A GERNSBACK PUBLICATION

RADIO'S LIVEST MAGAZINE

Radio-Craft

Special Public Address Number

May 35
25 Cents
Canada 30¢

NRA CODE

HUGO GERNSBACK Editor

NEW WAYS TO SELL P.A. EQUIPMENT

See Page 650

Acoustic Labyrinths—"6B5" Amplifiers—Now-the "Infinite Baffle"
How to Make Money in the P. A. Field—Novel Loudspeaker Installations

SERVICE MEN'S ESSENTIALS FOR ALL MEMBERS OF THE ORSMA

WHAT ARE THE SERVICE MEN'S ESSENTIALS?

THE OFFICIAL RADIO SERVICE MEN'S ASSOCIATION has arranged to supply a number of "Service Men's essentials" for its members and associate members only.

These essentials are priced at cost, plus a small additional fee which is the only source of income that the Association has. No one obtains any profit or benefit, except the Association itself. Whatever profit accrues, is reinvested for the furtherance and enlargement of the Association.

By using the letterheads, billheads, etc., you present the business-like appearance to your customers. In addition, the Association has made arrangements with most of the prominent manufacturers to allow special discounts to members, providing ORSMA letterheads are used when ordering.

No. 14—50c each
(Plus 10c for Postage)

No. 1 ORSMA LETTERHEADS

These letterheads, shown on the right, are furnished with your name, address and telephone number, printed on excellent paper. They are sold in lots of 100 or multiples thereof, with a distinct saving for single orders of 1,000 or more. Per 100, 60c; per 1000, $3.00.

No. 2 ORSMA ENVELOPES

These are furnished to match the letterheads, printed with your name and address and seal of the Association. They go hand in hand with the letterheads and are usually ordered in the same quantity. Per 100, 60c; per 1000, $3.00.

No. 3 ORSMA SERVICE RECORD CARDS

These serve a double purpose; whenever you complete a job you fill out the report-bill and hand it to the customer; this is the "psychological moment" to collect. By the use of carbon paper a permanent record is kept. Furnished with name, address and telephone number. Per pad of 50, 60c; per 10 pads, each of 50, $3.00.

No. 4 ORSMA INSPECTION LABELS

The label is to be filled in with the proper dates, and pasted inside the set or cabinet where the customer will see it. It is a continuous reminder to him that when service is needed, he can call you again. The advantage is apparent. Per 100, 60c; per 1000, $3.00.

No. 5 ORSMA LAPEL BUTTON

At the suggestion of many members a handsome lapel button bearing the name and emblem of the Association has been designed. It signifies that you belong to the ORSMA; and in addition it gives your customers a better appreciation of the professional nature of your work. 50c each.

No. 6 ORSMA BUSINESS CARDS

These are furnished on a fine grade of paper in two colors with a blotter back. Thus they present an incentive to customers to keep them in a prominent place. They are printed with your name, address and telephone and bear the official seal of the Association. Per 100, 75c; per 1000, $4.00.

No. 5—50c each

Nos. 9 & 10 ORSMA EMBLEM CUTS

These cuts for printing, advertising, etc., are furnished in two styles and sizes. They may be used for newspaper or telephone-book advertisements or for printing of any kind. Large size, 1⅛ x 1⅛ in., $1.35 each; small size, ¾ x ¾ in., $1.20 each.

No. 11 ORSMA MEMBERSHIP SIGN

A set of three signs, printed on heavy cards, and having holes punched in order to hang in office or store. These are sold to members and associate members. Large enough to be quite prominent and the two tone effect makes them attractive. Set of three, 50c.

No. 12 ORSMA ADVERTISING DISPLAY SIGN

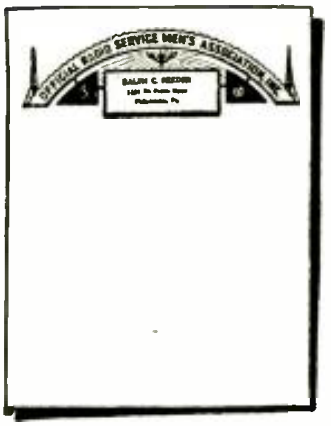
A two color sign printed in large letters with your name, address and telephone, with the seal of the Association. This sign is sold in quantities of 25 or more and is ideal for hanging in stores, offices, etc., for advertising purposes. Set of 25 cards, $3.00.

No. 13 RADIO SERVICE MEN'S ASSORTMENT PACKAGE

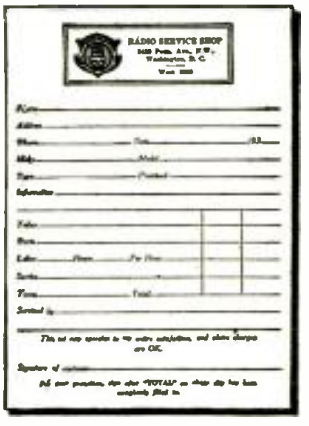
This includes one gold filled label button, 100 letterheads, 100 envelopes, 50 service record cards, and 100 labels printed with your name and address as described above. The whole assortment costs only—$3.00—a worth-while saving. Complete, $3.00.

No. 14 ORSMA MEMBER CERTIFICATE

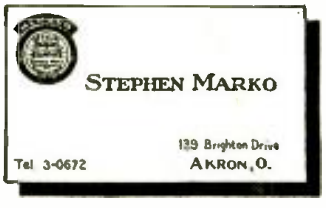
A handsome diploma-like certificate engraved on stiff vellum-bond. The certificate is personally signed by the President and Executive Secretary and the corporation stamp of the Association is impressed on a red seal attached to it. Your name, certificate number and date of registration are lettered by hand and the Certificate is mailed in a cardboard tube to insure safe delivery. Each 50c, plus 10c for postage.



No. 1—60c per 100
$3.00 per 1000

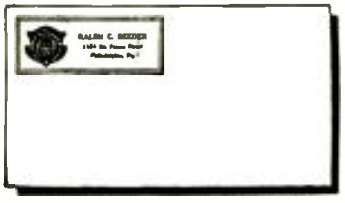


No. 3—60c per pad of 50
$3.00 per ten pads, each of 50



No. 6—75c per 100
$4.00 per 1000

No. 4—60c per 100
$3.00 per 1000



No. 2—60c per 100
$3.00 per 1000

Application for Membership in ORSMA

Executive Secretary, ORSMA
99 Hudson Street, New York, N. Y.

Kindly send an application blank for

☐ Full Membership
☐ Associate Membership

Name .....

Street or Box .....

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

RC-5-35

OFFICIAL RADIO SERVICE MEN'S ASSOCIATION

99 Hudson Street, New York, N. Y.

RC-5-35

Please send me the following RADIO SERVICE MEN'S ESSENTIALS which I have selected from this advertisement. My remittance for $..... is enclosed. *Send remittance in form of check or money order. Register letter if it contains cash, currency or unused U. S. Postage Stamps.*

.....

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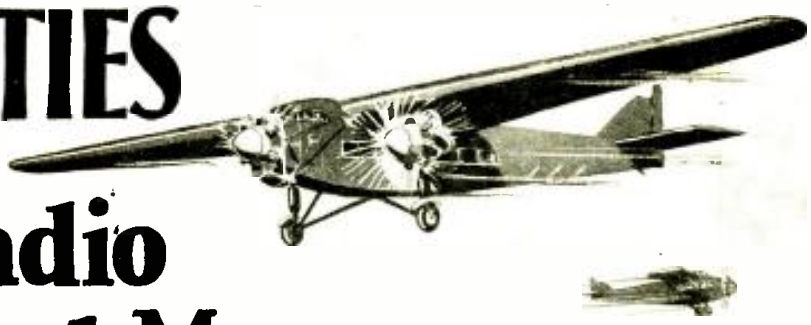
.....

.....

Name ..... ORSMA No. .....

Address ..... City and State .....

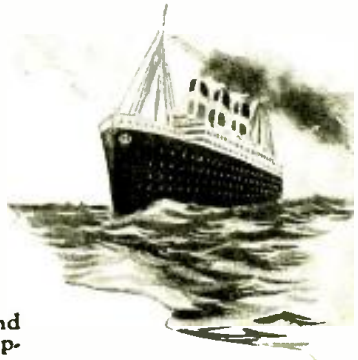
OPPORTUNITIES *are many* for the Radio Trained Man



Don't be an untrained man. Let me show you how to get your start in Radio—the fastest growing, livest money-making game on earth.

Jobs Leading to Salaries of $35 a Week and Up

Prepare for jobs as Designer, Inspector and Tester—as Radio Salesman and in Service and Installation Work—or for work in a Broadcasting Station—as Wireless Operator on a Ship or Airplane, or in Talking Picture or Sound Work—HUNDREDS OF OPPORTUNITIES for a real future in Radio!



Ten Weeks of Shop Training

Pay Your Tuition After Graduation

We don't teach by book study. We train you on a great outlay of Radio, Television and Sound equipment—on scores of modern Radio Receivers, huge Broadcasting equipment, Television apparatus, Talking Picture and Sound Reproduction equipment, Code Practice equipment, etc. You don't need advanced education or previous experience. We give you—RIGHT HERE IN THE COYNE SHOPS—the actual practice and experience you'll need for your start in this great field. And because we cut out all useless theory and only give that which is necessary you get a practical training in 10 weeks.

TELEVISION *and* TALKING PICTURES

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

PAY FOR YOUR TRAINING After You Graduate

I am making an offer that no other school has dared to do. I mean exactly what I say. You can get a complete training by the world's oldest and largest Practical Radio School and I'll finance your Tuition. You won't have to start paying me back in small, monthly payments until 2 months after your required training period is over. I consider the fellow who is ambitious enough to want to get ahead by taking my Training, worthy of my help. MAIL THE COUPON BELOW, and you can prove to me that you are willing to spend just TEN WEEKS in the Coyne Training Shops Learning RADIO. Then, I'll tell you how I finance your Tuition—give you your complete Training and let you pay me back later.

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

ELECTRIC REFRIGERATION AIR CONDITIONING

To assure your thorough preparation for a prosperous future, I include—at no extra cost—a course in Electric Refrigeration and Air Conditioning, taught you by personal instruction and actual work on latest-type equipment.

ALL PRACTICAL WORK At COYNE in Chicago

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

MANY EARN WHILE LEARNING

You get Free Employment Service for Life. And don't let lack of money stop you—my plan makes it possible to get Coyne training with very little money. Many of our students make all or a good part of their living expenses while going to school and if you should need this help just write to me. **Coyne is 36 years old.** Coyne Training is tested—proved beyond all doubt. You can find out everything **absolutely free. Just mail coupon for my big free book!**

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

Coyne Electrical School

500 S. Paulina St., Dept. 55-8H, Chicago, Ill.

Mail Coupon Today for All the Facts

H. C. LEWIS, President
Radio Division, Coyne Electrical School
500 S. Paulina St., Dept. 55-8H, Chicago, Ill.

Dear Mr. Lewis:—Send me your Big Free Radio Book, and all details of your Special Offer, **including Electric Refrigeration, Air Conditioning courses and your "Pay After Graduation" offer.**

Name _____

Address _____

City _____ *State* _____

Radio-Craft
FOR THE SERVICE MAN · DEALER · RADIOTRICIAN

CONTENTS — MAY, 1935, ISSUE

Volume VI Number 11

FEATURING AUTO-RADIO IN OUR NEXT ISSUE

Auto Radio is a subject that interests millions of autoists. It is this fact which should make it relatively easy for the radio Service Man to sell his expert service to the car owner. If Mr. Jones or Mr. Brown does not have a radio set "awheel," it shouldn't be so hard to demonstrate a good working model and make a profitable sale; if the gentlemen already own car-sets, contact them for service—maybe the set isn't as sensitive or loud as it used to be, or maybe the A.V.C. circuit is off-kilter. In any event, read the next issue of RADIO-CRAFT in which the subject of auto-radio will be discussed from all angles, and show the issue to your prospects—it may assist both of you.

RADIO-CRAFT is published monthly, on the first of the month preceding that of date; its subscription price is $2.50 per year. (In Canada and foreign countries, $3.00 a year to cover additional postage.) Entered at the post office at Mount Morris, Ill., as second-class matter under the act of March 3, 1879.

HUGO GERNSBACK, President I. S. MANHEIMER, Secretary

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European Agent:

Gorringe's American News Agency, 9A Green St., Leicester Square, London, W. C. 2.

I will help you start a Spare Time or Full Time RADIO SERVICE BUSINESS *Without Capital*

J. E. Smith,
President
National Radio Institute

HERE ARE A FEW EXAMPLES OF THE KIND OF MONEY I TRAIN MY MEN TO MAKE

Now Owns Own Business

"If I had not taken your Course I would be digging ditches instead of running my own business. One week I made $75 on repairing alone, and this doesn't count sales. If a fellow wants to get into Radio, N. R. I. is the starting point." R. S. Lewis, Modern Radio Service, Pittsfield, Ill.

Spare Time Jobs Earn $15 a Week

"I have no trouble getting Radio work. I have the reputation of being the best Radio man in town, and average $15 to $20 a week for spare time only." G. Bernard Croy, 151 Washington St., Bronson, Michigan.

FREE New Lesson on Loud Speaker Systems

Full of practical, up-to-date, straight-to-the-point dope on this profitable branch of Radio. Tells exact procedure for assembling pickups, mixers, meter controls, voltage amplifiers, level indicators, power amplifiers and loud speakers into amplifying systems, both large and small, for indoor or outdoor use. Tells how to match sections to get perfect coordination. Get this sample lesson to prove how practical my training is and how profitable it can be to you. Mail coupon.

Free Book Tells How. Mail Coupon!

The world-wide use of Radio sets for home entertainment has made many opportunities for you to have a spare time or full time Radio business of your own. I give you instructions early in your Training for doing 28 Radio jobs common in almost every neighborhood. Many N. R. I. men make $5, $10, $15 a week extra in spare time while learning. I show you how to install and service all types of receiving sets. I give you Radio equipment and instructions for conducting experiments, for building circuits and testing equipment and for making tests that will give you broad, practical Radio experience. Clip the coupon below and get my free 64-page book, "Rich Rewards in Radio"—it gives you a full story of the success of N.R.I. students and graduates, and tells how to start a spare time or full time Radio business on money made in spare time while learning.

Many N. R. I. Men Make $5, $10, $15 a Week Extra in Spare Time While Learning

Many of the seventeen million sets now in use are less than 50% efficient. I will show you how to cash in on this condition. I will show you the plans and ideas that have enabled many others to make $5, $10, $15 a week in spare time while learning. Ford R. Leary, 1633 Davison Road, Flint, Mich., wrote: "My part-time earnings while taking the N.R.I. Course were $651."

Get Ready Now for a Radio Business of Your Own and for Jobs Like These

Broadcasting stations use engineers, operators, station managers, and pay up to $5,000 a year. Radio manufacturers use testers, inspectors, foremen, engineers, servicemen and buyers, and pay up to $6,000 a year. Radio dealers and jobbers employ hundreds of servicemen, salesmen, managers, and pay up to $5,000 a year. Radio operators on ships enjoy life, see the world, with board and lodging free, and get good pay besides. My book tells you of the opportunities in these fields. Also in Aviation Radio, Television, Police Radio, Short Wave Radio, Automobile Radio and other new branches of this fast growing industry. Get it.

I Train You at Home in Your Spare Time

Hold your job until you're ready for another. Give me only part of your spare time. You do not need a high school or college education. Hundreds with only a common school education have won bigger pay through N.R.I. J. A. Vaughn jumped from $35 to $100 a week. J. E. McLaurine increased his earnings 100 per cent. The National Radio Institute is the Pioneer and World's Largest organization devoted exclusively to training men and young men by Home Study for good jobs in the Radio Industry.

You Must Be Satisfied

I will give you an agreement to refund every penny of your money if you are not satisfied with my Lesson and Instruction Service when you complete my Training. And I'll not only give you thorough training in Radio principles, practical experience in building and servicing sets, but also Advanced Specialized Training in the type of Radio work you choose.

Get My Free Book of Facts

Mail the coupon for "Rich Rewards in Radio." It's free to any ambitious fellow over 15 years old. It tells you about Radio's spare time and full time opportunities; about my training; what others who have taken it are doing and making. Mail coupon in an envelope, or paste it on a 1c post card.

J. E. Smith, Pres., Dept. 5EX
Washington, D. C.

National Radio Institute — **MAIL THIS NOW**

FOR FREE BOOK OF FACTS ABOUT RADIO

J. E. SMITH, President.
National Radio Institute.
Dept. 5EX.
Washington, D. C.

Dear Mr. Smith: Without obligation, send me the Sample Lesson and your free book about spare time and full time Radio opportunities, and how I can train for them at home in spare time. (Please print plainly.)

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

Address .....

City ..... State ..... "53"

MEMBERS' FORUM

OFFICIAL RADIO SERVICE MEN'S ASSOCIATION, INC.

A department devoted to members and those interested in the Official Radio Service Men's Association. It is the medium for exchanging ideas, kinks, gossip and notes of interest to Service Men or anyone interested in servicing.

A WELL-ARRANGED SERVICE BENCH

RADIO-CRAFT, ORSMA *Dept.:*

I am sending a photo of our complete radio service department, hoping you may find room for it on the Forum page of one of your forthcoming issues.

We are very proud of our shop as it contains every necessary piece of equipment for the repair of radio and sound equipment.

In addition to our radio equipment we also have a small television demonstration transmitter and receiver which is located in the rear of the shop.

JOSEPH M. STUTZ
108 So. Main Street
Goshen, Indiana

EMERGENCY MEASURES

RADIO-CRAFT, ORSMA *Dept.:*

I was called to repair a Columbia SG8 one Saturday afternoon, some time ago. I found that the power transformer was burned out. I replaced the transformer with a new one which I purchased, but the set wouldn't work. All the voltages were much below normal.

Later it was found that one of the wet electrolytic condensers was almost dry—and it was too late to obtain a new one.

The customer wanted the set for Sunday so I finally solved the problem by refilling the dry condenser with distilled water to replace that which had evaporated.

I use two glasses, one three-quarters full of cold water and the other three-quarters full of hot water. I filled the top of the electrolytic condenser container with distilled water so that it covered the rubber cap. Now by putting the condenser in the cold-water glass, the air in the condenser contracted and sucked in the water. Then I put the condenser in the hot water and some of the expanded air forced its way out. By repeating the process and constantly refilling the top of the condenser container with distilled water, it was gradually filled and the condenser worked normally.

Other ORSMA members may be stuck in the same way and use this kink to advantage.

L. O. GINSBOURG
763 Dawson Street
Bronx, N. Y.

A GOOD ENGLISH-READING TUBE CHECKER

RADIO-CRAFT, ORSMA *Dept.:*

Here is a reliable English-reading tube tester which can be made at very low cost. I have used it for several months and have checked it against a manufactured instrument which cost many times more.

The meter is an inexpensive 0-10 ma. meter calibrated red "BAD" from 0-3½; yellow or "?" from 3½-4½; and green "GOOD" from 4½-10. The device NL in the circuit (on this page) is a small ¼-watt neon bulb used for short check between heater and cathode or control-grid and cathode. Switch Sw6 is a double-pole single-throw unit labeled "SHORT" and "QUALITY" corresponding to 1 and 2 in the diagram.

Resistor R is a 6000 ohm wire-wound volume control that will carry sufficient current—the one used in my tester is from an Atwater Kent 55.

