electron*, free to move about wherever it is attracted by the charges. Of course, the unbalanced positive charge remaining in the ion exerts a force tending to attract it back, this force diminishing as the square of the distance between them. If the free electron becomes attached to a neutral atom, the amount of negative charge or electricity in the atom becomes excessive, and this atom exhibits a resultant negative charge as in C of Figure 3. It is then known as *a negative ion*. The actual substance of an ion remains the same, since the protons—which contains the mass of the atom—are not removed or combined. However, some substances exhibit increased chemical activity when in an ionized condition. It is evident that the more electrons that are removed from each atom during ionization of a substance, the greater becomes its unbalanced electrical charge.

Electrolytic Action

When salts or acids are dissolved in water, the act of solution separates or *dissociates* many of the salt or acid molecules, each molecule yielding a negatively charged atom (— ion) and a positively charged atom (+ ion). Thus when sulphuric acid (H_2SO_4) is mixed with water, there are present in the solution the positive hydrogen ions H^+, H^+ and the negative SO_4 ions SO4. We might say that the SO_4 ion takes an electron from each hydrogen ion.

Listeners' Survey

(*Continued from page 372*)

ognition of sponsorship and sales results than do programs for parents about their children.

5. Dramatic sketches with a continuous plot carrying over from broadcast to broadcast rate high in effectiveness. However, a drawback to this type of program is the difficulty of maintaining a standard of freshness and interest over a long period of time. Listeners show a tendency to lose interest in such programs after a certain length of time.

The findings of the survey seem to indicate that there are many good hours going to waste, while advertisers diminish their chances for a full audience by clustering in comparatively few hours which have come to be considered as most profitable.

The findings of this survey among all classes of radio listeners indicate an active interest in radio as a means of entertainment and education, a tolerant attitude toward good and non-abusive advertising on the air, and a desire for more vital and diversified programs *of a higher standard!* Also, indications are that whatever faults are now checked up against radio as a means of exploitation *ought rightly to be checked up against the advertisers who blindly try to reach an audience not only unseen, but also unknown!*

MICROPHONE FOR OFFICE AND OPERATING ROOM

Figure 2, at left, shows the author's arrangement for using a microphone in his regular office practice. Figure 3, at right, shows the arrangement as used over the operating table

A PRACTICAL APPLICATION OF PUBLIC ADDRESS *in the* Teaching of Surgery

[*By* Rafe C. Chaffin, M.D.]

MY early interest in, and some knowledge of radio, acquired by several years of study and experimenting, gave me the idea of using an amplifier and a loudspeaker to talk to medical students while operating. Microphones, loudspeakers and amplifiers were available, but how to make a practical application of the several units to the operating table presented somewhat of a problem.

Medical schools at the present time are making every effort to better equip their students for the care of the sick. The medical graduate, with his brain so crammed with knowledge, is what one might call a "general specialist." He has a good theoretical knowledge of not only medicine and surgery, but also all the specialties.

Most of the present-day medical schools require an internship before granting the diploma—a feature of great value—and give the student some opportunity to make a practical application of his vast store of knowledge.

The interneship and resident plan came about as a result of the teachers' recognition of the lack of sufficient practical work in the medical school. While our schools now are not only keeping up, but actually increasing the hours for study of the theory and science of medicine and surgery, we are also making every effort to increase the practical work so that the student will be a better doctor for the sick when "out on his own." This discussion is concerned chiefly with surgery, as this is where the student learns his "living pathology" and where it is necessary to make decisions quickly. The symptoms and physical signs may be studied leisurely at the bedside, but the judgment of what organ is pathological, the nature of the pathology, and the proper procedure in a surgical case must be decided in a matter of minutes. Therefore, the necessity for more and better opportunities to learn pathology is obvious and the best place to do this is the operative clinic.

I am not forgetful of the fact that the interneship and residency is a great opportunity for the student, but the better we can prepare him for these positions, the more he will get out of his practical work. We who have been out of school for a number of years readily recognize in the recent graduate his ability to describe accurately almost any of the common pathological conditions, especially in the abdomen. He may even be able to make elaborate and accurate drawings of the change taking place and the deviation from the normal. Often in my clinical work, which for several years has been teaching gynecology, I would be almost embarrassed by a new interne in the service, because of his accurate, detailed description of a concealed pathological condition in the abdomen. But what a difference, when the living pathology was encountered and exposed. All his accumulated knowledge seemed to leave him at once. As I have always stressed the value and importance of exploring the open abdomen, I will take as an illustration the gall-bladder. Although my interne knew that in chronic gall-bladder disease the wall was thick and changed in color, adhesions were present, the adjacent liver was fibrosed, small stones were present, as well as most of the other signs, he was absolutely helpless to tell me whether the gall-bladder was normal or a pathological one. The same is true of the stomach and duodenum. Or in the pelvis, he could examine the patient in the out-patient department and state fairly accurately that an organ was average sized or altered, but when shown the actual living organ he

could not recognize even the common gross pathological changes. On analyzing the situation, it seemed to me that the reason was that he had not seen enough living pathology during his laboratory and textbook study to recognize the living, gross pathology which he knew to exist.