To calibrate this tester, the dial of R is marked off from 0 to 100. A tube which is known to be good is inserted in the correct socket and the switches set. Then starting from 0, carefully turn the knob of R until the meter reads in the "GREEN" section at about 5 or 5½. Then a poor tube will read in the YELLOW or RED. In testing tubes, Sw6 is first snapped to 1 or "SHORT TEST" and allowed to warm up. If the neon bulb glows in this position, there is a short in the tube. All other switches must be set correctly for the type of tube under test, of course. Then snap Sw6 to "QUALITY" and read the value of the tube's performance.

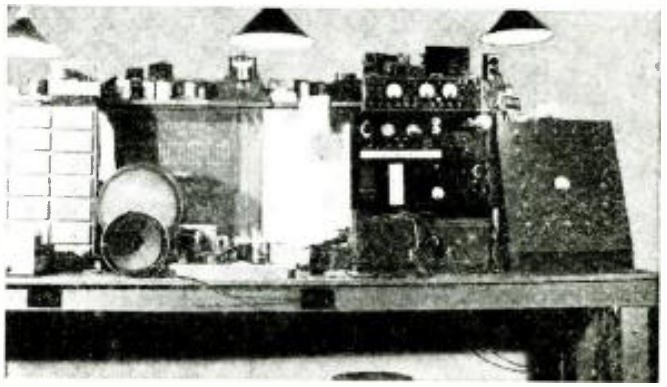
A partial list of tubes and the methods of testing them is given below:

01A, 00A, 10, 12A, 2A3, 2A5, 1A6, 1C6, 20, 26, 27, 30, 31, 37, 41, 42, 43, 45, 48, 50, 56, 71A, 76, 182B, 183, 484, 485, 585, are all tested in Socket 1 with no switches turned. (All switches in position 1.)

2A6, 6C6, 6D6, 15, 22, 24, 32, 34, 35/51, 36, 39/44, 38, 55, 57, 58, 75, 77, 78, 85, 89. Are all tested in Socket 1 with Sw5 in position 2.

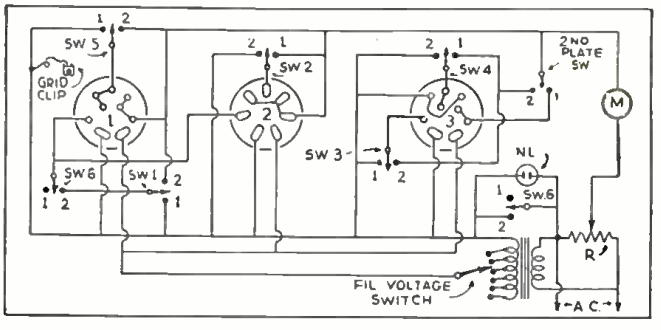
2A7, 2B7, 6A7, 6B7, 6F7 are tested in Socket 2 with no switches turned.

(*Continued on page* 695)

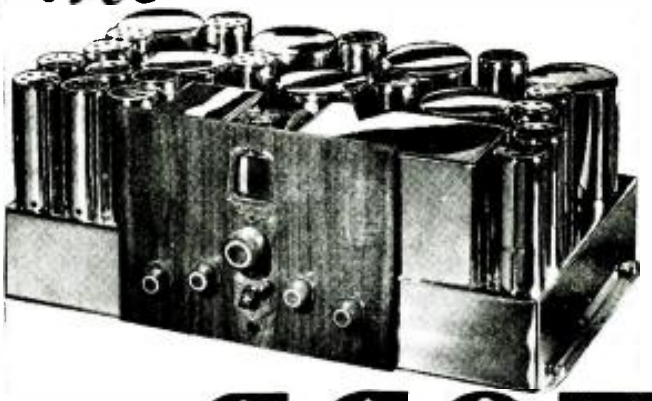


Above
An efficiently arranged service bench—note the replacement parts drawers at the left and test panels at the right.

Below
The circuit of the easily built tube checker.



Presenting the



SCOTT

Imperial Hi-Fidelity

• All-Wave

FULL RANGE
High Fidelity
25 TO 16,000 CYCLES

Triple A.V.C.

Surplus Power
35 WATTS STRICTLY CLASS "A"

Variable Selectivity

The genius of Scott engineering now takes sound reproduction into thrilling new fields. The new SCOTT *Imperial* HI-FIDELITY ALL-WAVE reproduces every sound vibration up to 16,000 cycles . . . covers the human ear's full tonal range and more than doubles the best previous accomplishment of high-fidelity radio reproduction. With this uncanny ability every colorful overtone, every shade of sound, lives with breath-taking actuality for the first time.

At last you can take advantage of the first high-fidelity broadcasts from the new high-fidelity stations. Ordinary radios of today are incapable of bringing more than a fraction of the tonal beauty available—with a SCOTT *Imperial* HI-FIDELITY ALL-WAVE, you can enjoy this new type of radio program NOW! Again Scott offers a receiver years ahead of competition.

The SCOTT *Imperial* HI-FIDELITY ALL-WAVE achieves still another great scientific feat by combining Full Range High Fidelity with startling sensitivity and selectivity beyond that ever known before. It brings in station after station—on both broadcast and short wave bands—that you have never heard before. Only Scott gives you a radio that is a true musical instrument, and also a world-cruiser to take you on journeys-by-ear to the most distant points of earth.

More than a score of revolutionary new technical features characterize the SCOTT *Imperial* HI-FIDELITY ALL-WAVE. Among them are Triple Automatic Volume Control, that keeps every program constantly at predetermined volume . . . exclusive Scott-designed visual tuning . . . exclusive Scott between-station noise suppressor . . . etc.

To realize the full beauty of tone brought by the SCOTT *Imperial* HI-FIDELITY ALL-WAVE, new and wholly different consoles have been especially designed.

The SCOTT *Imperial* HI-FIDELITY ALL-WAVE is custom-built to most exacting laboratory standards in one of the world's finest radio laboratories. Its every part, excepting tubes, is warranted for five years of trouble-free service. Sold only direct from the Laboratories, for 30-day trial in your home, anywhere in the U. S. A.

Complete details ready...Mail Coupon

Send today for complete details, definite proof of the amazing performance of the SCOTT *Imperial* HI-FIDELITY ALL-WAVE, and particulars of the 30-day trial-offer.

E. H. SCOTT RADIO LABORATORIES, INC.,
4404 Ravenswood Ave. Dept. 24115, Chicago, Ill.

Please send complete details of the new Scott Imperial Hi-Fidelity All-Wave and particulars of your 30-day trial offer.

Name.....

Address.....

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

Please Say That You Saw It in RADIO-CRAFT

Radio Men!

GOOD BOOKS WHICH HELP MAKE RADIO WORK MORE PROFITABLE

Presented on this page are books of the RADIO-CRAFT LIBRARY SERIES—a most complete and authentic set of volumes treating individually, important divisions of radio. Each book has been designed to give radio men the opportunity to specialize in one or more of the popular branches of the industry. You will find them a real help in your work and they will contribute to your money earning capacity. Read these books during your spare time at home.

The authors of these books are well-known to everyone. Each is an expert radio man; an authority on the subject—each is thoroughly familiar with the field which he represents.

This is the first real opportunity that you have ever had to build a library of radio books that are authentic. MOST OF THE BOOKS HAVE BEEN RECENTLY REVISED AND REWRITTEN TO KEEP THEM UP TO THE MINUTE. Mail coupon below for your books.

Book No. 1

Radio Set Analyzers

And How To Use Them

By L. VAN DER MEL

With Full Instructions and Descriptions of Set Analyzers, Tube Checkers, Oscillators, etc. (Just revised.)

Book No. 2

Modern Vacuum Tubes

And How They Work

By ROBERT HERTZBERG

With complete Technical Data on All Standard and Many Special Tubes. (Just revised.)

Book No. 3

The Superheterodyne Book

All About Superheterodynes

By CLYDE FITCH

How They Work, How to Build and How to Service Them.

Book No. 4

Modern Radio Hook-Ups

The Best Radio Circuits

By R. D. WASHBURNE

A Complete Compendium of the Most Important Experimental and Custom-built Receivers.

Book No. 5

How to Become a Radio Service Man

By LOUIS MARTIN

How to get started in the business of servicing radios and how to make money in this field.

Book No. 6

Bringing Electric Sets Up to Date

By CLIFFORD E. DENTON

With Pentodes, Multi-Mus, Dynamic Speakers—Complete Information How to Modernize A. C., D. C. and Battery Operated Receivers.

Book No. 7

Radio Kinks and Wrinkles

By C. W. PALMER

For Service Men and Experimenters

A Complete Compendium on the Latest Radio Short-Cuts and Money Savers—These Kinks Are Great Time-Savers.

Book No. 8

Radio Questions and Answers

By R. D. WASHBURNE

A Selection of the Most Important of 5,000 Questions Submitted by Radio Men During the Course of One Year—They Are All Answered by a Technical Expert.

Book No. 9

Automobile Radio and Servicing

By LOUIS MARTIN

A Complete Treatise on the Subject Covering All Phases from Installing to Servicing and Maintenance. A Book That Is Greatly Needed Today. (Just Revised.)

Book No. 10

Home Recording and All About It

By GEORGE J. SALIBA

A Complete Treatise on Instantaneous Recordings, Microphones, Recorders, Amplifiers, Commercial Machines, Servicing, etc.

Book No. 11

Point-to-Point Resistance Measurements

By CLIFFORD E. DENTON

The Modern Method of Servicing Radio Receivers—a Book Which Radio Service Men Have Referred to More Than Any Other.

Book No. 12

Public Address Installation and Service

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"Takes the Resistance out of Radio"

Editorial Offices: 99 Hudson St., New York, N.Y. HUGO GERNSBACK, Editor Vol. VI, No. 11, May, 1935

THE PUBLIC-ADDRESS BUSINESS

An Editorial by HUGO GERNSBACK

RADIO has the trick of dividing itself into numerous branches and very frequently some of the branches grow into big businesses.

Public Address, which was known a few years ago under the title of Radio Amplifiers has now reached the estate of "big business" and it is one branch of the radio art which is growing by leaps and bounds each year, showing tremendous progress over the year before. Today, anything that utilizes an A.F. amplifier and a reproducer goes under the name of Public Address, even if it doesn't properly come under this classification. Thus. for instance, if the switchboard operator of a busy concern having many offices announces to an executive, via a microphone and loudspeaker interoffice call system, that a certain caller wishes to see him, this really is not *public* address, but *private* address. Nevertheless, applications such as this one (and many others) today come under the heading of Public Address.

The business phase of this latest branch of radio has assumed huge proportions. Public-address systems go into practically every nook and corner of our busy existence, to wit: loudspeakers in the theatre (whether on the stage or throughout the house) make the voice of the performer more easily heard; the aviator, by means of a reproducer, speaks in a stentorian voice for advertising purposes, or, to the landing field a thousand feet below; the waitress in a busy restaurant gives her order to the kitchen over a loudspeaker system; political and other ballyhoo wagons cruise our streets—yet, it all comes under one general classification that spells b-i-g b-u-s-i-n-e-s-s for the P.A. specialist.

Many large firms are in this new business, and many organizations today are *specializing* in various types of public-address work. The cost of some installations may run into very large figures—in some instances, nearly $100,000 for a single installation (such as in a huge hotel). Various radio firms specialize in supplying different types of public-address equipment. Thus, some concerns furnish theatrical sound equipment, others cater to the hotel trade, and still others install sound apparatus only in public buildings. Then, there is a host of smaller organizations, not so ambitious, specializing in the rental and sale of more modest installations. Finally, we have the Service Men who take odd jobs making small P.A. installations.

All of these endeavors are highly successful—usually they pay well because Public Address is a branch of the radio business which does not permit the use of cheap, shoddy material. As a matter of fact, practically all the public-address installations in use are, with few exceptions, well constructed. The materials usually are of the best type, and a saving of a few dollars here and there is rigorously shunned. After all, *a public-address installation is taken seriously*, since it is realized that the system must not fail under any condition—Few chances are taken if the installation is an important one. Frequently, the entire system is duplicated; even the microphones being supplied in multiple, with different cable connections and separate wiring. In many instances separate amplifiers and loudspeaker connections are provided in order that one system may be operative should the other fail. (Hardly ever do *both* systems go out of order simultaneously.)

It is in the smaller communities, however, that the up-to-date, progressive Service Man has what is really a marvelous chance to start a very lucrative business. Most of the smaller cities and even villages can use numerous applications of public-address equipment. A host of ideas will present themselves to the enterprising Service Man; if applied, they will enable him to make a name for himself, if he will but cash in on his knowledge by making even small public-address installations. There are, first of all, convention halls (even if they *are* only the size of a large room) where a public-address system is always needed. The small court house, the same as its larger contemporary, can always use a public-address system to advantage—particularly, where the court-room acoustics are poor (often resulting in the jury and the rest of the court room being unable to hear witnesses).

Recreation grounds too, are now "wired" for public address (particularly where there is a bandstand) in order to pipe the music to other parts of the park. Office buildings, apartment houses, athletic fields, bathing beaches, baseball parks, charitable institutions, churches, dance halls, factories, parks. hospitals, hotels, skating rinks, open-air assemblies, orphan asylums, railroad depots, race tracks, restaurants, sanatoriums, schools, department stores, summer resorts, and dozens of others, all can be sold the idea of public-address installation if you know what you are about and realize the needs. Enterprising Service Men who own portable public-address systems very frequently have been able to *demonstrate* to the owners of various institutions and business places that there was distinct *need* for a public-address system; by making such "spot" demonstrations, sales have usually followed.

And, of course, when we speak of "public address," it must be remembered that the human voice is only one factor in this field. For *entertainment* purposes, for instance, we must have good phonographs, good records and good pickups before we can broadcast satisfactory music and other entertainment over the public-address system—the phonograph and public address frequently go hand in hand. And then, of course, we must not forget the factor of radio entertainment because, in many instances, is required to amplify programs in one form or another over a public-address system. This is a simple matter for the Service Man or the engineer.

A curious phase of the public-address business at the present time is that for several years past it has been considered a spring and summer business; usually starting in April and ending about the end of September.

However, the business is still young. It is still in its development stage and a tremendous amount of work remains to be done. Those who "get in on the ground floor" *now*, will reap not only an immediate profit from the "P.A." field, but a rich future harvest as well.

THE RADIO MONTH

METAL TUBES IN THE U.S.A.?

DAME Rumor was around again, last month, with a report that one of the foremost manufacturers of radio tubes is feverishly installing machinery preparatory to the manufacture of an entirely new line of tubes—the so-called "metal" variety —to replace existing types.

It will be remembered that these tubes, nicknamed Catkins, made quite a splurge on the English market when they were introduced (RADIO-CRAFT, August 1933).

We hope the American manufacturer who is "tooling up" to make these tubes will have the foresight to insulate the plates from probing fingers—and not leave them exposed as their British cousins did!

In the same rumor, it is stated that the manufacturer intends to standardize tube bases at 8 prongs—which is certainly a drastic step to take.

Are these rumors correct? A certain company could tell, if they would.

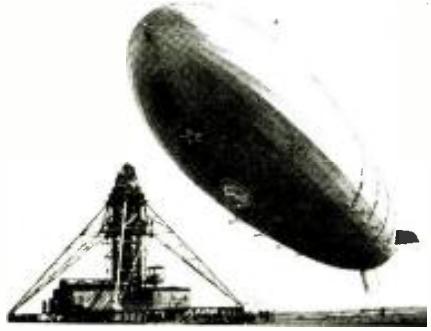
RADIO AND THE MACON

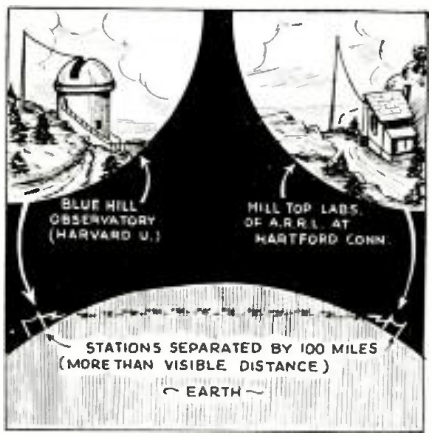
WHEN the $4,000,000 Macon, last of Uncle Sam's dirigibles, made her final plunge into the Pacific, last month, one of the two men to lose their lives was the radio operator, Ernest M. Dailey, who stuck to his post until he was ordered to "abandon ship."

Lieutenant H. N. Coulter, his commanding officer, said he had "upheld the highest traditions of naval service." He added: "Dailey's calmness and courage in sticking to his key constitute another incident of the unflagging devotion to duty, long a heritage of seagoing radio men."

Dailey's name should be added to the long list of radio heroes.

The ill-fated Macon whose radio operator stuck to his key at the expense of his life.





DX communication on ultra-high frequencies is now a possibility as proved by the ARRL.

100 MILES ON 2½ METERS!

AN EPOCH-MAKING achievement in short-wave communication took place last month when the hill-top radio station of the American Radio Relay League, near Hartford, Conn., started a continuous schedule of transmissions with Harvard University's Blue Hill Observatory, near Boston, on a frequency of 110 megacycles (about 2½ meters).

Up to this time it was considered impossible to transmit on these ultra-high frequencies further than the longest visible distance between any two points, and it comes as startling news that a distance of 100 miles can be spanned on a wavelength of 2½ meters. A unique feature of the performance was that it was accomplished when the longer and more tractable 5-meter waves exhibited very poor transmitting conditions.

While this is not the first time that transmitters and receivers have been made to work on wavelengths of this order, spasmodic, "freakish" signals having been heard on somewhat lower frequencies over distances of 50 or 75 miles, it was not until recently that signal radiating and collecting systems were devised, and the proper technique of their operation formulated, which enabled the epochal performance mentioned above.

The gradual increase in frequency attempted by amateurs has left behind a path of commercial application, all the way down from 200 meters. Some of the waves in this spectrum (which were regarded as worthless and given to the amateurs to "play" with) have proved to be most valuable! This is exemplified by the transatlantic telephone; police radio; commercial point-to-point telegraphy and telephony, etc.

Pilot Olsen directed the rescue ship, El Oceana, to the lifeboats by radio.

AIRCRAFT RADIO AIDS S.S. HAVANA'S PASSENGERS

NEWS came, early last month, that radio had played an important part in the rescue of passengers of the Ward liner Havana, when she was hurled on Mantanilla Shoal, in the Bahamas, during one of the heavy storms of this winter.

A Miami Coast Guard plane, piloted by C. B. Olsen, located the first of the lifeboats and directed the liner El Oceana to it. The boat appeared waterlogged and in immediate danger, according to the radio report sent by Olsen to the Oceana. However, due to the timely radio message from the plane, all six of the lifeboats were picked up and their occupants hauled aboard.

Thus, another "epic of the seas" was written—thanks to radio.

The ship went aground during the night, but the first SOS was not sent out until dawn, when it was found that she was in danger of being pounded to pieces. The seas calmed sufficiently by 11 a.m. to permit the boats to be lowered and soon after, the Coast Guard plane sighted them and reported their position to El Oceana.

It is interesting to note that the last two men to leave the ship were the Captain, A. W. Peterson, and the Chief Radio Officer, George Loya; Loya sending a final SOS and warning rescuers that all hands were abandoning ship. This is according to unwritten laws of the sea.

IN REVIEW

Radio is now such a vast and diversified art it becomes necessary to make a general survey of important monthly developments. RADIO-CRAFT analyzes these developments and presents a review of those items which interest all.

The radio on the trawler Jeria flashed out a final farewell to families and friends.

ICELANDIC RADIO TRAGEDY

DAVY JONES' locker was virtually adorned with a radio mike and transmitter last month when the trawler Jeria foundered on the west coast of Iceland, under the sheer cliffs of Latlatjarg.

The trawler which had shipped from a port in England had 13 men on board, including the radio operator. They were nearing the end of their fishing voyage and were ready to head back for their homes when the storm broke which sent their little boat to the bottom.

When hope of rescue was abandoned, the 13 men of the crew crowded around the radio operator sitting at the key of his transmitter and the following message was cast out into space: "We do not know if this will be heard by anybody, but if it is, give our last farewell to our families and friends in dear old England."

The message was heard—by another ship beyond reach of the crippled trawler and the message was subsequently carried to their homes and the rest of a sympathetic world.

There is a certain amount of consolation in this tragic message of farewell from the 13 courageous men of the Jeria's crew—at least, their families and friends received their last words—thanks to radio. Without the radio equipment, their fate would never have been known. Thus radio was again an instrument of mercy, even though it could not be a rescuer in this case as it has been in so many other instances.

And now radio sets have another application—that of amusing nursemaids in the park.

RADIO SETS IN A NEW ROLE

WE HAVE had radio sets installed in many odd places—beds, bathrooms, etc., but last month came news of a new one—radio in the baby carriage!

It seems that the idea is not to lull the baby to sleep or anything of that sort, but rather to entertain the nursemaid between her busy moments of retrieving the woolly bow-wow and watching the bottle.

It seems that everyone forgot one important question in thinking up this "new one," though—Is it fair to poor Junior?

ONCE AGAIN— THE THIRD CHAIN

WITH the change in program rates made last month by both NBC and CBS, the two big chains definitely turned toward the "big" advertisers who use coast-to-coast networks at the expense of the smaller companies desiring sectional groups.

This decision of the two nation-wide chains has caused a definite flurry in the ranks of those who have aspirations to form the much-heralded but never-achieved third chain. Here is just the chance they have awaited to take advertising from the "big brothers."

Two contenders stand out among the competitors grasping for this business. The Mutual Broadcasting System, including WOR, WXYZ, WLW and WGN have already obtained sufficient new business to warrant leasing permanent telephone wires for 16 hours a day. The other "third" chain, American Broadcasting System, met the news by changing their key station from WMCA to WNEW and their name to American Broadcasting Company.

RADIO AIDED AMELIA EARHART ON PACIFIC FLIGHT

SOME of the most dramatic stories of radio are unpublished ones.

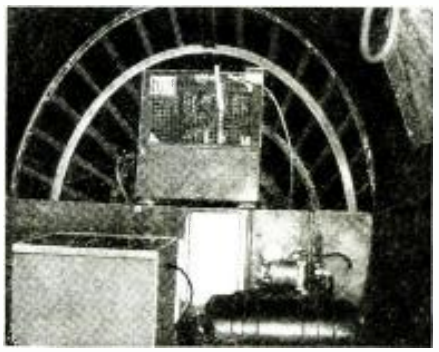
When Amelia Earhart Putnam took off from Honolulu, last month, for the faraway landing field at Oakland, Calif., she carried with her a tiny, but efficient 50-watt transmitter and a receiver. During her gruelling 17-hour flight she was heard repeatedly calling "Hello—K F I—hello—K F I, Okay!—and then she would shut her transmitter down with this brief reassurance.

She was transmitting on a frequency of 3,105 kc., which is a difficult channel for daylight transmission. However, several short-wave listeners stuck to their receivers, and their careful manipulation of the dials stood them in good stead—*they kept receiving her feeble calls long after the commercial reception points had lost her signal.*

Probably the best reception during this period was had by Mr. Walter B. McMenamy of Los Angeles, who, utilizing the regular aerial of KECA in Los Angeles, never missed a single transmission from Miss Earhart's plane. In fact, Mr. McMenamy was the only one so far as can be ascertained who actually knew of Miss Earhart's location when she was being reported lost; off her course; and the subject of other erroneous reports.

It was at this time that station KFI broke into the Metropolitan Opera program with the welcome message that "Amelia is safe and coming along, Okay!" Mr. McMenamy and another listener, Mr. Frank D. Andrews, kept KFI informed throughout the long vigil of Miss Earhart's messages, and during the night, KFI would come back to Miss Earhart's messages through their own 50 kw. transmitter. It is needless to say that those who were fortunate enough to be listening that night were treated to one of the greatest radio dramas of all times.

The compact 50-watt transmitter in Amelia Earhart's transpacific plane.



PUBLIC–ADDRESS PICTORIAL

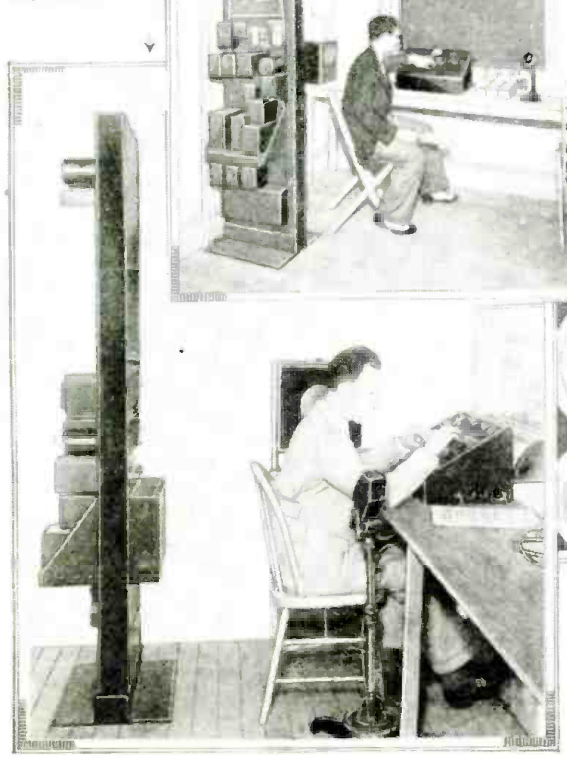
Close-up of a veritable "sea of faces"—32,000 strong! Public address with a vengeance! The occasion was the picnic of Franco, sponsors of the Hi-Jinks program over KFWB, Los Angeles. All day, cars trekked from Los Angeles to San Fernando Valley, Calif., until 7,000 cars were parked at Wineman Ranch. The P.A. system was kept on the jump announcing races, various acts of a mammoth radio show, and the dinner call. Trumpets proved adequate for these demands, and projection of band music.

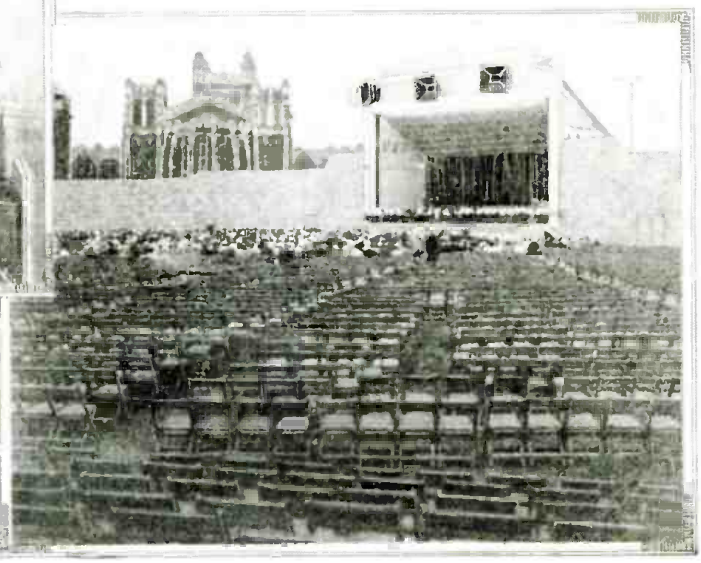
Control Room at Robin Hood Dell, Philadelphia, Pa. The booth is soundproof and located in front of, and off-side the orchestra "shell." This installation at the Dell was the first one attempted by the engineers of station WCAU; (a second one, more than twice as large, is the Lewisohn Stadium installation illustrated and described on this page). Such sound systems contribute greatly to mass enjoyment of good music.

A concert in progress at Robin Hood Dell, Philadelphia, Pa. To cover the audience of 7,000 persons, two large 10-foot directional baffle-type reproducers are used, atop the "shell." Velocity-type microphones at strategic points in the pit and on the stage pick up, respectively, sounds of orchestra and performers. Sound-absorbing baffles fitted to the stage microphones render them partially directional and thus prevent pick-up of orchestral passages.

Photos and data concerning Robin Hood Dell and Lewisohn Stadium, courtesy BROADCAST NEWS.

Control Room at Lewisohn Stadium, City College, N.Y.C. Operator is following score. This sound reinforcing installation is one of the largest in the world.

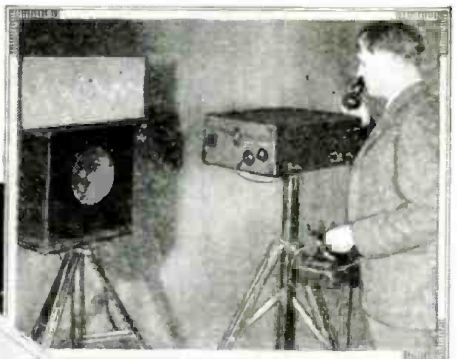


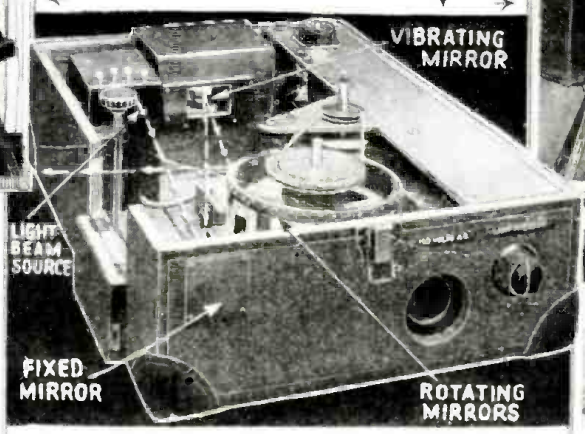


A rehearsal of New York Philharmonic Orchestra at Lewisohn Stadium. The sound-reinforcing equipment utilizes three large 10-foot directional baffle-type reproducers, directed for complete coverage of capacity attendance—17,000 persons! "Pianissimo measures are carried, limpid and clear, to the farthest reaches of the stone tiers," writes one observer. Main portion of amplifying equipment is placed in a small room (photo, left), in stage wing, giving engineers full view of stage.

(Widely diversified applications of public-address equipment are illustrated in this department. We will be glad to receive glossy photographs and short, semi-technical descriptions of equipment and installations not mentioned in Table 1 on page 654.)

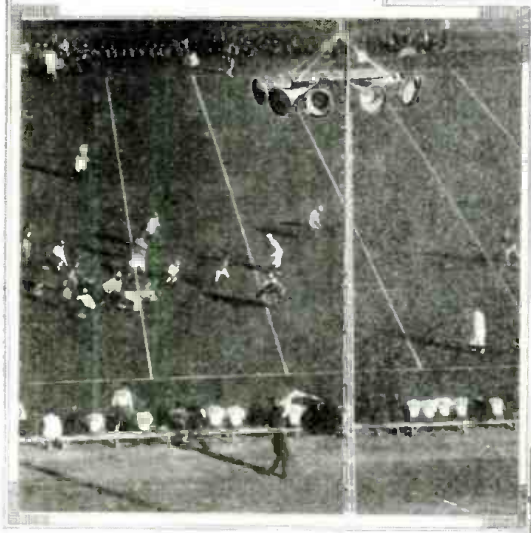
Century of Progress visitors viewed voice waveforms as pictured at left (waveform—record-recorded), below (oscilloscope unit), and at right (waveform—verbal equivalent of record). A light-beam reflects, from a mirror fastened to a dynamic microphone's diaphragm, to a rotating mirror. (BELL LAB. RECORD)





A novelty ash receiver and cigarette case in an imitation of a latest-type velocity microphone. Made in limited quantities, by a large radio company, for seasonal-gift purposes.

Stringless puppets, a P.A. field. Phono. records, an amplifier, and reproducers supply "sound." The mike and phonograph with P.A. Amplifier supply the voice and music. (Halbran)



Trumpets at famous Rose Bowl, Pasadena, Calif. Public-address system brings bleacherites details of a fumble during Alabama-Stanford football game last January. (Keystone)

The library loudspeaker is disguised as books. (Rosen)

"Mummifiec" records (left) of copper, chromium plated and sealed in tarlike compound, carry "sounds of the times," as recorded (above) via a spring-driven-motor recording unit and battery-type amplifier (right). Cornerstone of Am. Foundation for the Blind's new N.Y.C. building contains such records and a phono. pickup. Posterity, centuries hence, may "discover" these records (compound removable in warm water), and accompanying directions (etched on glass). (Halbran)

NEW WAYS TO SELL P.A. EQUIPMENT

There are many possible applications of P.A. equipment that mean extra dollars—as pointed out in this article.

C. W. PALMER

As indicated by the cover illustration, reproduced above, a logical and probably eventual use for directive P.A. equipment is in fire-fighting units, to prevent panic, direct rescue work, and otherwise employ amplified voice to overcome the din of crackling flames, falling timbers, shouted orders, etc.

Trains can be equipped to supply passengers with entertainment, en route.

THAT public address work—either selling equipment or service—is a highly profitable line for any dealer or Service Man to concentrate on, cannot be disputed. This business which usually starts as a side line has become the "main stay" of many a retail or servicing business. And the great advantage of it is that it is not highly seasonal. Public address facilities either indoors or outdoors are required in both summer and winter wherever people gather, in meeting for amusement, or for other reasons.

But, even though the P.A. business is flourishing for most of the men who have undertaken to supply the equipment or the rental of equipment, the uses to which P.A. amplifiers have been put only scratch the surface of possible applications. A notable lack of imagination and foresight has been shown by most of the men who make this their business—and as a result many interesting and profit-making uses have been neglected.

For instance, there is the very useful application shown on the cover of this magazine. Fire fighting is greatly dependent upon cooperation of the men and engines and what better means of bringing about this teamwork is there than the judicious use of a P.A. system? Also, a public address amplifier of sufficient size could be used to advantage to supplement the siren to warn pedestrians and motorists of the approach of the fast-moving fire engines. Too, highly directive, projector-type horns may be used at high sound-output levels, to combat the noise of roaring flames, falling timber, etc., in order to direct the work of rescue at a given point, or to calm the fears of persons trapped at high points in buildings but who are near to rescuing firemen; the projector-type horns permit the gain to be raised to very high levels without the sound output being a source of interference to unrelated near-by work.

In Europe, several trains have recently been equipped with P.A. and radio equipment to amuse the passengers while traveling. Railroads in this country could very effectively utilize P.A. systems, permanently installed in the cars, to furnish entertainment, either by means of radio or phonograph records, to relieve the monotony of long trips and especially on excursion trains running to beaches or other resorts. The same equipment would also serve to eradicate the unintelligible station announcements that conductors invariably give, by correct projection of the conductors' voices throughout the train. Public address men might think seriously of this application as it offers a tremendous market for P.A. equipment.

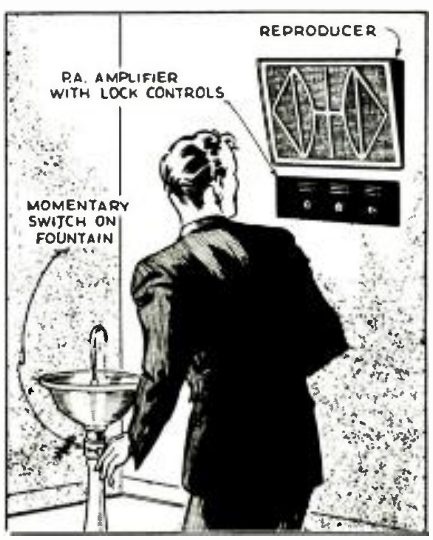
Another application which has not received the attention it deserves is the use of P.A. systems in aircraft. True, a few enterprising companies have fitted planes with high-power amplifiers for ballyhoo purposes, for advertising sponsored products over cities, etc., but city ordinances in many instances have put a definite damper on this application. However, there are other interesting and profit-making applications that can be used to sell amplifiers and equipment to the owners of planes. For instance, think of the aid that a P.A. system would be in making blind landings, when the airport cannot be seen. And then too, a

(*Continued on page* 679)

Public address from planes can be accomplished where town ordinances permit.

The barker on the rubberneck bus will certainly welcome the P.A. unit.

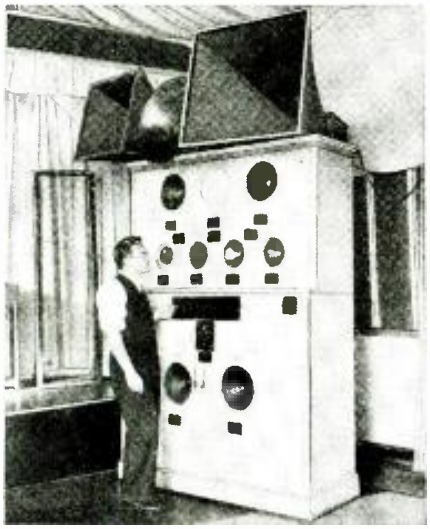
Advertising from "momentary P.A. units" is an interesting, new possibility.



HOW TO MAKE MONEY IN THE P. A. FIELD

Many radio Service Men and experimenters have seen the fine opportunity presented by the installation and rental of P.A. equipment—you will also find it a profitable business. Here are a few hints on getting started.

ANDREW HALBRAN



VARIOUS TYPES of loudspeakers are used in sound work today. In this cabinet, erected for comparison purposes, are mounted several electro-dynamic speakers of various sizes, and on top are exponential horns. In high-fidelity work a combination of both horn and cone type dynamics is used to cover a wide-frequency response. Even piezo-electric crystal units are being used to faithfully reproduce the high frequencies (those above 2,000 cycles).

THAT people are becoming more and more "sound conscious" every day is amply proved when we realize how extensively sound amplification is used today. Wholly apart from the talking movies and our own home radio, the scope of the so-called "public address" systems alone has reached tremendous proportions and every day seems to find new possibilities for their use.

A large candy store chain has placed the soda fountain in the basement of some of their stores and your order for an ice-cream soda is transmitted through convenient microphones—then your drink comes up on a dumb-waiter.

Cafeterias are beginning to use microphones to send your order to the chef. Traffic is being controlled from police booths equipped with loudspeakers in some towns. Paging is done in hotels by P.A. installations. Fishing boats are being equipped with amplifiers for entertainment with high-grade phonograph recordings while you wait for the fish to bite! Politicians, of course, are using sound amplification *extensively*, as are churches, schools, etc.

Small auditoriums, demonstrators in drugstore windows, and even advertising sandwich men have gone in for the "sound vogue" thanks to the portable outfits devised for this purpose.

Good equipment for all purposes is available today at very reasonable cost or parts can be readily obtained and assembled by anyone with the aid of diagrams and a fundamental knowledge of radio—and good money is being made through the rental or permanent installation of sound amplifying systems by radio experimenters and Service Men. As a matter of fact, by far the greatest number of installations of sound systems has been made by Service Men and experimenters who saw the opportunity and took advantage of it.

Service Men—install, repair or rent out a P.A. installation. Read the article, "The Growth of Public Address," for ideas.

MAKING RECORDS should be within the knowledge of the man working with P.A. equipment. This work is surprisingly simple now that a variety of devices are available. Making records of educational features, talks, political speeches, etc., and then sending the records out in sound trucks or to schools and auditoriums in various parts of the city has proved very profitable. In this photo the sound man (left) is making a record of an educational talk given by a teacher (right). A velocity mike is being used.