The only opportunity the student has to educate his visual sense to living pathology is in his attendance to the operating surgical clinic. And furthermore, the amount of visual education he obtains is dependent upon the operating surgeon's ability and desire to disseminate this knowledge with the facilities at hand. Many of our best surgeons and best teachers do not have the knack of talking while working, but that may be because of the lack of proper facilities to talk directly to the class while carrying out the surgical procedure. In visiting many of the large clinics of the country, it has always been noticeable to me that the surgeon who would talk to his audience and describe the pathology, technique, etc., always had an attentive group of listeners. All of this prompted me to try and give the student group in the amphitheatre, whether large or small, a better understanding of the whys and wherefores of the work being done.

The Medical profession will do well to read this article which tells how one of their fraternity installed a public-address system with advantage. Servicemen can build and install similar equipment for you

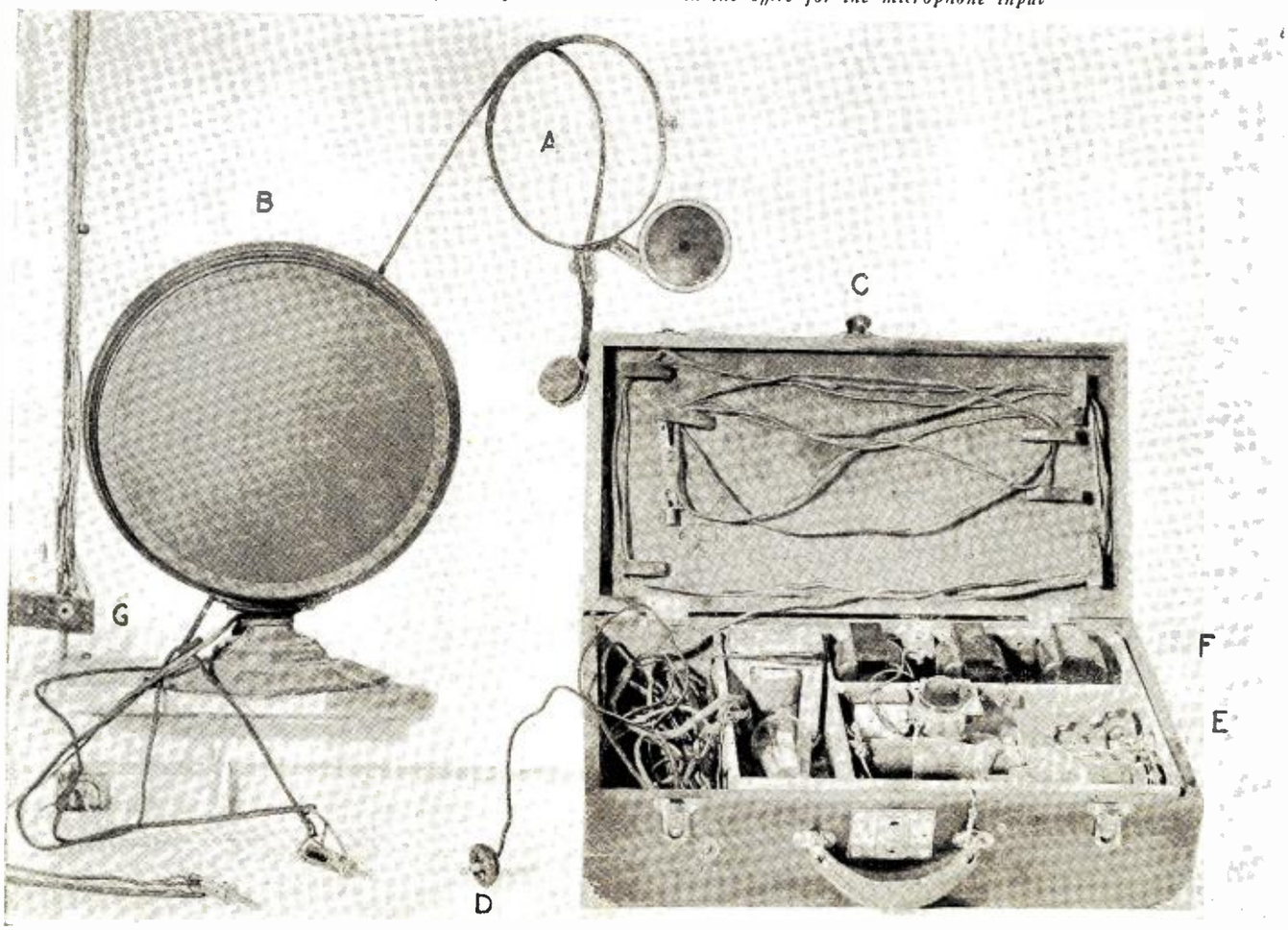
The amplifier shown here, Figure 1 (c), is a home-made one and very satisfactory, and when used with any good loudspeaker, Figure 1 (b), the voice is clear and distinct. In all public-address systems in other uses than the operating room, it is a simple matter to place the microphone in the correct and convenient relation to the speaker, who does not materially change his position or direction of voice during the entire conversation. But how about the operating surgeon? His attention must not be taken from his work, so it was necessary for the microphone to follow the speaker. The accompanying diagram shown here illustrates the solution, Figure 1-A, Figure 2, Figure 3.

The microphone must be small and light, not too sensitive, and be devoid of extraneous noises incident to moving and shaking. After trying out a great many in general use, I found one that is entirely satisfactory. As the illustration shows, Figure 1-A, it is attached to a reflector head-band of any type that is comfortable to the head. A small rod passing down over the nose is entirely out of the field of vision and holds the microphone securely in position over the mouth, Figures 2 and 3. A fiber diaphragm is placed over the microphone, spaced about ⅛ inch to eliminate the rushing noise of the exhaled breath. The whole appliance is easily covered with an approved face-mask and the operator is at once entirely unconscious of its presence, Figure 3.