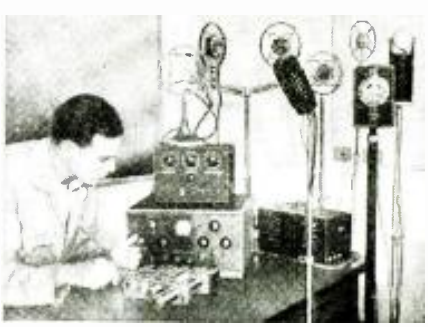
(The interesting photos on this page were all taken in the P.A. rooms of Wholesale Radio Service Co., Inc.

GOOD MICROPHONES are now available for regular and high-fidelity sound work. Included in this group are those of the carbon, crystal, condenser and velocity (ribbon) types. All have certain advantages and the P.A. worker should be familiar with the characteristics of each. The Service Man in this photo is making a decibel test by means of a level indicator and mixer in conjunction with a set of chimes.

FREQUENT TESTING of amplifiers is a necessity in sound work to prevent breakdown at a crucial moment, as well as maintaining a flat frequency range. Variations in the quality or values of condensers, resistors, tubes, etc., when they have been used for some time often result in reduced frequency range and power output, even though complete failure is not encountered. This Service Man does not depend on ear alone, but uses a cathode-ray oscilloscope, shown on right, to test a 28-watt amplifier.

PORTABLE P.A. outfits have vastly increased the possibilities for making money. Small and compact, they are very effective in small auditoriums, window demonstrations and similar places. They offer fine reproduction over limited areas and are simple in construction. This small 5-watt model has two dynamic speakers mounted in the covers.

BUILDING portable P.A. sets is highly profitable now, for the Service Man has found that the transportation of large, bulky equipment is, in many jobs, entirely unnecessary. The instruments are easily assembled and can be designed to meet your own specifications or obtained completely assembled ready for use. This P.A. man is attaching two dynamic speakers to the covers of what will be a 15-watt portable unit. The P.A. man should have several portable outfits available in addition to the regular high-power equipment.



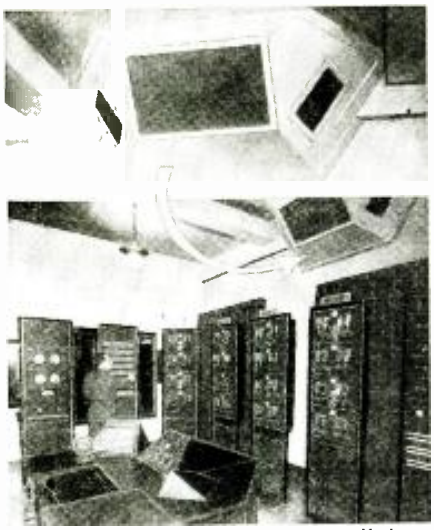


Fig. A—"Infinite baffle" in Hotel New Yorker.

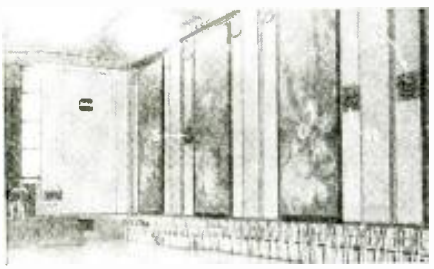


Fig. B—The speakers are at S, S1 and S2.

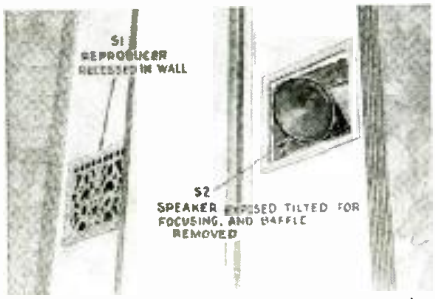


Fig. C—Speaker in wall recess, baffle removed.

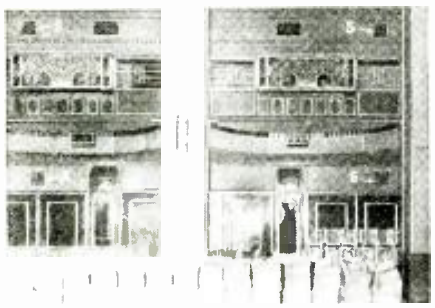


Fig. D—Camouflaged, recessed speakers (S).

FACTS ABOUT THE INFINITE BAFFLE

It is no longer necessary to have an unsightly baffle in order to reproduce low notes—just properly install the loudspeaker in a wall-recess and you have an "infinite baffle."

ELI M. LURIE

IN PAST issues of RADIO-CRAFT, the author explained in some detail the derivation and mechanics of the modern sound reproducer. (See RADIO-CRAFT Oct. 1932, Dec. 1932 and Feb. 1933.) Particular attention was focused on the baffle and its application in actual practice. Most important it was shown that the propagation of the low frequencies did not depend entirely on the distance from the center of the loudspeaker cone, out and around the baffle to the rear of the instrument, but instead was a function of the size of the flat area on the front of the speaker itself.

This, of course, meant that even though a radio cabinet with a short front baffle and a wide back had theoretically sufficient baffle area from the middle of the cone out and around to the back of the cabinet to reproduce the low frequencies, yet the low notes would not be heard but other abnormal characteristics would present themselves. In some cases for instance, there would be a seeming lack of low frequencies within some range (as perhaps 120 cycles to 180 cycles or 200 cycles); or on the other hand there might be a terrific booming affect within this same range—and of course plenty frequency and transient distortion would also manifest itself over the rest of the frequency spectrum. If the size of the cabinet were changed, other effects would be produced (using, of course, the same chassis and loudspeaker) so that even an attempt to catalog the sound variations with different sizes and shapes of cabinets would be very difficult.

This phenomenon might be said to be indirectly due to the air in the cabinet around the speaker and is usually called "cavity resonance."

The reason that cavity resonance is so named is that a body of air like almost any other object, will have a natural period of vibration at which it will always tend to vibrate. A few years ago one of the largest manufacturers of radio receivers incorporated in the cabinets of their receivers a pair of tuned air chambers that had a period of vibration in the lower frequencies. The sole purpose of the chambers was to boost the low-frequency response. As the public at that time was clamoring for boomy low tones, the effect was all that could be desired. This just illustrates what the "natural period" of an air chamber can do to greatly affect the performance of any acoustical system.

BACK-PRESSURE TROUBLES

Now in the case of a small cabinet, the air will not only vibrate at its natural frequency, but in addition a considerable amount of back pressure developed by the plunger action of the reproducer diaphragm will be produced. This back pressure is almost equivalent to the "back E.M.F." (or "counter-voltage") developed in an electric motor, in that it tends to oppose, mechanically, the movement of the diaphragm in much the same way that the back E.M.F. tends to oppose, electrically, the line E.M.F. in a motor.

Again, in a motor the back E.M.F. produces a distortion of the field flux; likewise in the loudspeaker the back-wave pressure produces both frequency distortion and transient distortion. All these facts were explained in the aforementioned articles.

On the other hand, it is true that a straight, flat baffle equivalent to the necessary distance and area for low-

(*Continued on page* 700)

Fig. 1—Method of constructing the "infinite baffle" unit.

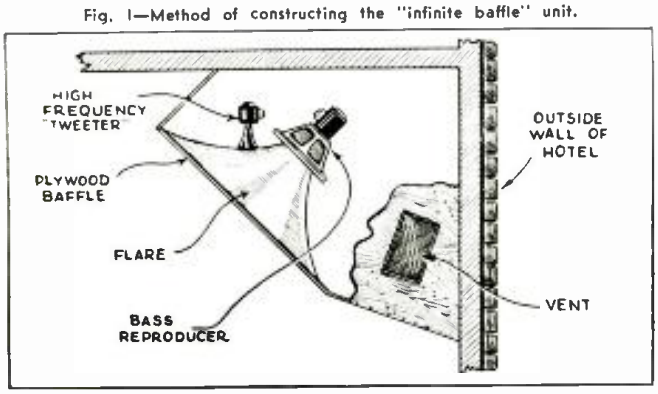
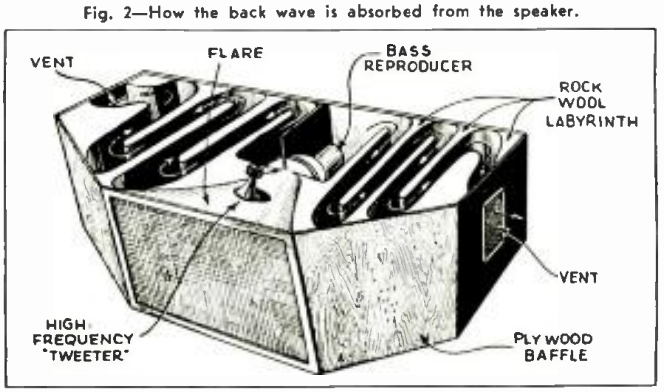


Fig. 2—How the back wave is absorbed from the speaker.



HOW TO MAKE A P.A. BEGINNERS' A.C.-D.C. PUBLIC ADDRESS ADAPTER

R. D. WASHBURNE
and N. H. LESSEM

This 1-tube P.A. adapter when connected to the antenna and ground posts of your radio set gives you a practical, inexpensive P.A. system! Voice fidelity is unusually good.

"HOW much will it cost to make just a simple public address outfit?" and, "How much will it cost me?" are the first questions the beginner in the "P.A." field will ask. The writers submit the following data in reply.

In the first place, it must be realized that a simple P.A. system is composed of the following units: (1) microphone; (2) microphone amplifier or "preamplifier"; (3) power amplifier; and, (4) reproducer. Now, for a beginner to undertake to build up, and coordinate the operation of all these items is somewhat of an undertaking, when even the commercially available units all too often present horrible examples of how a light-duty P.A. system should *not* work!

How, then, to easily solve the problem? Well, suppose we make up a sort of A.F. modulated "service oscillator," such as the writers' "R.F. Phonograph Attachment" first introduced to the radio world in the April 1934 issue of RADIO-CRAFT—we have then only to substitute a microphone for the phonograph pickup, and our job is nearly done!

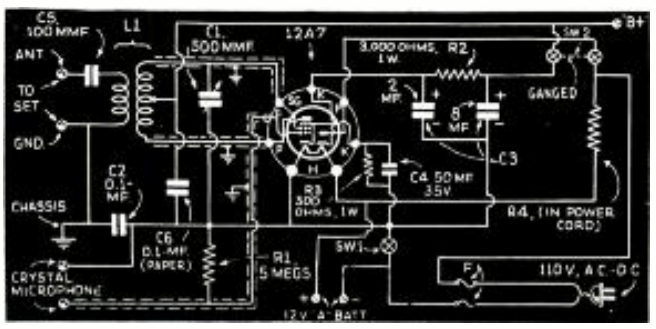
Nearly, but not completely—until the device has been modernized. This final step is accomplished by combining in one of the new multi-purpose tubes, the 12A7, the functions of the "osc.-mixer" and "rect." tubes in the earlier circuit. The modernized device is termed a "P.A. adapter," and is shown in use in the heading illustration; the schematic circuit is shown in Fig. 1.

HOW TO USE THE P.A. ADAPTER

Before we discuss construction details, or circuit design, the operation of the unit will be described.

This P.A. adapter is a miniature broadcast station; however, it operates "directcast," that is, it is directly connected to the receiver and consequently does not have an opportunity to radiate and thus cause interference.

Fig. 1
This adapter "talks" into your ultra-midget set!



The power rating? Well, it just doesn't have any *in itself*, in the usual sense. The "power" status is entirely dependent upon the power output rating of the associated radio set—the voltage output of the P.A. adapter is so great it will drive *any* radio set at full capacity. Thus, if the radio set is a little ultra-midget using in the power stage a 47 pentode operating at about 250 volts, our "P.A. system" will have a power output of about 2.5 watts.

This is adequate for addressing small assemblages—auctioneering, selling patented items, addressing "pep" meetings, as a "call" or "order" circuit for offices and restaurants (respectively), etc.

CONSTRUCTION DETAILS

There is little to say about the construction of the P.A. adapter, except as follows: Use the specified parts in the circuit shown. The R.F. coil details are given on page 621 of the April 1934 issue of RADIO-CRAFT (in this article condenser C4 should be connected to chassis instead of cathode, and R2 may be varied to secure increased sensitivity and lowered hum).

The metal box acts as cabinet and electrostatic shield. Do not draw up too tightly on tuning condenser C1 (which is screw-controlled, through a hole in the case, by means of a knob-topped machine screw, as shown), as this may break its bakelite "backbone." Reverse the positions of the microphone tips to determine correct connection, then color-code the tips and jacks; talk close to the microphone for best modulation. Shield the microphone leads if a lengthy run is necessary; use "transposition cable" (short-wave antenna lead-in wire) if a long line is required from adapter to set. In a few instances it may be desirable to dispense with condenser C2. An increase in volume may be obtained upon increasing the value of R1 to about 10 megs.

CIRCUIT DESIGN

Due to the compact design of this novel instrument (several units incorporating an A.F. modulated R.F. oscillator of this general type have been developed—See "A Wired-Radio Public Address System," RADIO-CRAFT, November 1933, and "'Wire-less' P.A. Installations," May 1934—but they were not nearly as small, inexpensive or versatile as this P.A. Adapter), it was necessary to utilize several tricks in instrument design.

For instance, nothing but the external ground connects directly to the chassis; thus, the chassis is not "alive" at any time. Fuses in both power-line leads are installed as an additional safety factor. The use of a "power cord" containing the filament limiting re- (*Continued on page* 697)

Six Wright-DeCoster reproducers in a large horn furnished adequate coverage for 65,000 people at Michigan U's stadium.

THE GROWTH OF "PUBLIC ADDRESS"

The average radio man little realizes that in the footsteps of the 1/4-billion dollar radio receiver business of 1934-'35 has followed Public Address.

D. H. WRIGHT*

A SHORT time ago the adequate sound installation was unknown, and it is only during the last few years that "sound" has become recognized as an essential feature for any large gathering.

Think back a few years and you can see in your mind's eye the man with the megaphone walking in front of the stands at the football, baseball, and other athletic games, calling the necessary announcements. Unfortunately (or fortunately—for the public-address field!), these were very seldom understood.

Today, if there is not an adequate sound system in every athletic field, auditorium, or concert hall, the public shows its disapproval by staying away.

Those unfamiliar with "sound" do not even start to realize its importance. They take it for granted that they should be able to hear the announcer perfectly when attending a prize fight or any other entertainment regardless of the size of the auditorium or stadium. We know this is true because you never hear from them as long as the announcements are easily understood, but just let a sound system go out of commission for a few seconds when an announcement is being made and you will hear plenty!

The first introduction of sound occurred at large gatherings where speeches or announcements were to be made such as political meetings, race tracks, prize fights, etc. The loudspeakers used at that time were what are known as trumpet-type units and were for voice only, as the frequency range was altogether too narrow to attempt musical reproduction.

Later, some attempts were made to reproduce music. It was just about at this time that sound hit the theatres. Those who were connected with the sound business in any of its branches at that time, will never forget the grand scramble there was by theatre-owners to have sound installed after it was brought home to them that they would either have to install sound in their theatres, or close up.

When the first sound picture ap-

(Continued on page 685)

*Pres., Wright-DeCoster, Inc.

TABLE I

101 APPLICATIONS OF PUBLIC ADDRESS EQUIPMENT

In Schools

1. Centralized radio systems.
2. Address systems for auditoriums.
3. Address systems for stadiums and athletic fields.
4. Music systems for gymnasiums.
5. Music systems for swimming pools.
6. Music systems for ice rinks.

In Hospitals

7. Address systems in special clinical rooms where acoustics are bad and operating doctor cannot face the class directly when speaking.
8. Centralized radio for patients.
9. Paging system for doctors and nurses.
10. Centralized radio for nurses' homes.

In Hotels

11. Centralized radio for guest rooms.
12. Music system for lobbies and private dining rooms.
13. Music system for main dining room to displace dinner orchestra.
14. Amplification for ballroom orchestra.
15. Paging system for guests.
16. Public address for speakers in the convention rooms.
17. In coffee shop to relay orders to kitchen.

In Dance Halls

18. Amplification for band or orchestra.
19. Music system for use in place of band in afternoons.
20. Ballyhoo—with loudspeakers on roof.

In Road House and Chicken Shacks

21. Amplification for orchestra in adjoining rooms.
22. Ballyhoo—with loudspeakers on roof.
23. Music system to supply music when place is too small to afford orchestra.
24. In larger chicken shacks to call orders to kitchen—one man could take almost all orders.

In Restaurants

25. Music system for background.
26. Address system for calling orders to kitchen.

In Churches

27. Public address in main room.
28. Public address to carry program to adjoining rooms.
29. Loudspeakers instead of bells for chimes system.
30. Music system to supply organ music.
31. Music system to supply music at ice-skating rink sponsored for the young people to keep them too busy to get into trouble somewhere else.
32. Public address to bring sermon-recording from nationally known ministers.
33. Public address to bring speeches from the Vatican broadcasting station, etc.

In Large Auditoriums

34. Public address for main arena.
35. Public address for adjoining rooms.
36. Ballyhoo—with loudspeakers over entrances at amusement auditoriums.
37. Small systems for sound-effect records used in plays.
38. System to supply music before and after events.
39. Paging system for larger auditoriums.
40. Car-calling systems at larger auditoriums.

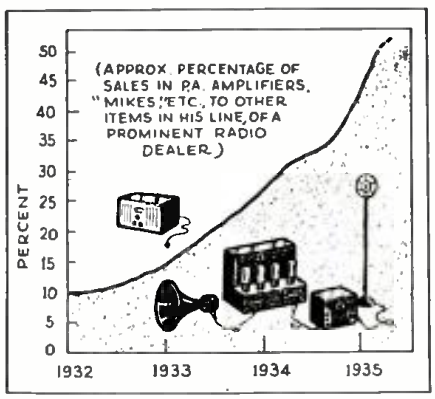
In Undertakers' Chapels

41. System to amplify ceremony in adjoining rooms.
42. Music system to supply organ music or other sacred music during, or before and after ceremonies.
43. In large chapels, system to amplify ceremony within chapel.

In Cemeteries

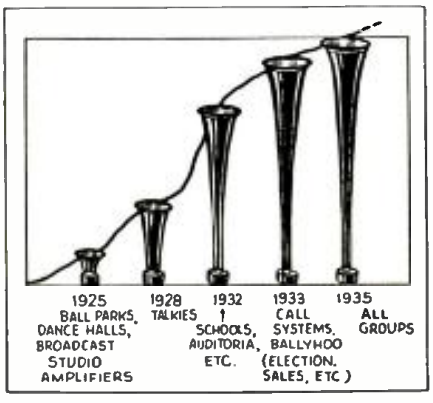
44. System to supply organ music throughout grounds.
45. System to amplify organ music throughout grounds.

(Continued on page 685)



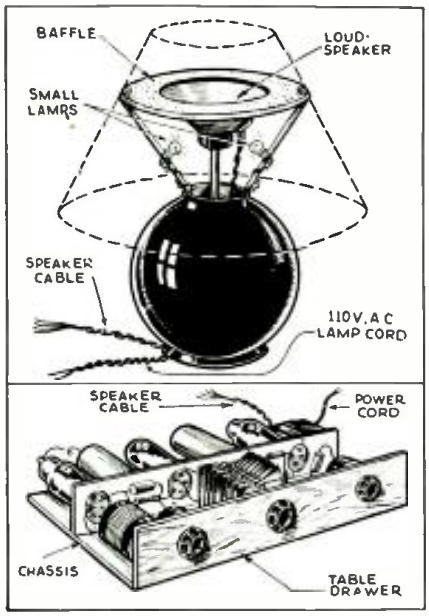
The steadily increasing sale of public-address equipment is indicated in the above.

Note that the increase in applications of P.A. installations closely follows the sales graph.



AN UNUSUAL RECEIVER AND REPRODUCER

Complete concealment of a radio set is possible by this ingenious method of placing it in a table drawer.



MANY attempts have been made from time to time to conceal the radio receiver, either by utilizing remote control or by mounting the set in a cabinet which is not apparent in the furnishings of a room.

An interesting example of the latter type of installation is shown in the illustrations here. The receiver, itself, is built into the drawer of a table, server, or other piece of furniture, depending on the room in which it is to be used. By mounting tubes and other parts on their sides, it is possible to place the entire set in the drawer, and have the controls on the front. The knobs appear to be drawer pulls and are quite inconspicuous as illustrated.

The speaker is also concealed in a novel way—and one which does not limit the radiation of sound in any way. A lamp, shown in the sketch, serves the double purpose of illuminating the room and holding the dynamic reproducer mechanism. Two lamps of the candelabra type supply the illumination. A small dynamic cone with a circular baffle mounted on supports from the bowl of the lamp provides the source of sound.

The set is mounted in the drawer and the speaker is concealed in the lamp.

It will be noticed that the baffle is not limited in size to the diameter of the baffle disc, as the lamp shade also acts as a part of the baffle, thus increasing its effective size.

The details of set construction and actual constructional details of mounting the speaker mechanism are not given, but are left to the ingenuity of the experimenter. Naturally these details must be adjusted to the size of the drawer and the size of set which is to be made.

Le Radio-Monteur.

A NOVELTY IN RADIO REPRODUCERS

The source of radio music is effectively disguised by mounting the speaker and amplifier in a small pedestal table.

NOVELTIES in radio set construction have always found interest among set constructors and experimenters who try "those new ones" whenever they appear.

Here is a novelty which originated on the other side of the Atlantic—in Germany.

The original idea was to make a reproducer which would mystify listeners by disguising the source of the sound. A table having a large pedestal and a round top was prepared as shown in the sketches. A dynamic reproducer was mounted in the top of the pedestal and the power amplifier of the receiver was constructed in the bottom. A number of small holes were drilled in a regular and neat pattern through the table top for radiation of the sound.

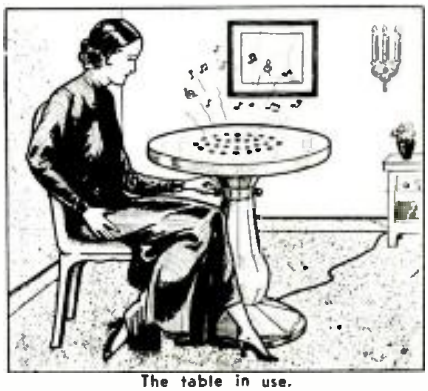
A volume control and power switch were mounted in the base, as shown. The radio receiver was made in such a way that it was obvious that no reproducer was included—and it was quite amusing to see visitors look for the source of the radio music.

The details for making this novel speaker are shown in the sketch here. The speaker is mounted vertically at the top of the pedestal; the top is removed from the base, of course, and a screen and set of flanges are secured to the under side, beneath the holes so that the top cannot shift.

Small holes are sufficient for the sound projection, but quite a number should be used, so that the volume is not attenuated too much. If the design of the table permits, the amplifier, or an additional stage (to compensate for the loss incurred by the method of mounting the speaker) can be mounted in the base.

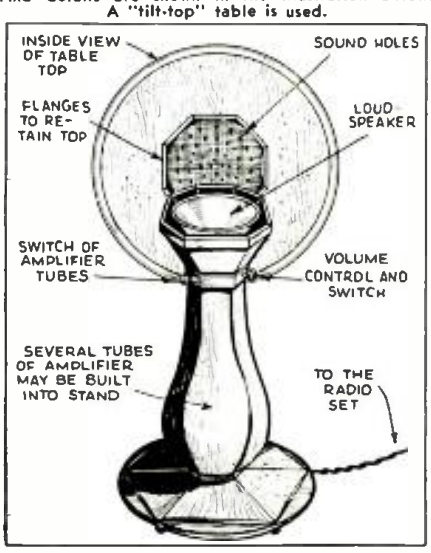
In order to make the installation more complete, the power switch for the receiver should be located in the table, so that the set can be turned off at this point.

A thin tablecloth, either lace or similar fabric, will effectively cover the small holes in the table top. And to complete the disguise, a lamp on the table can be connected in such a way that the lamp cord also carries the connecting wires for the set.—Hans F. Kutschbach.

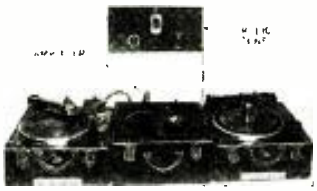


The table in use.

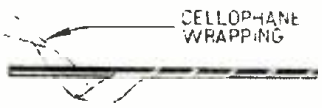
And details are shown in the illustration below. A "tilt-top" table is used.



THE LATEST RADIO EQUIPMENT

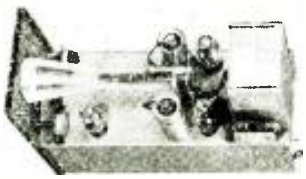


A 5-purpose studio recorder. (686)



"Cellophane"-insulated wire. (687)

"Bridge" resistance tester. (688)



Cathode-ray oscilloscope. (689)

Quality crystal hand-mike. (690)

Compact 5-band superhet. (691)

A "UNIVERSAL" STUDIO RECORDER (686)

(Presto Recording Corp.)

THE equipment shown in the photograph is used for recording instantaneous programs from the air, or, direct from the studio by a microphone. Two turntables are used for continuous recording. The recording amplifier has built into it a high-quality dynamic speaker, calibrated volume indicator and also a control panel which provides five selections, namely: (1) microphone public address; (2) microphone recording; (3) play-back; (4) radio recording; or, (5) radio.

"CELLOPHANE" MAGNET WIRE (687)

THE development of a method of applying "cellophane" to magnet wire, is announced. "Celenamel," as the new magnet wire is called, is a great space-saver, has greatly increased dielectric strength, and costs no more than cotton-covered enameled wire. The new wire has approximately the same space factor as silk-and-enameled wire. The "cellophane" insulation is bonded to the wire with an adhesive. It cannot unwrap when cut, or open when bent at sharp angles. The "cellophane" covering, which is sealed with a baked lacquer finish, protects the enamel insulation against heat and varnish solvents.

WHEATSTONE BRIDGE FOR RESISTANCE TESTING (688)

HERE is a new, low-priced bridge, designed to measure resistance in any circuit. It is fine for testing resistors in radio receivers. It consists of a hand-calibrated standard resistance, adjustable roughly by a selector switch, and finely by means of a calibrated dial. The selector switch has 8 ranges: 0-.1; 0-1; 0-10; 0-100; 0-1,000; 0-10,000 ohms; 0-.1- and 0-1 megohm.

LOW-PRICED CATHODE-RAY OSCILLOSCOPE (689)

A COMPLETE and inexpensive oscilloscope suitable not only for radio service work but also for amateur radio operators, high schools and colleges, radio manufacturers, radio dealers, or anyone who needs an instrument for visual study of alternating currents is now available. The unit includes two power supplies (one for the 3-in. cathode-ray tube and one for the amplifier), vertical and horizontal amplifiers, sawtooth frequency generator and 6 tubes, including the cathode-ray tubes.

CRYSTAL HAND-MICROPHONE (690)

(Shure Brothers Co.)

FOR "cross-talking" purposes a hand-type crystal microphone, of piezoelectric type, is now available. The crystal unit is mounted in a gold-plated, cast-metal case. A push-to-talk switch is built into the handle. The instrument is of diaphragm-actuated type; the cantilever principle is utilized for the transfer of energy from diaphragm to crystal. The microphone works directly into the grid circuit of a tube (across 5 megohms) and does not require a polarizing voltage. Hiss is noticeable by its absence.

COMPACT 5-BAND, 10 TUBE SUPER. (691)

MEASURING only 19¼x16½x10 ins. over all, the handsome cabinet of the latest in radio sets contains a thoroughly modern 10-tube superhet. Chassis, identical to that used in higher-priced consoles. It tunes broadcast and short waves to 22,000 kc. In addition, it can tune above the broadcast band between 150 and 350 kc. Tubes employed are: 1-6D6 R.F. amplifier, 1-6A7 oscillator—modulator, 1-6D6 I.F. amplifier, 1-6F7 second I.F. amplifier and diode detector, 1-76 A.V.C., 1-6D6 first A.F. amplifier, 1-76 phase inverter, 2-42s output, and 1-80 rectifier.

SILVER-FINISH P.A. HORN (692)

(Wright-DeCoster, Inc.)

A NEW horn which has been developed for eye appeal as well as good performance is silver-finished. The horn is 48 ins. long; the bell opening is 30x20½ ins. A screen across the inside of the flare provides a desirable surface for advertising copy; at the same time, it prevents foreign substances getting into audio motor.

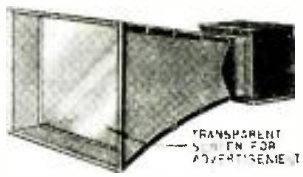
SMALL, COMPLETE TUBE TESTER (693)

THIS tube tester is extremely portable and moderately priced, and yet it will completely check all types of tubes. Heater-cathode leakage indicates on the meter. Selector switch method and combination sockets make ample provision for future tube types. The English reading dial says simply, "Poor" or "Good," eliminating confusion. Operates on 110V., A.C.

5 W. 2B6 PORTABLE AMPLIFIER (694)

(Coast-to-Coast Radio Corp.)

USE of the new 2B6 tube has made possible the production of a compact, inexpensive P.A. unit capable of a wide variety of P.A. applications. The unit features an "input-mixer-fader" control system; also, self-contained mike and speaker current supplies. Unit incorporates a double-button carbon microphone and 8-in. dynamic reproducer. Input impedances: 200 ohms, 500 ohms and high impedance. Weight, 8 lbs.; size, 13½x13½x9 ins. deep.



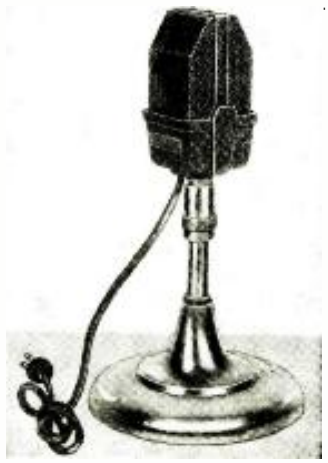
Silver-finish P.A. horn. (692)

Small, complete tube tester. (693)

Portable, "2B6" amplifier. (694)

Vibration-free flush socket. (695)

"Beam" velocity microphone. (696)



Name of manufacturer of any device will be sent on receipt of a self-addressed, stamped envelope. Kindly give (number) in description under picture.

Condenser mike and amplifier. (697)

Auto battery charger. (698)

High-fidelity A.C. reproducer. (699)

"Dual"-type motor-generator "B" unit for sound trucks. (700)

Complete recording and playback outfit, including radio broadcast tuner, for a "recording studio." (701)

FLUSH-TYPE SOCKET RESISTS TUBE VIBRATION (695)

SEVERAL interesting features of this new-type socket claim the attention of auto-radio and all-wave set builders. In this socket the tube base fits flush with the surface; much mechanical vibration is avoided, and quieter operation is claimed. Bulldog grips and wide spacing of wiring tabs, reduce prong-contact troubles.

"BEAM" VELOCITY MICROPHONE (696)

(Amperite Corp.)

AS COMPARED with the standard or "wide angle" ribbon microphone the new "beam" velocity unit permits 8 times more volume before feedback occurs and 20 times more than the diaphragm-type microphone; the sensitivity within the range of the beam remains the same, however. Recommended for use under unusual acoustic conditions; and where feedback is difficult to handle as, for instance, in rooms with tile walls, etc. of prime importance is the sturdy construction of this unit.

TWO CONDENSER MICROPHONES (697)

(Universal Microphone Co.)

TWO new microphones were announced recently. One is designed for two type 864 tubes for all-battery operation, or filaments from battery and plate supply from A.C. power pack. The second model is built for two type 30 tube filaments in series, which can all be A.C. power pack operated without batteries of any kind being needed. The unit is actually quieter in average operation than with batteries, being operable below the hiss level of the tubes.

HIGH CHARGING RATE BATTERY CHARGER (698)

REALIZING the greatly increased current-drain from batteries used in modern automobiles, due to radio sets, twin horns, high-compression motors, etc., one manufacturer has brought out an improved model of their *home charging* device. In the new model, the high charging rate of 10 amperes, tapering off as battery becomes charged, makes it possible actually to charge the average battery overnight. A convenient snap-on clamp is furnished, making it unnecessary to remove car floor boards. Since it costs about a nickel for current during the charge, there should be a real demand among car owners for this equipment. Service Men will do well to cultivate the market for home-chargers.

HIGH-FIDELITY A.C. REPRODUCER (699)

DECLARING that this latest model speaker reproduces frequencies between 50 and 7,500 cycles with a response variation of less than 10 decibels over the entire range, the manufacturers throw their hats in the ring of high-fidelity competition. It is a special, 15 W. job, designed for receivers capable of high-fidelity output, or for P.A. systems with specially designed amplifiers.

SOUND-TRUCK DUAL "B" UNIT (700)

A "POWER PLANT" of the motor-generator type has been designed especially for sound truck and airplane transmitter use. Readings: input, 12 V.; output, 150 to 200 ma. at 500 and 400 V., respectively. Oilless bearings; runs in any position; designed for continuous use; the dual motors required are mounted on a base with rubber cushions; no filter required. Size 5¾x7x4 ins. high; weight, 14 lbs.

COMPLETE RECORDER AND PLAYBACK UNIT (701)

(Federated Purchaser, Inc.)

HERE is a complete "recording-studio" unit. The recorder consists of the rim-driven turntable, the specially-designed and concealed screw-driven recording head, and the playback pickup placed on a heavy duralumin panel, at a convenient height for adjustments in operation.

A high-quality amplifier, capable of delivering up to 15 W. of undistorted audio output, with a heavy-duty auditorium speaker enables the operator to record and reproduce at any volume level. A special, T.R.F. tuner is built into the unit for recording radio programs.

"SCENOGRAPHIC" RADIO SET (702)

A TRANSPARENCY of any member of the family may be put in back of the escutcheon; interior pilot lights then illuminate the view—result, manufacturer is able to advertise "the forerunner of television"! The receiver chassis is a conventional 6-tube superheterodyne incorporating A.V.C. Dual range: 550-1,750 kc., 5½-18 mc.

DYNAMIC-TEST TUBE CHECKER (703)

THE newest in tube checkers permits dynamic mutual conductance tests in preference to emission test of performance. Every type of tube is accommodated; the separate functions of multi-purpose tubes are individually tested. A neon lamp indicates shorts, and leakages up to 3 megs.

"HIGH-FIDELITY" I.F. TRANSFORMERS (704)

(Hammarlund Manufacturing Co.)

RADIO manufacturers hitherto have been content to use fixed-coupling between primary and secondary of an I.F.T., setting the selectivity "somewhere" between the flat-top required for high-fidelity reception, and a point necessary for early evening DX-ing. Here is a transformer arranged to be instantly variable between knife edge selectivity and 30 kc. separation, all without increased size of required shield can. An insulated screwdriver turns a worm drive attached to the movable coils. Coils are triple-type, pie-wound with Litz, with air-dielectric trimmers.

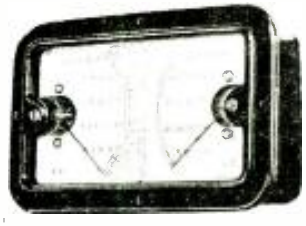
(*Continued on page* 702)

"Scenographic" radio receiver. (702)

Dynamic-test tube checker. (703)

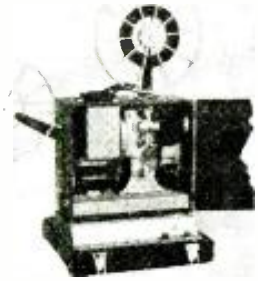
Variable-selectivity I.F.T. (704)

Power wire-wound resistors. (705)



Volt-ohm-milliammeter kit. (706) Scales: Volts, 0-50-250-500-1000, D.C.; ditto, A.C.; Ma., 1-10-50-250; Ohms, 1,500; Megs., 1.5 and 3.

Improved 16 mm. talkies. (707)



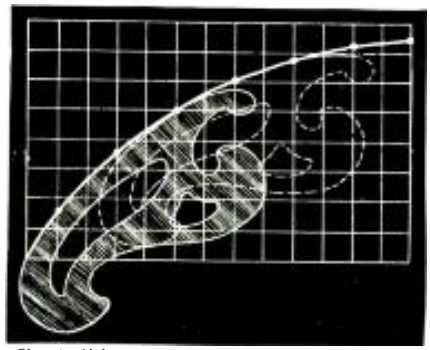


Fig. 1—Using a French curve for graph making.

HOW TO READ GRAPHS AND CHARTS IN RADIO WORK

Part II is a continuation of elementary principles, dealing particularly with the problems of the Public Address man.

W. EGLIT

PART II

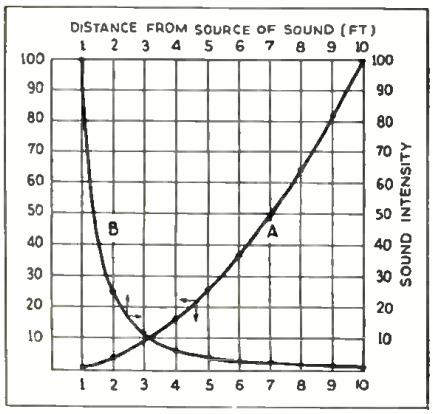


Fig. 2—Exponential figures plotted in two curves.

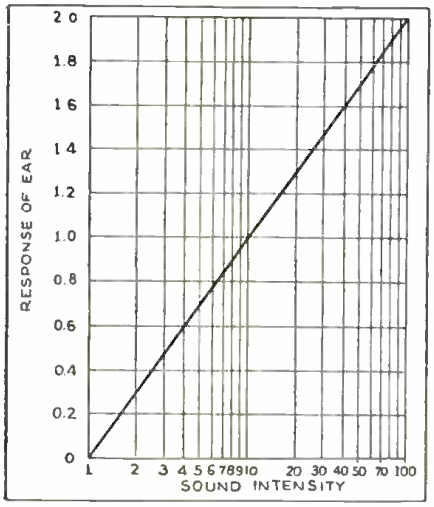
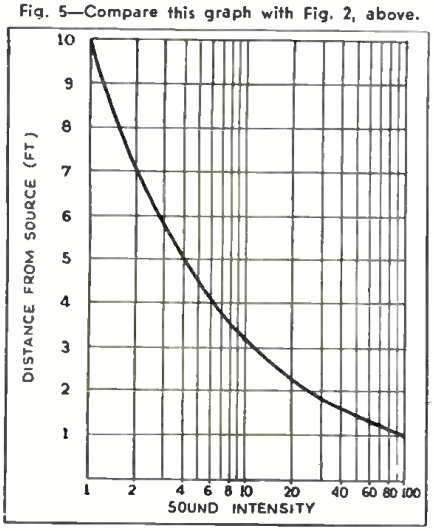


Fig. 4—Semilog. paper straightens out curves.