I have recently added a "cut-out" device (not shown here) to enable the surgeon to disconnect the microphone from the horn if he does not wish parts of his (*Continued on page* 378)

COMPLETE PUBLIC ADDRESS SYSTEM USED IN CLINICAL LECTURES

Figures 1A to 1G: A shows the headband with microphone and mirror attached. It plugs into jack at E. Mirror is detached for operating room work. B shows any standard type of speaker which plugs into jack at F; C is the carrying case holding all parts except the speaker. The knob at center is for volume control. D is the a.c. plug for 110-volt, 60-cycle source of current; G is a separate jack to be located in the office for the microphone input



Neon Tube Oscillators

(*Continued from page* 343)

of the capacity and the resistance, or, since the frequency is the reciprocal of the period, the frequency is inversely proportional to the product of the capacity and the resistance. Although it cannot be expected that this exceedingly simple relation should follow precisely in practice [note should be made of the assumption upon which equation (4) was deduced], yet it will be found sufficiently exact for most purposes.

Because of the principle upon which the neon tube oscillator operates, it is apparent that the value of the series resistor may not be reduced below a certain point, if the flashing of the lamp is to be maintained.[7] Oscillation will occur as long as the amount of current flowing from the condenser during discharge exceeds the quantity flowing from the charging battery, or, in algebraic terms, the relation

$$\frac{E - E_c}{R} < M\,(E_c - E_k)$$

must be satisfied.

Since E_c may vary between E_a and E_b, the minimum value of R to maintain flashing is expressed by:

$$\frac{E - E_b}{R_{min}} = M\,(E_b - E_k)$$

or,

$$R_{min} = \frac{E - E_b}{M\,(E_b - E_k)} \qquad (9)$$

This value for R_{min} is that obtained by varying the resistor from a large value to a smaller, when the lamp is already oscillating. If it is desired to bring the lamp into oscillation from the stable condition, it is necessary to increase the resistance beyond the value indicated in the above expression.

Appendix

An alternative method for the calculation of t_2[8]:

From Figure 3, E_c being the intercept of the E-I curve on the E axis,

$$\cot\theta = \frac{E_c - E_o}{I_c}$$

and

$$I_c = \frac{E_c}{R}$$

where R is the resistance of the lamp.

Hence,

$$\cot\theta = \frac{R\,(E_c - E_o)}{E_c}$$

and, (1)

$$R = \frac{E_c \cot\theta}{E_c - E_o}$$

The current consumed in charging the condenser is

$$i_1 = \frac{E - E_c}{R}$$

and the current through the lamp is given by

$$i_2 = \frac{E_c}{R}$$

which, from equation (1), becomes

$$i_2 = \frac{E_c - E_o}{\cot\theta}$$

Since the rate of discharge of the condenser (i) is $i = i_2 - i_1$, hence

$$i = \frac{E_c - E_o}{\cot\theta} - \frac{E - E_c}{R}$$

$$= E_c\left(\frac{1}{R} + \frac{1}{\cot\theta}\right) - \left(\frac{E}{R} + \frac{E_o}{\cot\theta}\right)$$

Rate of discharge is also

$$i = -\frac{dg}{dt} = -K\frac{dE}{dt}$$

hence

$$\frac{dE}{dt} = -\frac{E_c}{K}\left(\frac{1}{R} + \frac{1}{\cot\theta}\right) + \frac{1}{K}\left(\frac{E}{R} + \frac{E_o}{\cot\theta}\right)$$

or, solving the differential equation, E_c being equal to E_b, when $t = 0$:

$$E_c = \frac{E\cot\theta + E_oR}{R + \cot\theta}\left(\frac{R + \cot\theta}{1 - \varepsilon} - \frac{R + \cot\theta}{KR\cot\theta}t\right) + E_b\,\varepsilon^{-\frac{R + \cot\theta}{KR\cot\theta}t}$$

or,

$$E_c = \frac{E\cot\theta + E_oR}{R + \cot\theta} + \left(E_b - \frac{E\cot\theta + E_oR}{R + \cot\theta}\right)\varepsilon^{-\frac{R + \cot\theta}{KR\cot\theta}t}$$

When E_c falls to E_a, $t = t_2$ and

$$E_a = \frac{E\cot\theta + E_oR}{R + \cot\theta} + \left(E_b - \frac{E\cot\theta + E_oR}{R + \cot\theta}\right)\varepsilon^{-\frac{R + \cot\theta}{KR\cot\theta}t_2}$$

or, solving,

$$t_2 = \frac{KR\cot\theta}{R + \cot\theta}\log\varepsilon\,\frac{E_b - \dfrac{E\cot\theta + E_oR}{R + \cot\theta}}{E_a - \dfrac{E\cot\theta + E_oR}{R + \cot\theta}}$$

which is equivalent to equation (6) in the text.

[1] a. Pearson and Anson, Proc. Physical Society (London), 34, 175 (1922), and later.
b. Pearson and Anson, Proc. Physical Society (London), 34, 204 (1922).
[2] Taylor, Clarkson and Stephenson, Journal of Scientific Instruments, 2, 154 (1924).
[3] See footnote, 1b.
[4] An alternate method for the calculation of t_2 is given in the appendix.
[5] Compton and VanVoorhis, Physical Review, 15, 492 (1920), and Skinner, Physical Review, 12, 143 (1918).
[6] Taylor and Clarkson, Journal of Scientific Instruments, 1, 173 (1924).
[7] Taylor and Clarkson, Proc. Physical Society (London), 36, 269 (1924).
[8] Pearson and Anson, Proc. Physical Society (London), 34, 204 (1922).