Fig. 5—Compare this graph with Fig. 2, above.



THE FIRST important consideration in plotting graphs—following the matter of graph construction discussed in Part I—is the choice of scales. These should be divided, if practicable, into decimal intervals, as, 0.1, 1, 10, 100, etc., units per inch or per major division on the cross-section paper. It is customary to use the abscissas, or horizontal distances from the origin for such concepts as time, distance, speed, or such units as are known or easily measured. The other units used in conjunction with these are scaled off on the axis of the ordinates. No hard and fast rules can be fixed in this regard and the choice between abscissas and ordinates for different scales and units depends to a great extent upon custom and common sense. We might venture to say that usually the cause is the abscissa and the effect is the ordinate. Oftentimes one alternative is as good as another. To illustrate these more or less indefinite rules let us look ahead to Figs. 2 and 3. In Fig. 2 the abscissa is used for distance, and in Fig. 3 the sound intensities (cause) are the abscissas and the responses of the ear (effect) are the ordinates.

THE FRENCH CURVE APPLIED

Our next consideration is the curve itself. In graph plotting the reliability of the curve depends upon the number and distribution of the points plotted as well as the accuracy with which these points can be determined. Figure 1 shows the method of connecting the plotted points with the edge of a tool called a "French curve" as a guide for the pencil or draftsman's ruling pen. This guide is lined up with at least three points at once but one does not ordinarily strive to connect more than three points on one setting of the guide. With finely divided graph paper it is preferable to use very small circles for plotting the points, marking the course of the curve instead of employing completely blackened dots. This is because open centers of the circles will permit the locations of points to be more accurately read in the event that it becomes necessary to check back to the data. In order to minimize errors in plotting the points it is well to make a table of two columns, one for the abscissas and the other for the ordinates with the two values identifying each point opposite each other, as has been done in this article.

The straight line is, of course, the most easily plotted "curve" (for such it is correctly called!). It is necessary to plot only two points, preferably widely separated on the graph sheet, and with the aid of the tool called a "straightedge" a line is drawn through them. If we make one of the units, say the abscissa, equal to zero and we discover that in such instance the other unit becomes zero, the curve will pass through the origin, and hence we need only one other point for fixing the slope of the line. However, we must be certain beforehand that the curve will be a straight line and not of some other form.

CONSTANTS AND VARIABLES

If one unit is always a definitely fixed percentage of the other the graph will be a straight line and will pass through the origin. Expressing this in the language of algebra, we have the equation, $x = Ky$, where, for any and every point on the curve, K is a fixed value (a "constant"), x is the abscissa (a "variable"), and y is the ordinate (a "variable"). Not all straight lines pass through the origin and this is when the above equation is altered to the form: $x = Ky + C$, where C is another constant. The equation

(*Continued on page* 686)

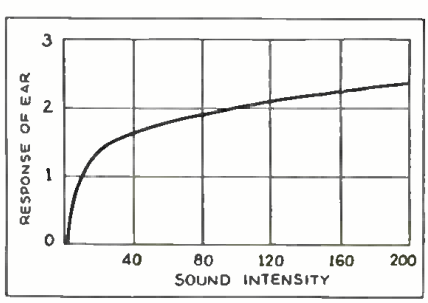
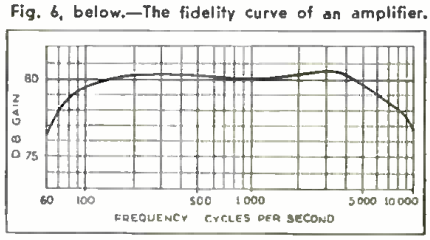


Fig. 3, left.—A problem of particular interest to Public Address men—the ear response.

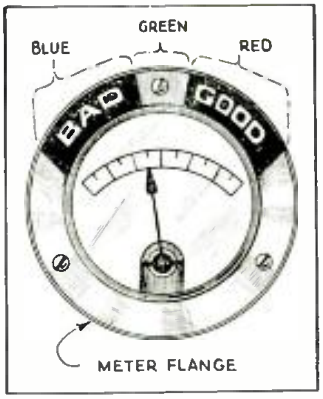
Fig. 6, below.—The fidelity curve of an amplifier.



SHORT-CUTS IN RADIO

FIRST PRIZE..... $10.00
SECOND PRIZE..... 5.00
THIRD PRIZE..... 5.00
Honorable Mention

EXPERIMENTERS: Three cash prizes will be awarded for time- and money-saving ideas. Honorable mention will be given for all other published items. Send in your best "kinks"!

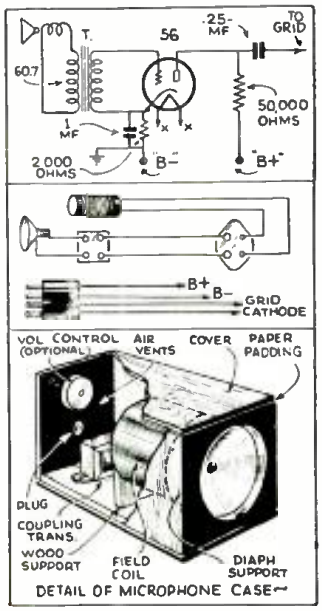


FIRST PRIZE—$10

METER FLANGE AS SCALE SURFACE. It is easy to make an English-reading scale on your regular milliammeter. Merely wipe the flange *clean* with a cloth dipped in alcohol. Apply two coats of colored enamel. Lettering is then added. To protect the scale add a coat of clear varnish or shellac. (If you wish to try it over again, the enamel may be removed with alcohol or thinner.)

This tube checker clears up any doubt concerning tube condition, and when included in a standard analyzer, completes the equipment.

HERB. JONES



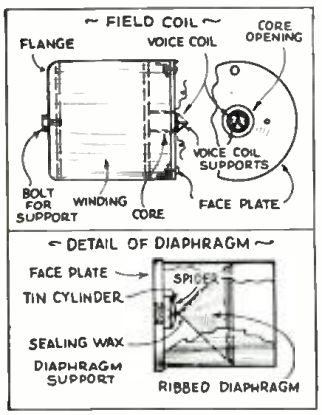
SECOND PRIZE—$5.00

A HOMEMADE DYNAMIC MICROPHONE. The microphone here described is particularly useful because it gives faithful reproduction over the entire audible musical range. Obtain a small dynamic speaker field coil, such as an old 6 V. Magnavox field and voice coil. The field, however, must be rewound with No. 38 wire, to add sensitivity.

Obtain a heavy tobacco tin, about 4 ins. in diameter. Drill some ⅜-in. holes around the sides and back, to prevent air cushioning. Connections to the voice coil should be very flexible. The diaphragm must be extremely light, but tough. Using watercolor paper of light weight, make a cone with 3 ins. overlap. Moisten the edges of the cone. Place the diaphragm and trim the edges so that it will slip freely in as far as the voice coil spider. Make a small hole in the diaphragm through which the nut on the voice coil may project slightly. A little sealing wax will secure the diaphragm to the can. Make a case as illustrated. Get a good audio transformer with a heavy core. Remove the core, and cut through the outer layers of the coil. Wind on 60 turns No. 24 wire. When used with a good amplifier, it is perfect with the spoken word. It has wide-angle pickup and hence is excellent for orchestral work.

The illustrations on this page show all necessary details, and a little care will produce a fine job.

G. E. FAULKNER

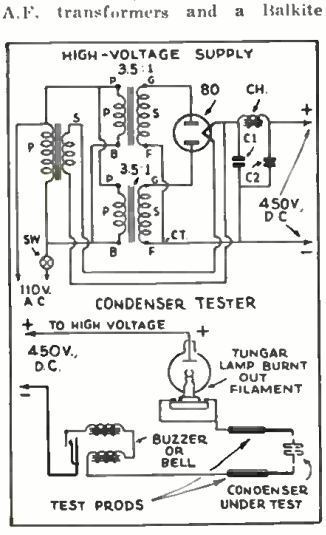


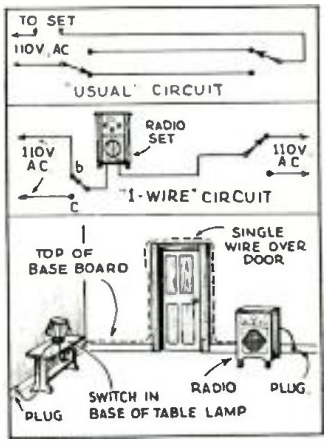
HONORABLE MENTION

A CONDENSER TESTER. This uses a high-voltage "B" supply, and a burned-out tungar; the "B" utilizes A.F. transformers and a Balkite charger transformer. Good condenser, one initial click and glow; short, click and sustained glow; open, no glow or click; leaky, intermittent.

The choke should have a value of at least 30 henries. Condensers C1 and C2 should be 8 mf. electrolytics.

LORENZO O. GRAHAM





THIRD PRIZE—$5.00

A 1-WIRE REMOTE CONTROL. The illustrations above show, by steps, the genesis of a simple remote control unit. Do not connect the two plugs to opposite sides of a grounded-neutral 3-wire system. The cost of "3-way" switches can be eliminated by using one prong of a plug top at each point of contact.

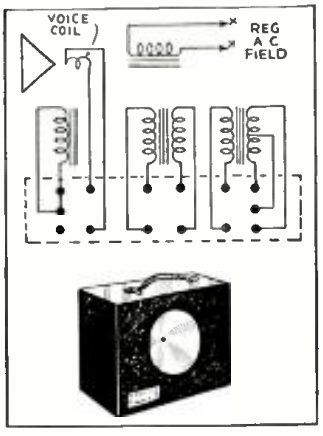
The switches shown in "C" must, of course, be set on opposite sides of the line to complete the circuit.

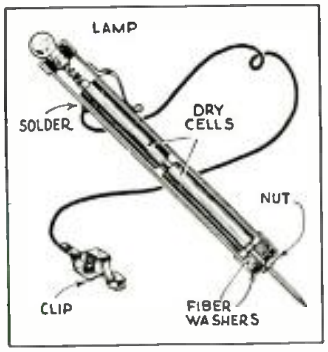
ROBERT F. WALLACE

HONORABLE MENTION

TEST TABLE SET-UP FOR DYNAMIC SPEAKERS. For testing sets received without a loudspeaker, etc., the use of a standard dynamic reproducer mounted in a portable case is illustrated. In one corner are mounted a single tube to speaker and a push-pull transformer, and a filter choke. Leads are brought to tip jacks. Five leads terminating in phone tips at one end and spring clips at the other are provided for matching.

B. C. SMITH

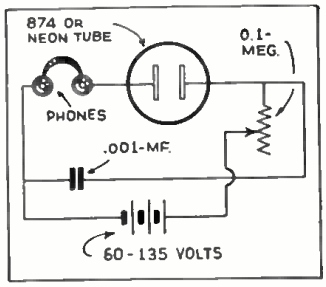




HONORABLE MENTION

"PEN LIGHT" TEST LAMP. By arranging a fountain pen type of flashlight in the manner illustrated a serviceable test lamp was made, for moderately low resistance circuits.

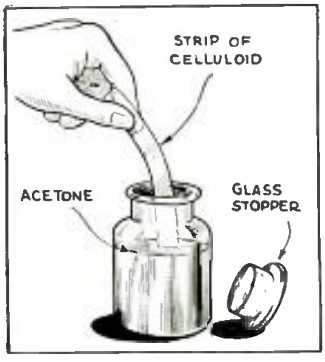
JOHN RILEY



HONORABLE MENTION

FILAMENTLESS CODE PRACTICE OSCILLATOR. Use an 874 or a neon bulb with low striking voltage and close electrodes, to secure good tone in the circuit illustration.

ED. DYKE



HONORABLE MENTION

KEEPING SPEAKER TONE "DOPE" LIQUID. Cellulose acetate cements have a habit of drying up just when wanted most. Try the use of a small, wide-necked bottle and glass stopper; nearly fill the bottle with the mixture. Maintain the level by adding acetone and celluloid.

The chief points to remember when making up any solution for occasional use are: maintain the correct proportions, be sure it has the required consistency for easy use.

R. F. LAMBERT

A UNIVERSAL-TYPE 52-W. RACK-AND-PANEL AMPLIFIER

This P.A. system can be operated equally well from 6 V. battery or from the 110 V. lines.

LEON J. LITTMANN*

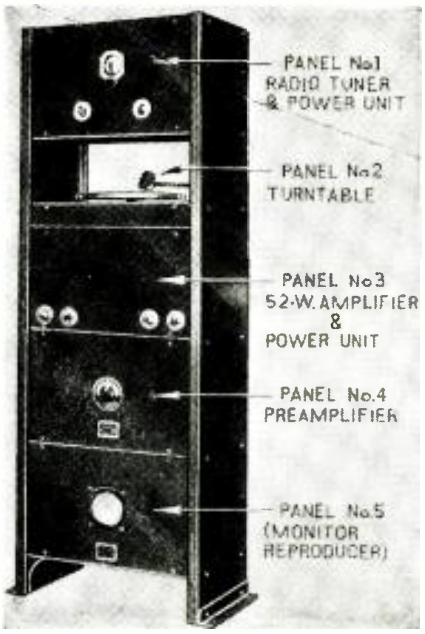


Fig. A
The complete rack-and-panel P.A. amplifier.

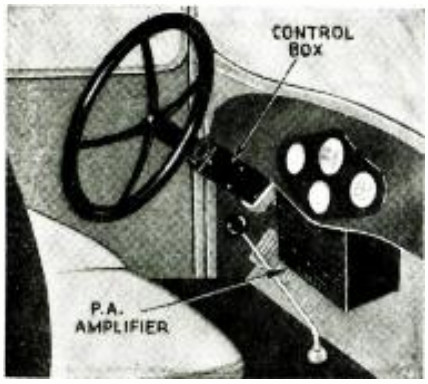
THE engineering advancements incorporated in the design of this modern amplifier brings to P. A. men a series of features not found in formerly designed amplifiers, which incidentally sold for five to ten times the price of this system! These new features have primarily been made possible by the development of new tubes, circuits, and associated components which, in every instance, provided superior performance in both higher fidelity reproduction and larger power output at lowered equipment and operating costs. The complete rack and panel system is essentially composed of the following components: (1) superheterodyne tuner; (2) a phono. motor turntable and phono. pickup; (3) a high gain preamplifier; (4) a combination dual-channel 52-watt amplifier and two-channel input-mixer-fader control; (5) a monitor speaker for gauging the audio output of distantly-located loudspeakers.

*Chief Engineer, Coast to Coast Radio Corp.

UNIVERSAL OPERATING FEATURE

In order to make the system applicable to every type of installation either mobile in sound trucks, stationary in hotels, hospitals, schools, churches, etc., it has been designed to operate from either 110 Volt A.C. power lines or from storage batteries, *or from both!*

If, at the time of the initial purchase, it is desired to operate the outfit only from 110 V. A.C., then the storage battery operated power supplies are not purchased but are added at some future date when storage battery operation is necessitated by lack of available power lines. On the other hand, if the system is to be operated only within a sound truck it may be purchased without the 110 V. A.C. power supplies, but with the appropriate storage battery operated dynamotors. As each of the units is equipped with its own power supply plug, it becomes a relatively simple task to change from one mode of operation to the other. (*Continued on page* 680)



A 6B5-TUBE AUTOMOBILE P.A. AMPLIFIER

An unusual automobile P.A. amplifier having some features not found in most amplifiers designed for this purpose.

CLIFFORD E. DENTON*

EVER SINCE P. A. equipment was accepted by the general public as a necessity, sound engineers and Service Men have found themselves in a very lucrative field.

One of the most interesting and profitable types of amplifiers has been called an "automobile amplifier" for want of a better name.

In this new automobile amplifier, considerable thought was devoted to the mechanical design as well as the electrical features. This was done to insure the utmost simplicity of installation, the minimum voltage drop in the power supply lead (a source of distortion), and to provide a method for smooth, rapid control of either phonograph reproduction, or microphone pickup. The logical solution to this problem was to build the amplifier in such a manner that it could be mounted under the dash on the fire wall right up close to the driver's seat, in much the same manner that the conventional automobile radio receiver would be mounted. A remote control unit which is mounted on the steering column, containing the microphone batteries, microphone transformer, volume control, and mike phonograph switch with the microphone receptacle suitable for single or double button microphones, and the receptacle for the tip jacks which are generally placed on the end of the cord of the phonograph pickup, added to the (*Continued on page* 698)

*Chief Eng. Federated Purchaser, Inc.

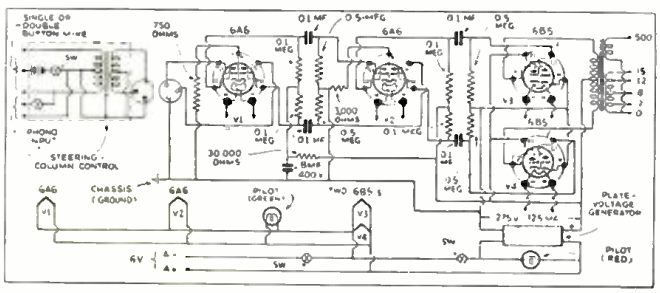
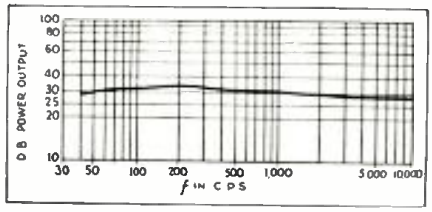


Fig. 1, left—The circuit of the auto amplifier showing how the complete push-pull system is maintained with a minimum of tubes.

Fig. 2, right—The frequency response of the amplifier plotted against power output in db.



CENTRALIZED SOUND FOR SCHOOLS

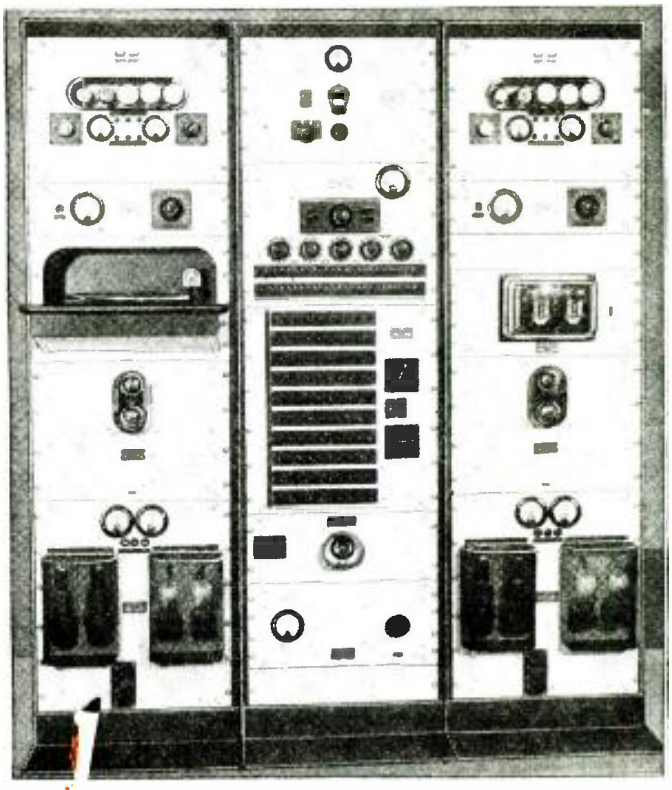
A P.A. system for supplying radio and sound to schools of all sizes—a real source of income.

ONE of the most extensive fields for the installation of P.A. and sound systems, is to be found in public and private schools.

The idea is not a new one but during the earlier stages of its development there was considerable resistance from instructors, due to the fact that the original installations were considered to be primarily centralized radio. Sales promotion efforts pointed to the value of educational programs and the teaching profession in general, resented the idea. It was assumed that one teacher, broadcasting from a central point, would take the place of a large staff. It is realized that this situation is not true for while programs of an educational nature are received and transmitted to the rooms, it has been found that the centralized system has even more value from an administrative standpoint. Such a system is also used for athletic events, and in dramatic and public-speaking classes; and many elementary schools are organizing classes for instruction in broadcasting. Possibly no other equipment finds so many uses in a large school.

While many schools now have such systems, the majority of them are without them. A canvass of the schools shows either some definite plan or a hope that such a system can shortly be acquired. Where public funds are not available as is the case in the majority of schools, the PTA organiza-

(*Continued on page* 681)



A 2-channel sound and centralized-radio system, including remote control devices and automatic relays; designed for a 100-room school, including outdoor playgrounds, athletic field, gymnasium, cafeteria, and auditorium. Even the smallest size, for a 10-room school, contains an all-wave radio tuner, amplifier, input and room control panels, and crystal automatic phono. pickup. Additional 7-watt amplifier may be added.

—Sound Systems, Inc.

The appearance of the new "fidelity-controlled" A.F. and coupling transformers.

VARIABLE-FIDELITY A.F. TRANSFORMERS

A new type of A.F. transformer which incorporates high- and low-frequency control for high-fidelity amplifiers.

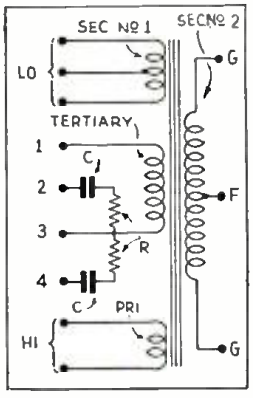
I. A. MITCHELL*

THOSE who have watched the progress of radio reception over the past few years have seen radical changes in audio fidelity performance. First, we had the receivers of six and seven years ago, which gave us the accentuated highs and "tinny" tone. Then came the reaction in the later receivers with the accentuated lows and booming resonant cabinets. However, the past year has shown a strong tendency toward true high fidelity in radio receiver tone quality. The better broadcast stations have improved their equipment and equalized their lines to a point where really wide range programs have been made a practical reality. Phonograph recordings have also been improved with reference to the range of frequency reproduced and scratch has been appreciably lowered on late recordings, particularly since the end of 1934.

Unfortunately, high fidelity as it has been applied to radio receivers recently has been far too theoretical. While it is true that we have high fidelity transmitters and we can obtain a flat-top tuner and a straight-line amplifier, there are other flaws in the high-fidelity picture. The perfect loudspeaker has not as yet been developed. In addition to this, the acoustic effects both in the studio and in the home have been found to bear greatly on the actual response. Poor acoustics may be partially corrected by re-locating the set.

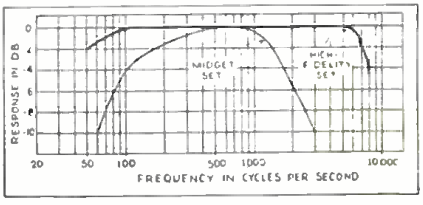
The over-all frequency response of the typical cheap midget set is illus-

(*Continued on page* 683)



Interior connections. Pri. ("HI"), 15,000 ohms (triode plate or high-impedance phono. pickup). Sec. No. 1 ("LO"), 500 ohms (mike, line, or low-impedance pickup). Sec. No. 2, high-impedance (to tube grid). Tertiary has high leakage reactance; capacitative reactance condensers C differ in leakage, R.

Fig. 1, below. The comparative response of low-price midget vs. high-fidelity radio receiver.



*Chief Engr., United Transformer Corp.

A completely self-contained preamplifier for the high-quality mike.

A LOW-COST PREAMPLIFIER

V. V. GUNSOLLEY and R. E. JONES

THE advent of the velocity microphone brought many new problems into the field of sound engineering. Its superior fidelity, and the discovery of its directional characteristics that make possible a minimum of difficulty from feedback between speaker and microphone; that reduce the effects of undesirable reflections and reverberations in certain room structures; and that give ability to pick up large musical productions single-handed, so to speak, has led to a greatly increased demand for its application. To meet this demand many manufacturers have entered the field and consequently a great variety of instruments, ranging in sensitivity down to —90 db., are offered. It is the extremely low sensitivity of the instrument that gives birth to engineering difficulties. Before taking up the considerations of amplifier design, let us analyze these engineering difficulties.

(*Continued on page* 691)

A "BOOM-SOCKER" AMPLIFIER

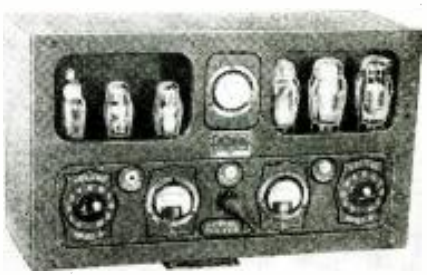
WIDE-range theatre amplifiers are the product of years of research and development devoted exclusively to sound-on-film reproducing amplifiers.

To meet the requirements of strength and unfailing service, the amplifier shown here is built on a heavy die-cast panel with a recess for the tube rack. All parts are mounted on this casting, and the parts layout provides maximum accessibility for servicing. The transformers, condensers, resistors, and variable controls used are designed with liberal overload margins and are especially treated to withstand any climatic conditions of heat and humidity in tropical countries.

The amplifier supplies variable polarizing voltages to two photo-cells and self-adjusting exciter lamp current to two exciter lamps, thus allowing the use of two projectors. Provision is also made for a built-in or external monitor

(*Continued on page* 694)

Sales on Sound Corp.



A theatre amplifier built in a heavy die-cast panel with a recess for tube mounting. A special frequency control permits accentuation or attenuation of low tones to suit the acoustical needs of the installation.

A 7½W. P.A. UNIT

A complete P.A. system of mike, 7½W. amplifier with special impedance matcher, and speakers.

A "CONVENIENT" unit, is a good way to describe this complete system of amplifier, crystal mike and special reproducers.

The amplifier is compact in size and neatly enclosed in a crystalline metal case. The amplifier uses a 53 in the first stage, another 53 in the second stage and two 2A5s in the output stage. All stages are resistance coupled and because of the selection of tubes, the complete amplifier is push-pull.

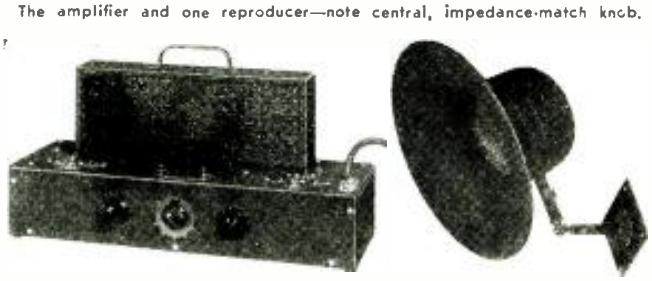
A feature of the amplifier is a dial on the chassis which permits matching from one to six speakers to the amplifier so that the same high quality can be obtained regardless of the number of reproducers employed.

A crystal microphone of special design having a level of approximately —60 db. and having a frequency re-

(*Continued on page* 694)

Toledo Sound Equipment Labs.

The amplifier and one reproducer—note central, impedance-match knob.



New wide-range amplifiers and radio receivers need high-quality speakers to project the high and low frequencies.

C. J. BROWN*

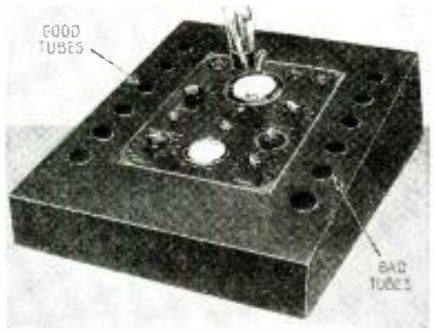
NEW HIGH-QUALITY REPRODUCERS

A WELL-KNOWN reproducer manufacturer is now offering a new line of electro-dynamic cone speakers designed especially to meet present-day, high-fidelity standards.

Two types are available: one incorporates a 12 in. cone of an efficient construction that assures uniform response up to 7500 cycles. In addition, a new special "bass compensation" device has been supplied to the cone, which increases the response efficiency at the lower end of the audible band. This avoids the raspy and shrill effects so noticeable with the ordinary types of high-fidelity speakers which are not properly balanced for both high and low

(*Continued on page* 690)

*Sales Engr., Racon Electric Co., Inc.



The tester ready for operation.

A COMPLETE, MODERN TUBE CHECKER

This test unit is an improvement over the Compact Tube Tester in the October 1934 issue—it is more complete.

MILTON REINER*

A LARGE number of readers showed considerable interest in the Compact Tube Tester article by the writer, which appeared in October 1934 RADIO-CRAFT. This article gave a brief description of the advantages, design, and performance of the tester. So much enthusiastic and favorable comment has been received that this tester has been further improved and brought up to date so that it will benefit both the owners of the original design as well as those Service Men who now need to build a tester.

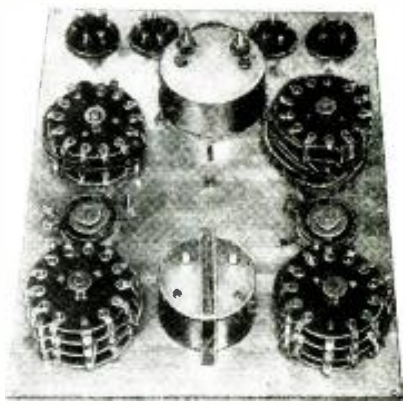
The Tube Test switch is omitted in the later design as the final reading or indication will be obtained immediately, once the switches are set according to the instructions. This has a better psychological effect upon the customer and also eliminates one of the operations formerly necessary.

The improvement in making the hot-cathode leakage test will be appreciated by the present owners of the Compact Tester. While the larger meter and the finer neon lamp add to the desirability and attractiveness, they do not involve any circuit changes. Naturally the 3¼-in. meter has a larger scale resulting in better visibility and discrimination between varying degrees of "good." The new neon lamp is easily removable and gives a very pretty circular disc of light.

The Short Test switch is now a 4-gang selector and provides for more inter-element short and leakage tests than before. Also a leakage-short test is available between external cap and cathode. Additional points are now used on the Tube Selector switches so that points U and V are utilized. The list of tubes and settings, shown in Table I give evidence of additions and revisions to the former chart.

One less socket is used in that the new combination 7-prong socket provides for both (*Continued on page* 688)

The apparatus mounted on the panel.

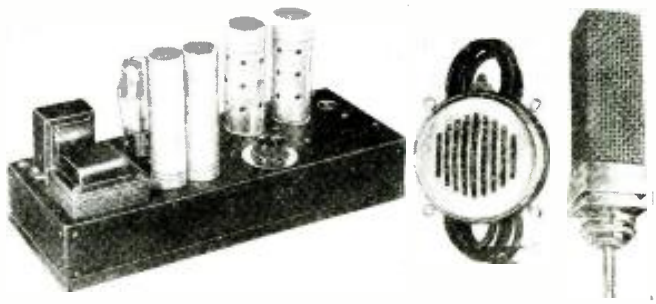


*Chief Engineer, Radio City Products Co., Inc.

"CRYSTAL MIKES" AND AMPLIFIERS

These new devices are a necessity, if P.A. is to be kept on a par with broadcasting.

H. W. JOHNSON

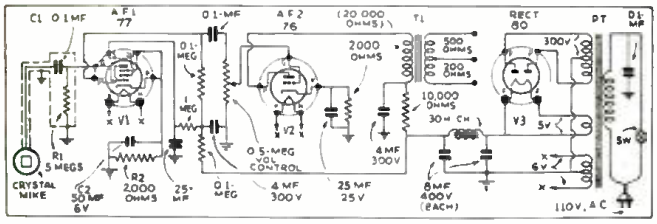


ALL HI-FIDELITY microphones available today have the disadvantage of having low output level; and existing amplifiers seldom have sufficient gain to realize the possibilities of these better microphones. It is the purpose of this article to show how crystal microphones may be used in conjunction with existing amplifiers. Due to the lower output level of the crystal microphone, additional amplification is generally needed.

A preamplifier is the logical solution to the problem and there is no reason why this unit should not be A.C. operated. The hum level of the unit shown in Fig. 1 is absolutely of no consequence if proper attention is given to its construction.

The crystal microphone requires no input transformer. This eliminates inductive hum-pickup from the power transformer (which makes it ideal for the purpose). This also automatically eliminates the frequency discrimination that an input transformer is bound to introduce. No energizing current or polarizing voltage is needed and it can be handled while in operation, without damage.

Fig. 1. The preamplifier for use with the crystal mike.



THE MICROPHONE CABLE

Cable should be highly shielded and must be of low-capacity construction, otherwise severe loss of level will occur in the conductor cable itself. Twenty feet of average low-capacity cable results in a loss of approximately 10 db. If an extremely long line is used more amplification will be required to offset the losses.

INPUT WIRING

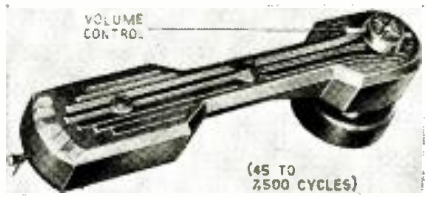
Continuing the rigid shielding and isolation of the grid lead, the input tube should be of the type which has the control-grid at the top of the tube. This tube *must* be completely shielded.

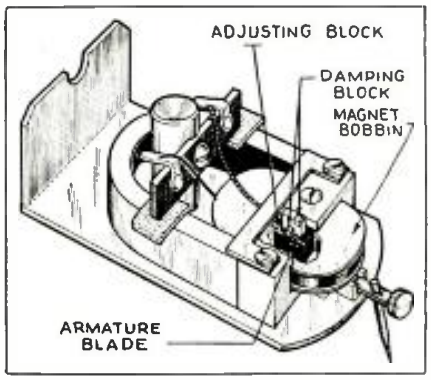
Referring to Fig. 1, condenser C1 is included to isolate the crystal elements from any D.C. voltage which might appear across R1 due to grid current through R1. This condenser and resistor should (*Continued on page* 681)

A WIDE-FREQUENCY MAGNETIC PHONO. PICKUP

The author points out how high-fidelity phonograph records can be appreciated by using this new pickup.

JOHN ERWOOD*





The appearance of the new pickup and the mechanical makeup used in its manufacture.

SINCE the advent some years ago of electrically cut and reproduced records, steady progress has been made in securing better quality of reproduction. The original mechanical reproducing phonograph covered a frequency-range of from 256 to 3,000 cycles per second. More recently, an improved model of the same type had an extended range of 90 to 4,500 cycles per second. With the advent of electrical recording and reproduction, this frequency range was increased, being from 55 to 5,500 cycles per second. Efforts are being made to further increase the frequency range and records may now be obtained which have frequencies recorded as high as 7,000 cycles per second.

In order to obtain the excellent reproduction possible with such records, it is essential that the reproducing equipment be capable of handling, without distortion, the wide range of frequencies involved. The original electric pickups covered, as a rule, frequencies from approximately 60 cycles to 3,500 cycles. Due, however, to design defects, this response was not linear, and inevitably there were at least two pronounced peaks, one occurring at the low-frequency band between 60 and 200 cycles, and the other occurring beyond 1,500 cycles. The resultant reproduction gave evidence to the ear of the existence of these two peaks. Due to the high-frequency peak, all frequencies occurring after the peak response were always very badly attenuated or completely lost, which meant that though the frequencies beyond 3,000 cycles were on the record they were seldom reproduced.

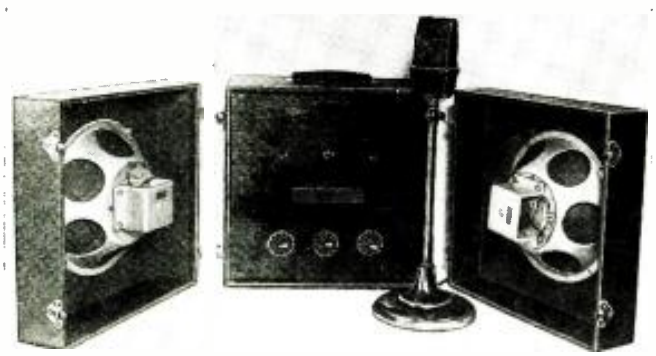
The following summary will tend to point out the desirable features of a good pickup and the reasons for them being so.

THE PERFECT PICKUP

Primarily, in order to obtain a constant voltage output from any magnetic pickup at all frequencies, it is essential that the recording equipment be so designed and adjusted that the resultant recorded groove will drive the needle point at *constant velocity*. All present-day records are made in this manner. It is apparent from this requirement, that the lower the frequency being recorded, the greater the amplitude necessary to maintain a constant voltage output. The converse, of course, is true in that the higher

(*Continued on page* 693)

*Sales Eng., Webster Electric Co.



A VERSATILE PORTABLE P.A. AMPLIFIER

This amplifier can be used in any one of 12 different ways to fit needed conditions.

CHARLES R. SHAW*

NO MATTER how, when or where you want to operate a portable P. A. system you will find this amplifier suited to your needs because it can actually be operated *twelve different ways!* For instance, it can be operated either as a three-, four-, or five-stage amplifier, from 110 V. A.C. lines or from 6 V. storage batteries, and with either 12½ W. or 25 W. output. Tabulation I lists the various modes of operation which can be applied to the amplifier without making any internal wiring changes or alterations. All of these operating changes are brought about by simply adjusting four double-throw switches, two of which are visible on the front panel.

In designing this unique amplifier the following six essential characteristics were embodied in its final form.

First, are those features which are prime requisites for Portable P.A. Systems, namely: 1. *Light weight* to enable an average individual to carry the complete system without causing unnecessary fatigue. 2. *Compactness* to provide for the operation and convenient storage in the smallest amount of space. 3. *Simplicity of installation and removal* for enabling the operator to quickly set up the outfit to meet acoustic conditions. 4. *Flexibility of operation* so that any kind of an input device as phono. pickup, all types of microphones, radio tuner, photo-cell, tranmission lines, etc., may be efficiently coupled to the input.

Second, are those features which are desirable in all sound system. 5. *Adequate sound coverage*, so as to be capable of developing a sufficient reserve power to easily "cover" the largest indoor or outdoor assemblages ever expected to be served. This portable system will fill 10,000 to 12,000 square feet of outdoor area, and will easily be heard by 8,000 to 9,000 people gathered indoors. 6. *Universal power supply*, so as to be completely unrestricted in operating applications regardless of whether commercial power lines are available or not. This feature is attained by incorporating two different power supplies, one for 110 V. A.C. operation and the other for 6 V. storage battery use. Both of these power supplies utilize the same filter system. 7. *Completeness* an unusually desirable feature for dealers and sound technicians who rent, tempo-

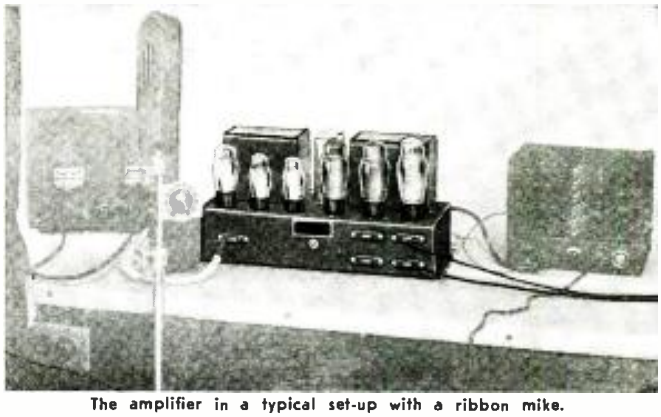
(*Continued on page* 682)

*Design Eng., Columbia Sound Co., Inc.