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.....

On ¾ Meter Transmission

(*Continued from page* 350)

has the same overall dimension as that employed in the crystal receiver.

The B-K receiver can be used either in an oscillating or stable state, depending on whether cw or a modulated signal is being received. Oscillations are suppressed by increasing the plate voltage slightly, in which condition it functions as a relaxation period tuner—a signal being favored, or tuned, the frequency of which corresponds to the relaxation period of the electron stream as governed by the grid potential. Oscillations are actually induced by the incoming wave—which, of course, is also favored by the dimensions of the pick-up system.

The output of this receiver can be readily amplified in conventional circuits—a combination receiver and amplifier being shown in Figure 8. With such a receiver, the transmitter described can be heard with good volume for several hundred feet. Under favorable conditions, communication has been established over a distance of several miles with this apparatus. Such results, however, are not easy to duplicate, and the experimenter may be gratified if he can pick up a good signal ¼-mile from the transmitter.

It is obvious that plenty of room exists for further development of the receiver. The addition of super-regeneration should result in greatly improved sensitivity. While the advantages accruing from the use of this system will not be so great as in the 5-meter band, experimentation along this line will be amply justified.

To the experimenter planning a thorough investigation into the possibilities of transmission and reception under 1 meter, a variation of the super-heterodyne principle, as applied to both transmitter and receiver, is also recommended. The transmitter oscillator is modulated at some super-audible frequency, say 175 kilocycles. The receiver input may consist of the B-K arrangement described above, with the output circuit tuned to the modulating frequency. The ¾-meter signal passing through the Barkhausen-Kurz circuit will be demodulated at the intermediate frequency, which can then be amplified through a conventional 175 kc. amplifier to any desired degree, to be followed by a second detector and the requisite amount of af. amplification. If the second detector is operated in conjunction with a beat frequency oscillator a very steady cw signal is available. Also the 175 kc. signal at the transmitter can be voice modulated, which will be demodulated in turn by the second detector.

Learn the Code

(*Continued from page* 339)

from a receiver. Messages taken from the air may be recorded and later copied at a slower speed. Also, if the operator happens not to be present during the sending of press, the message can be recorded and transcribed later.

The amateur can record the signals received from his friends or correspondents and show them how they are sending. Another use for the amateur is to record a call or a CQ on a tape and paste the ends together. The headphone can be held near a small microphone and thus he can modulate his transmitter automatically. Messages can be recorded on a tape previous to their transmission and this tape could then be run off at any desired speed when the desired party has been contacted on the air.

Teaching of Surgery

(*Continued from page 375*)

conversation to be transmitted to the amphitheatre. This is in the form of a belt, worn under the gown, and a wide, flat, brass spring "lever" occupying a position just under the left elbow at the side. A very slight pressure over this metal lever "cuts out" the microphone. I have used this the past two years, and the students and others assure me that it adds very greatly to teaching and creates an added interest in the operative clinics.

The operator may present the case, discuss the diagnosis and outline the technique of the operation, even though separated from the amphitheatre by a glass panel. Each step of the procedure can be clearly demonstrated and, most important, all normal and pathological conditions in the living can be shown and described in detail. I have had many internes assisting me who for one and two years previously had sat in the amphitheatre, assure me that they felt much more competent to recognize "what they saw" because of this improved teaching method. I have no hesitancy in strongly recommending the use of the public-address system in teaching operating-room surgery.

I make no claim for originality for any part of the mechanism, but only for the practical application of the several units assembled.

Since using the system in the operating room, I have added it to my suite of offices to an advantage. My several rooms are wired with "input jacks," connected through the amplifier to a loudspeaker at the secretary's desk, and during busy hours it saves many minutes and steps in "one-way" communication with the "desk."

For this purpose I have a double head-set, Figure 1-A and Figure 2, one post holding the reflecting mirror and the other the microphone.

A short wire and "plug," carried in the pocket, make the contact convenient. When not using the microphone it is swung to one side, not too conspicuous and not in the least inconvenient.

Tube-Saving Super

(*Continued from page 354*)

minimum fixed bias determined by the drop across R9, in the bleeder circuit.

The –55 triode is coupled to the paralleled –47 pentodes by R3, C10, P2 and C11 also forming the tone-control circuit. Plate circuit filtration for the –55 triode is furnished by R4, C9. C13, from pentode grids to ground, is to suppress hiss that might develop in the pentodes, and for i.f. isolation as well.

The power supply employs only the speaker field for filtration, with only two condensers, C17 and C18. The field is in the negative leg, and across it is the bleeder circuit R9, R10, R11, which is obviously not as well filtered as it might be, as for that matter, is the entire power supply. This is intentional, all a.c. hum being bucked out by advantageous circuit phasing, resisistance capacity isolation, and last and most important, careful initial balancing of the speaker bucking coil. The final result is an output entirely hum free, even though on the basis of apparent filtration alone it should not be.

The speaker is a 10½-inch specially matched Jensen, connected to the chassis by a four-prong plug and cable.

Such, then, is what may be accomplished by really intensive depression engineering.

"Mike" Amplifier

(*Continued from page 341*)

shown in the illustrations is equipped with a metal rod mounted in a perpendicular position on the base of the shield. This rod is about ten inches long and fits into the top of a tripod. If desired the entire unit may be suspended from the ceiling by means of wires or cord.

The chief advantages of the absorption microphone circuit over the usual arrangement are high output level, low background noise, and the elimination of multi-stage head amplifiers. Substituting the absorption microphone for an ordinary condenser microphone, it was found possible to eliminate two stages in the voice amplifier and still obtain equivalent audio output power. This effected a real saving in tubes and associated apparatus. Even greater output may be obtained by the use of larger tubes and higher voltages.

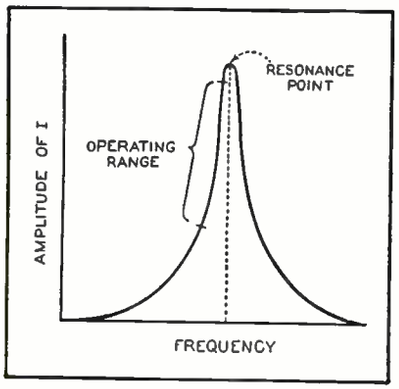


FIGURE 2

The unusually low background noise of the absorption microphone is striking. If an absorption microphone be substituted for the ordinary condenser-preamplifier arrangement of equal output, the improvement in background noise is about the same as when a condenser-preamplifier is substituted for a microphone of the carbon type. High insulation and noise free batteries must be used in order to realize this condition. Nothing but rosin core solder should be used in soldering joints during construction.

With the advent of good low priced condenser microphones and more efficient circuits the use of this type of microphone should spread rapidly among amateur phone operators. It is probable that condenser microphones will, before long, be as common as are the old single button microphones today.

List of Parts

C1—Midget variable condenser, 100 mmfd.
C2—Sangamo fixed condenser, .0005 mfd.
C3—Sangamo fixed condenser, .0003 mfd.
CM—Argabrite condenser microphone (see April issue for constructional details).
L1—10 turns of No. 16 d.s.c. wire on 1¼-inch tube, spaced by thickness of wire.
L2—13 turns of No. 28 d.s.c. wire on 1⅛-inch tube, spaced 3 times thickness of wire.
R1—Rheostat, 20 ohms for 3-volt supply; 100 ohms for 6-volt supply
R2—Fixed resistor, 40,000 ohms, 2-watt rating.
RFC—Short-wave choke coil.
SW—Toggle switch, s.p.s.t.
T—Any high-quality audio transformer of small size, ratio 3 to 1 or higher.
VT—4-prong tube socket equipped with type -30 tube.
1 4 or 5-wire shielded cable of required length with plug.
1 tube socket, 4 or 5-prong, for use as cable socket.
1 Alcoa aluminum box shield, 4½ inches by 4½ inches.

Midget Receiver

(*Continued from page 345*)

transformer should also be cut out before bending. Then the four sides are bent, forming a chassis 5 inches deep, 8 inches long and 2 inches high. Those who experience difficulty in assembling and wiring in a restricted area may increase the size of the chassis to suit their convenience. For example, the chassis may be 6 inches or 7 inches deep, without affecting the performance of the set.

The first step in assembling the parts is to mount all the wafer-type sockets. Next, the two-gang variable condenser is mounted on top of the chassis and also the antenna and ground binding posts and the power transformer. All other parts are mounted below the chassis.

The combined volume control and switch is mounted on the front chassis wall. The various r.f. coils, fixed condensers, r.f. choke, resistors, etc., are mounted as indicated on the underside of the chassis. The fixed resistors and small condensers may be soldered in place during the process of wiring.

Flexible hook-up wire should be used. Filaments are wired in first. The filaments of all three tubes, V1, V2 and V3, are connected in parallel. The grid circuits are wired next. Naturally, all grid leads should be as short and direct as possible.

For the benefit of those who have never worked with the new tubes before, detailed directions are given for wiring. On the -58 tube, the control grid connection is made at the cap. Looking down on the socket, the two large holes are for the filament prongs. Then, starting from the left filament terminal and going around the socket in a clockwise direction, the terminals are cathode, suppressor grid, screen-grid and plate. The suppressor grid terminal is the one which is connected externally to the cathode terminal. Looking down on the socket of the -56 tube, the isolated terminal is for the grid connection. In a clockwise direction from the grid, the terminals are plate, filament, filament and cathode respectively. The PZ tube also uses a five-prong socket, but in this case the isolated terminal is for the control grid connection. The screen-grid connection is made at the left, the plate connection at the right and the remaining two are for the filament connections.

The plate circuits are wired in after completing the grid circuits. Then cathodes, bypass condensers, negative returns and the power supply cricuits are completed. The latter include the rectifier tube, V4, and the primary of the transformer T1 to the switch S1.

The completed set is checked over carefully. Then tubes and speaker are plugged in and the set is connected to the 110-volt source. A few stations are tuned in at various points on the dial and the trimmer condensers are adjusted for maximum volume.

For the benefit of those who like to make their own coils, the following coil-winding data is given. The secondary of L1 should be wound with 130 turns of No. 10-41 Litz wire on a wood core of ½-inch diameter. The thickness of the coil is ¼ inch. Coil is lateral-wound. The primary is flat-wound directly on the core. It consists of 20 turns of No. 36 enameled wire, forming a coil 1/16 inch wide by 1/16 inch deep. Coil L2 is wound exactly the same as the secondary of coil L1. These coils may also be obtained specially wound for this receiver.

To deepen the tone of the speaker, shunt a small condenser, C7, across the primary of the speaker output transformer. Several values should be tried, from .006 mfd. to .002 mfd., until the most desirable tone is

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of RADIO NEWS, published Monthly at Dunellen, N. J. for April 1st, 1932.

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

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

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Teck Publications, Inc., 222 West 39th Street, N. Y. C.; Editor, Laurence M. Cockaday, 222 West 39th Street, N. Y. C.; Managing Editor, None; Business Manager, Lee Ellmaker, 222 West 39th Street, N. Y. C.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Teck Publications, Inc., 222 West 39th Street, N. Y. C.; Lee Ellmaker, 222 West 39th Street, N. Y. C.

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

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

LEE ELLMAKER.
Business Manager.

Sworn to and subscribed before me this 29th day of September, 1932.
(SEAL) ABNER GERMANN.
Notary Public.

(My commission expires March 30, 1934.)

obtained in the loudspeaker output.

Parts List

BP1, BP2—Binding posts, one for antenna, one for ground
C1, C5—Trutest 2-gang variable condenser, .00035 mfd. each section
C2, C3, C4—Aerovox pigtail type condensers, .1 mfd.
C6—Aerovox mica condensers, .00015 or .00025 mfd.
C7—Aerovox mica condenser, .002 to .006. mfd.
C8—Aerovox mica condenser, .006 mfd.
C9, C10—Aerovox 4 mfd. dry electrolytic condensers, type P5-4, in cardboard containers
C11—Aerovox 10 mfd., 75-volt, dry electrolytic condensers, cartridge type
L1—Find-All antenna coil, type MM1, or wind according to text
L2—Find-All r.f. impedance, type MM2, or wind according to text
R1—Electrad 1500-ohm flexible resistor
R2, S1—Electrad 10,000-ohm potentiometer, type R1-240-P, with switch
R3 R6—I.R.C. metallized resistors, 25,000 ohm, 1 watt
R4—I.R.C. metallized resistor, 5000 ohm, ½ watt
R5—I.R.C. resistor, 1 meg., 1 watt
R7—I.R.C. resistor, 1500 ohm, 5 watt
T1—Trutest DeLuxe midget power transformer, type 2C 1512
V1—6-prong wafer-type socket
V2, V3—5-prong wafter-type sockets
V4, J1—4-prong wafer-type sockets
1 –58 type pentode tube
1 –56 type tube
1 PZ pentode output tube
1 –80 type rectifier tube
Aluminum chassis, 8 inches by 5 inches by 2 inches deep
Four-prong speaker plug
Lafayette dynamic speaker, 2500-ohm field, single –47 output

The Service Bench

(*Continued from page 363*)

in this direction rather than fight the highly-competitive business of retailing factory built receivers."

ALL IN THE DAY'S WORK

Bob Evers Tripp, of Corsicana, Texas, sends in the following notes on Philcos:

"I have specialized in Philco service for the last two years, and have run across quite a bit of trouble due to open and shorted condensers.

"In the model 20, providing that analysis and other tests check okay, very low volume can often be traced to an open blocking condenser in the resistance-coupled amplifying stage.

"In the superheterodyne models, a distorted output, sounding as if the speaker's mouth was full of hot mush, will usually be traced to an open blocking condenser just before the pentode.

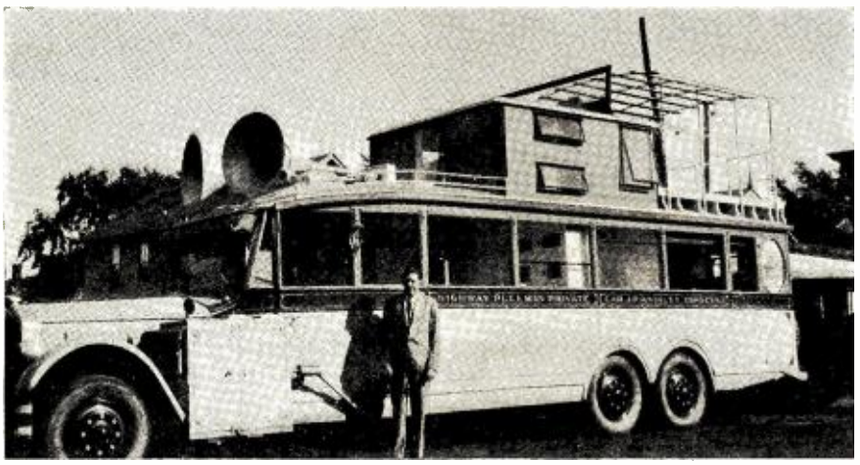
"Intermittent operation in a Philco will often be caused by a faulty bypass or coupling condenser in the radio-frequency or oscillator stage. Trouble of this nature is extremely difficult to locate, because any kind of tampering with the receiver may start it working again—temporarily. Occasionally, quick raps on a suspected condenser will localize the trouble by inducing intermittent operation.

"Unbalanced circuits may be suspected in cases of low sensitivity. When balancing these receivers, particularly the eleven tube models, great care must be observed, in order to attain full sensitivity.

"When replacing individual tubes, the same make should be used, otherwise different internal capacities will throw the receiver out of balance. Philco tubes differ from Eveready, for instance, sufficiently to provoke trouble of this nature. Either complete sets of the same tubes should be used, or the receiver rebalanced."

Speaker Trouble in a Crosley

"The a.c. operated Crosley Showbox employs a special type speaker known as the Dynacone—a modification of the conventional dynamic speaker—and the chassis is wired to operate this speaker only. I have serviced several of these sets, and found the coils in the Dynacone open by corrosion, requiring a new speaker, or at least a new Dynacone unit. I have repaired several units, only to have the trouble reappear at an early date. The new units are high in price, and it often takes some time to obtain them. My solution to the problem is to replace the Dynacone with a magnetic speaker, such as the R.C.A. 100.



WORLD'S LARGEST SOUND BUS

This is the sound bus written about in last month's Service Bench; built and designed by Mr. J. G. Montross. Notice the two large BUD horns and units

"The first step in converting the Showbox to magnetic use, is to cut the two phone tips from the old Dynacone cable and solder them together with about two inches of insulated wire. This is plugged into the right-hand pin-jacks (at the top, looking at the front of the chassis) in the back of the chassis. The magnetic speaker can now be connected to posts "N" and "P" on the antenna-ground post strip.

"As a point of interest, it is possible to operate as many as four magnetic speakers in series from a single Crosley Showbox, when connected in this manner.

"W. T. Golson, Dothan, Alabama."

P.A. System

(*Continued from page* 347)

RFC—Hammarlund radio-frequency chokes, 85 millihenries
S1—Hart and Hegemann rotary switch
S2—Rhodes "Mark-Time" switch
T1—Kenyon filament transformer, type KFT-66-45
T2—Kenyon power transformer, type KPT-45
T3—Kenyon input transformer, type KL-845-2G
T4—Kenyon output transformer, type KPP-845
4 Leeds 50-watt sockets
4 Plug-in receptacles
Panels, sub-panels, pyrex window, rack, etc.

With the Experimenters

(*Continued from page* 361)

in 50 and 100 feet lengths in leather-covered reels. They can sometimes be purchased cheaply at second-hand stores. It takes just a few minutes to unreel one, or to reel it up. A snap hook can be soldered to the end of the tape, as shown. This makes it very easy to fasten the end of the tape line to an insulator, or to a small branch of a tree when no insulator is handy. An insulated wire about five feet long, with a test clip or storage battery clip soldered to the end, can be attached to the aerial binding post on the receiving set. Where the space is limited, just the right amount of the steel tape aerial should be reeled out, and the test clip attached to the receiving set clamped onto the tape where it comes out of the reel.

GEORGE MARK,
Los Angeles, Calif.

Technical Review

(*Continued from page* 359)

25. Noise-Reducing Antenna System. A detailed description, with technical data, on the new Lynch antenna system which is effective in eliminating the great 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 installation and offers a big field for profitable jobs for the serviceman. Its use on amateur receivers makes possible more and better QSOs.

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 out-

INDEX TO ADVERTISERS

line covers the fundamental subjects of radio and the special subjects of radio technique and procedure in understanding circuits, equipment and the location and elimination of all radio troubles.

27. Wire Products and Antenna Supplies. A 4-page folder giving complete specifications of a wide variety of bare and variously insulated, solid and stranded wires for aerials, coils and transformers. Descriptions of aerial supplies, antenna kits, insulators, lead-in strips, lightning arrestors and ground clamps are also included.

29. Practical Radio Engineering. A 28-page book which gives a detailed description of the home-study course in practical radio engineering offered by the Capitol Engineering Institute. The course is divided into two main parts. The first part is intended to provide the student with the fundamental knowledge and training required to thoroughly understand the second part which is an advanced course in radio engineering. The course prepares the student for actual radio engineering work in the industry. Stress is laid on the practical application of radio principles.

Home Recording

(*Continued from page* 337)

As shown in Figure 3, two volume controls are used with the main amplifier, one at the input and one at the output. Both are potentiometers so modified that their adjustment does not greatly disturb the matching of impedances.

Class B Amplifier

(*Continued from page* 356)

List of Parts

(*Power Amplifier Equipment*)

C1, C4—Aerovox type PR-25, dry electrolytic condenser, 10 mfd., 25 v.
C2—Aerovox type PR-50, dry electrolytic condenser, 10 mfd., 50 v.
C3, C5, C6—Dubilier Himike electrolytic filter block, type PL-4456

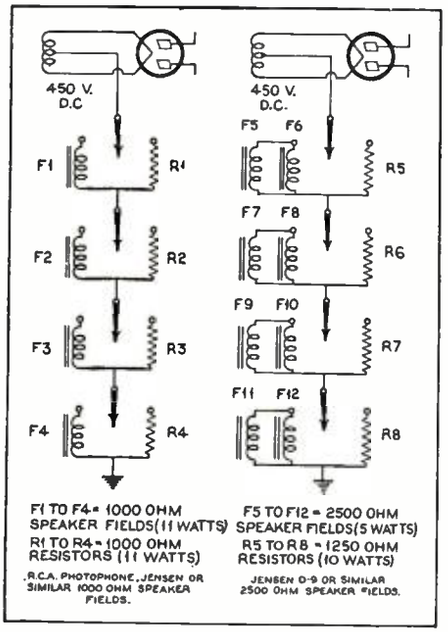


FIGURE 3

C7, C8, C9—Dubilier Himike electrolytic filter block, type PL-4461, triple 8 mfd., 500 v.
C10—Aerovox type 481 tubular condenser, .02 mfd., 400 v.

Ch1—Coast to Coast type 6767 filter choke, 10 henries, 200 ma., 100 ohms
Ch2, Ch3—Coast to Coast type 6167 filter chokes, 30 henries, 50 ma., 500 ohms
F—"Littlefuse" 2 amp. fuse with insulated mounting
R1—Lynch type LF-4 metallized resistor, 5000 ohms, 1 watt
R2—Lynch type LF-4½ metallized resistor, 100 ohms, ½ watt
R3—Lynch type LF-4 metallized resistor, 21,000 ohms, 1 watt
R4—Lynch type LF-4 metallized resistor, 60,000 ohms, 1 watt
R5—Lynch type LF-4 metallized resistor, 500,000 ohms, 1 watt
R6—Lynch type LF-4 metallized resistor, 2700 ohms, 1 watt
R7—Lynch type LF-4 metallized resistor, 25,000 ohms, 1 watt
R8—Lynch type LF-4 metallized resistor, 1500 ohms, 1 watt
R9—Lynch type LF-4 metallized resistor, 250,000 ohms, 1 watt
R10—Lynch type LR-4 metallized resistor, 4000 ohms, 2 watts
R11—Electrad type R1-203 potentiometer, 500,000 ohms
R12—Yaxley type 830-C center-tapped resistor, 30 ohms
S1—Hart & Hegeman s.p.d.t. toggle switch
S2—Hart & Hegeman s.p.d.t. toggle switch
S3—Coast to Coast type 6364-A dp.s.t. push-button switch
T1—Coast to Coast type 6151, 3-to-1 ratio audio-frequency transformer
T2—Coast to Coast type 7011 push-pull 46 Class B input transformer
T3—Coast to Coast type 7014-B push-pull 46 Class B output transformer
T4—Coast to Coast type 8001 Class B power transformer
TC—Coast to Coast type 6525 multiple condenser tone control
VT1, VT2, VT3, VT4, VT5—Coast to Coast type 6189-A, 5-prong tube sockets
VT6—Coast to Coast type 6188-A, 4-prong tube socket
W1 to W7—7 Eby binding posts, plain
W8, W9—Eby twin jacks
W10—Eby triple binding post mounting
1 Coast to Coast type 5767 crystalline-finish metal chassis with 4 shield cans and base plate, drilled ready for use
1 Bakelite strip for mounting binding posts, 7¼ inches by 1¼ inches by ⅛ inch
Miscellaneous wire and hardware, to include 8 multi-pigtail resistor mounting brackets.

DECEMBER, 1932

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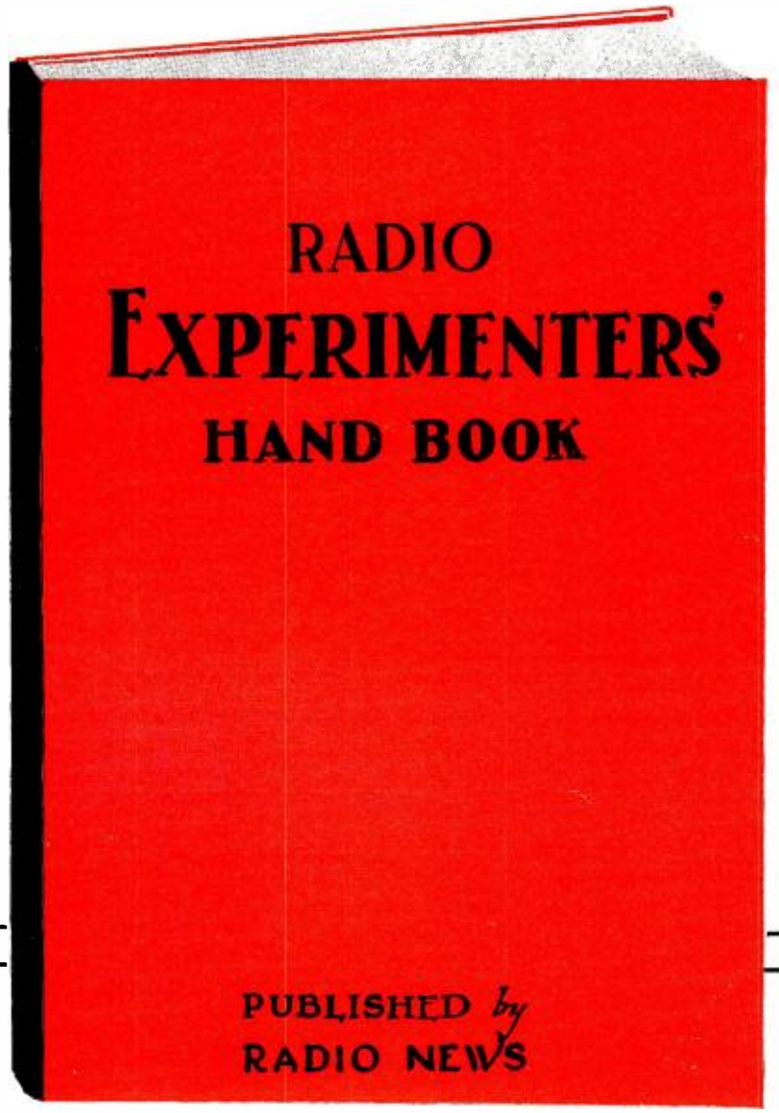

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