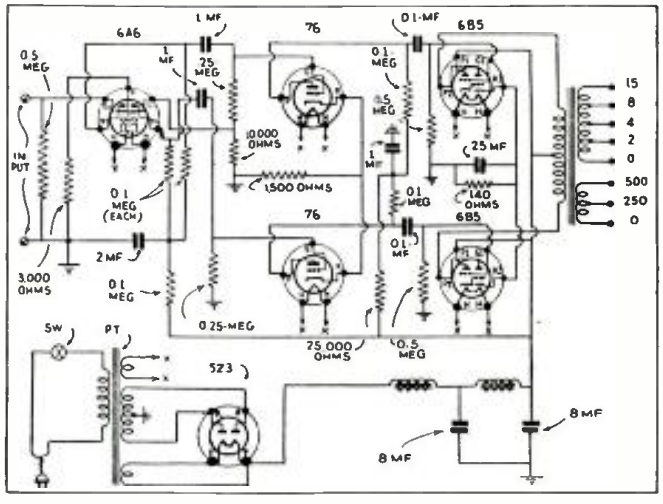
A NEW 20-WATT HIGH-QUALITY AMPLIFIER

A P.A. amplifier using the 6B5 and 6A6 tubes which is designed for high-fidelity operation.

HUBERT L. SHORTT*



The amplifier in a typical set-up with a ribbon mike. Below, the circuit of the amplifier described here.



THIS new 20-watt high-fidelity P.A. amplifier, the latest product of a well-known manufacturer of P.A. units, uses two of the new type 6B5 tubes in the output stages. The 6B5, it will be recalled, consists of two triodes in a single envelope, one a small driver section and the other a large power section. The cathode of the former is internally connected to the control-grid of the latter.

As shown in the diagram which includes all essential parts values, the input tube of this amplifier is a type 6A6, operating as a phase inverter into a pair of 76 drivers, which in turn feed the 6B5s. While the grid-cathode circuits of the input sides of the latter appear to be open, actually they are completed through the grid-cathode path of the output triodes.

The output transformer has two sets of secondary windings, for loudspeaker voice coils and for transmission lines. These take care of all ordinary requirements.

Two methods of rating this amplifier may be used. The output is full 20 watts with a 10,000 (*Continued on page* 691)

*Chief Eng. Wholesale Radio Service Co., Inc.

Baffle labyrinths are at left and right.

HOW SPEAKER FIDELITY IS INCREASED BY AN "ACOUSTICAL LABYRINTH"

The author tells how an acoustical labyrinth in a cabinet baffle is better than a flat one of equal proportions.

BENJAMIN OLNEY

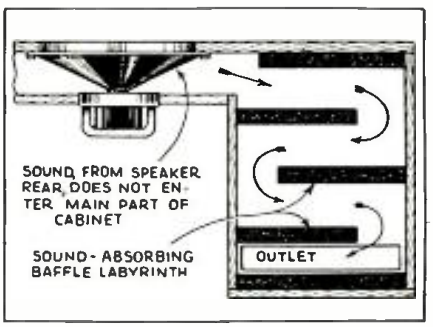
THIS system employs high- and low-frequency speakers, both being of the dynamic cone type. The cone of the low-frequency speaker is 11 ins. in diameter and is made of suitable material to permit high power-handling capacity. The efficiency which is high for a speaker of this class is secured by the use of a powerful field, consuming 40 W. The speaker may be used to the full capacity of a 30-W. amplifier without perceptible overload. The low-frequency speaker covers the range from 60 to 2,500 cycles per second.

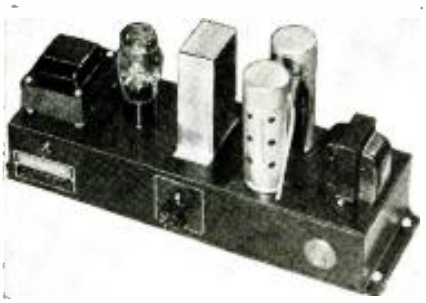
The high-frequency speaker has a cone 3⅝ ins. in diameter and the total mass of the moving system is only 0.8 gram. Its frequency characteristic is comparatively smooth and extends from 2,500 to 10,000 cycles per second. Its efficiency is such that it extends the frequency characteristic of the low-frequency speaker without change in level. The high-frequency speaker is provided with a set of deflector vanes which improve the uniformity of sound distribution.

Division of power between the two speakers is performed in the output circuit of the amplifier by a simple network of condensers and an air-core coil.

A novel feature of this speaker system is its adaptation to a cabinet without any of the usual attendant disadvantages, such as air-cavity resonance and variation in performance when the cabinet is placed close to a wall. The back of the low-frequency cone is not permitted to radiate sound into the space inside the cabinet, but discharges into a conduit having highly sound-absorbent walls, Figs. A and 1. This conduit is folded inside the cabinet in the form of a "labyrinth" and discharges through an opening in the bottom of the cabinet. The passages are of such length that the fundamental resonance of the tube occurs in the frequency range where the efficiency of the cabinet as a baffle begins to fall off, thus resulting in a smooth extension downward of the frequency range. Resonances of the conduit at its harmonic frequencies are made negligible by the increas- (*Continued on page* 695)

One side of the sound-absorbing maze.





The A.C. preamplifier described.

MODERNIZING STANDARD P. A. AMPLIFIERS

The use of a high-quality mike with an existing P.A. amplifier necessitates the use of an efficient preamplifier.

J. P. KENNEDY*

THE NEW crystal and ribbon types of microphones offer the greatest improvement available for existing P.A. systems. The average amplifier designed for use with a ribbon microphone and having an over-all gain of 70 or 80 db. requires a preamplifier when used with a crystal or ribbon microphone.

Heretofore, the problem of hum suppression in preamplifiers made the use of battery operated units almost imperative. Not only were the batteries cumbersome, but the battery-operated tubes were more inclined to be microphonic.

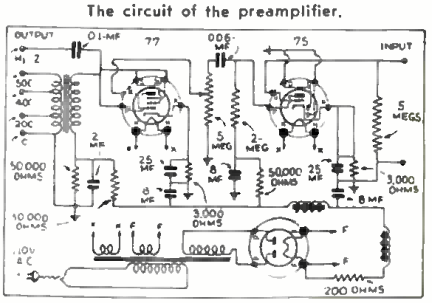
Hum in an A.C. operated preamplifier could be traced to three causes: (1) the first was in the power pack itself where even a very slight A.C. ripple in the rectified plate supply would be built up to a terrific roar after passing through a power amplifier; (2) the second cause of hum was usually produced by magnetic induction between any transformers used in the preamplifier circuit and the chokes or power transformer of the plate supply; (3) the third cause for hum was usually the proximity of the power amplifier to the preamplifier. In addition to these problems of hum suppression, there remained the imperative need for high voltage gain with negligible harmonic distortion.

A new amplifier has been designed which is A.C. operated from a power pack on the same chassis with the preamplifier. It is designed specially for a crystal microphone although a ribbon microphone may be used with a suitable ribbon-to-grid coupling transformer located a few feet away from the amplifier. A number of unorthodox variations in design make this preamplifier a startling deviation from standard practice. To secure distortionless amplification it was determined that a triode tube should be employed in the first stage. The type 75 operated close to its maximum plate voltage proved to have an effective voltage gain of 100. The diode plates were tied together and grounded as they served no purpose in the amplifying function of the tube. A resistance coupling was necessary, both because of its excellent frequency characteristic and because of its extremely high plate impedance.

The volume control appears in the input circuit of the second tube of the preamplifier. (*Continued on page* 696)

*Eng. Dept., Radolek Co

The circuit of the preamplifier.



MONEY-MAKING WITH THE ALL-STAR JR.

A Service Man in Chicago tells how he has turned "set-making" into "profit-making."

P. W. KIDD

HERE is an interesting story we have heard about the "All-Star Junior" receiver (announced in the March issue of RADIO-CRAFT, and described in further detail in April.

It is the experience of a Chicago radio Service Man, Mr. P. W. Kidd, 6053 Irving Park Boulevard, Chicago. Mr. Kidd is a 26-year-old "veteran" of the radio service business, operating his shop with the aid of his wife and 3-year-old daughter. He is located about 8 miles from Chicago's "Loop" and has a well-established clientele. (He is a graduate of two well-known radio schools and after completing his study was an instructor at another prominent school for 4 years. *Radio service work paid his way through school and permitted him to open his own shop a year ago.)* Here are his own words:

"Yep, it's a swell set. The first one I built brought in four European and three South American stations on an ordinary aerial in less than an hour. Since I put up a doublet (to get away from the noise of autos on Irving Park Boulevard) I've had so many strange stations, I can't keep track of them.

"I'm getting a kick out of building these sets, and the people I sell them to are telling their friends about the European reception they're getting. Two or three people drop in every evening to hear my demonstrator. If I think they are of German, French, Spanish, English, or Italian descent, I try to tune in a station from the country in which they are most likely to be interested—if I "sell" a few more Italians, I'll be able to speak their language!

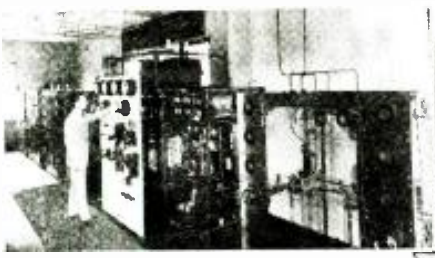
"I first read about the All-Star Junior in the March issue of RADIO-CRAFT The circuit looked good and I bought the parts I needed. Some of the items, like knobs, tubes, and binding posts, I had on hand. I had some resistors and condensers, too, but I wanted to be sure everything would match, so I bought the exact parts specified and followed the instructions carefully. The first one worked as soon as I turned it on, but I could hear every model "T" car in northwest Chicago, until I put up the doublet aerial recommended as optional equipment in the parts list.

"I talk about the reception on these sets while I'm out on repair jobs. Many people think they want to build their own set, and I encourage them to do so, offering my services at $1.00 an hour to help them if they get stuck. If they are afraid to tackle the job, I offer to build the set for them for $10.00 labor fee and give them three months' free service on it. They can buy the parts or, for a small commission I'll buy the parts for them and guarantee the performance of each part over the three-month guarantee period. This is a safe offer, as I have not had

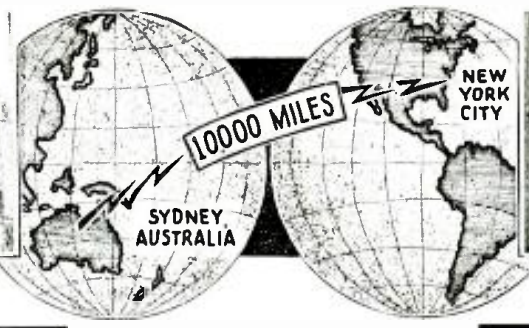
(*Continued on page* 680)

THE LISTENING POST FOR ALL-WAVE DX-ERS

C. A. MORRISON



The 20 kw. S.W. transmitter VK2ME at Sydney, Australia, heard in New York.



The listening post of C. J. Caafe, in New York, where VK2ME was heard.

BY THE first part of April, spring static, coupled with ever decreasing signal strength, will have generally reduced broadcast band foreign DX-ing in North America to an occasional cool night, when, with favorable conditions and a low noise level, Australia, New Zealand, and a few Japanese stations will be heard. DX-ing on the Pacific coast will hold up a little longer in the season than other parts of the U.S., and it is sometimes possible to receive some of the above-named stations in the heart of summer. South American stations will be heard throughout April on and off, although with no pep. By May 1, broadcast band DX-ing will have definitely been abandoned in favor of the more active short waves by those fortunate enough to possess all-wave receivers.

SHORT WAVES

On the short-wave bands at this season of the year static will also have invaded the 49-meter broadcast band so that it will be less desirable from a DX-ing standpoint than the higher frequencies which will just be coming into their own. The Europeans will be beginning to improve greatly and especially on their higher frequency schedules. The 16- and even 13-meter bands will be beginning to show some life, and the 19-meter band should be quite active all during the morning hours. Hams on 20 meters should be quite active, and many foreign hams should be showing up. We predict that this spring will show an increasing use of the 25-meter band, and undoubtedly more and more European stations will put on evening hours for America on this band in the early evenings. We further predict that several popular South American stations will desert the 49-meter band with its noise, and general dissatisfaction in the summer for the 19- and 25-meter bands. This will also give us a greater variety of programs through the summer, and should make this one of the greatest seasons yet.

NEW BROADCAST STATIONS TO TRY FOR

Winding up the present Broadcast Band DX for the season we take pleasure in giving you a few *new* stations to try for. Two new stations are nearing completion in Shanghai, China. These stations, which will be under the control of the "Ministry of Communications" of the Central Government, are XGOG, 800 kc., with 10 kw. and XGOH, 560 kc., with 10 kw, respectively. These Chinese stations should be exceedingly well received on the Pacific coast.

We now move down to Hong Kong Colony, China, where we find a new station of the Colonial Government of Hong Kong. This is station ZEK, on 640 kc. with 2 kw. This will be a real goal to try for.

We believe this is the first time details of these three new Asiatic broadcast stations have been published in North America.

The new regional station of the Australian Broadcasting Co. in Launceston, Tasmania, on 630 kc., with 10 kw., should be in operation by the time this article is in print. Station 1YA, Auckland, New Zealand, on 650 kc., with 10 kw., was completed in December 1934, and is being heard with great volume in all parts of North America. The new 10 kw. transmitter of 4YA, at Dunedin, New Zealand, is under construction and will be ready before the next fall DX season opens. It is also planned to raise the power of 3YA, Christchurch, N.Z., to 10 kw., probably before the end of the present year.

ANNOUNCING— AN ALL-WAVE DX CONTEST

Dig out the old microscope you use on your "ultra-super-super" when you want to tune within a gnat's whisker for those 'way off stations. First prize—a kit of eight standard Sylvania tubes for your set goes to the best DX-er; Second prize is a Lynch doublet antenna kit! (See contest rules for details.) Let's go-o-o!

FOR YOUR SHORT-WAVE NOTE BOOK

From Mr. John Shanks, of Russellville, Tenn., comes the first published data on the new short-wave station HJ3ABH, at Bogota, Columbia. This station is called "La Voz de la Victor," and may be addressed at "Direccion Telegrafica 'Alvictor'," or Post Office Box 565, in Bogota, Columbia. HJ3ABH operates on a broadcast frequency of 1005 kc., with 1200 watts, and on the short waves on 6012 kc., with 250 W. HJ3ABH operates irregularly in the evenings.

YV6RV, "The Voice of Carabobo," at Valencia, Venezuela, officially came on the air on Saturday night, Feb. 2, from 6:30-7:30 p.m., C.S.T., on a wavelength of 49.75 meters, or 6030 kc. This station is owned by those two famous Latin radio engineers, Herman and Guillermo Degwitz. It is unfortunate that YV6RV should be on the same frequency as HP5B, the Voice of Panama, as both stations would be very enjoyable to listen to. Probably before this article is printed, one station or the other will have shifted to a different frequency.

HB-9B

Mr. Hans Priwin of Copenhagen, Denmark, tells us that Basle, Switzerland, transmits every Thursday from 4:00-4:30 p.m., E.S.T., the program of the medium-wave transmitter at Basle on a wavelength of 85 m. for the benefit of the Swiss listeners abroad. This station is an experimental one and is owned by "Radio-Klub von Basel." The call sign is (*Continued on page* 689)

REPLACEMENT STATUS OF THE NEW TUBES

The beginner in radio who has been stumped by the numerous tubes now available will find this article an invaluable aid in learning just how they are intended to be used. Part III deals with the 2V. tubes.

H. M. NEUSTADT* PART III

IN PRECEDING sections of this article which dealt with 2.5- and 6.3-V. tubes, it was shown that the benefits derived from changing over an old set to use new tubes frequently do not justify the time and money spent on the change. The situation is the same among the 2.0-V. and other types that are dealt with in the following discussion.

Here again it is true that, since the original set design was based on the characteristics of the tubes used, a change to tubes with different characteristics means that the set must be (at least partially) redesigned. The difference between the characteristics of the tubes is shown in Tables V and VI. The changes in the set made necessary by these differences are indicated in the text dealing with each replacement.

SUBSTITUTIONS AMONG THE 2-V TUBES

PENTAGRID CONVERTERS

1A6 by 1C6 **Socket change: None.** This exchange of tubes is not very important except in receivers that tune down to about 30 meters or lower. The oscillator section of the 1C6 holds up better than that of the 1A6 at these short waves because of its high mutual conductance. At longer wavelengths the replacement produces little improvement. Because the 1C6 draws about twice as much filament current as the 1A6, a change in the filament resistor may be required. The difference in interelectrode capacity would probably necessitate realignment of the tuning condensers.

POWER AMPLIFIERS

31 by 33 **Socket change: Small 4-pin to medium 5-pin.** The 33 has approximately four times the power output of the 31 at the same plate voltage but draws about twice as much current from the "A" and the "B" batteries. They both require about the same plate load so no change in output transformer is usually required.

MISCELLANEOUS TUBE CHANGES

REPLACING THE 01-A, 99, AND 22

01-A by 37, 99 by 30, 22 by 32 or 34 **Socket Changes: 01-A by 37, medium 4-pin to small 5-pin; 99 by 30, small 4-nub or 4-pin to small 4-pin; 22 by 32 or 34, none.** The chief changes necessary in making these replacements are due to the differences in sockets and heater or filament supply. The other changes to be made depend so much on the set, on whether the change is being made in an R.F., A.F., or detector stage, and on how much set improvement is desired, that it would be difficult to cover all possibilities.

Used at the comparatively low plate voltages to which these early tubes are limited by their ratings, the new tubes have characteristics sufficiently close to those of the older types so that extensive changes in the set are usually not necessary, aside from the changes in sockets and heater or filament supply. However, *it is by raising the plate voltage that the most improvement can be gained from the replacements;* immediately, we find that at the increased plate voltages the characteristics of the new tubes are considerably different. Probably the best procedure to follow, therefore, is to investigate the characteristics of the tubes at different plate voltages and to use the principles stated below as a guide.

These principles are generalizations of the details which have been noted in connection with *all* the various changes. They may be stated roughly as follows.

(1) In an R.F. or I.F. stage, if any increase in gain is to be realized by changing tubes, shielding and R.F. filtering usually must be improved in order to avoid feedback. Since the interelectrode capacities are in effect connected across the tuning condensers, a new tube with new values of capacity usually necessitates tuning condenser realignment.

(2) In a detector, A.F., or oscillator stage it is usually sufficient to change the operating voltages to the values recommended for the new tubes. If the voltage-swing in the output is to be greatly increased, improved filtering may be necessary. A change in interelectrode capacity may affect the tuning alignment.

(3) In a power stage, a new triode with more output will be found to require more plate supply; a new pentode substituted for a triode will require higher plate load value. Changing power tubes to obtain more output will, therefore, require a change in the power supply, in the output transformer, or both; these considerations (plus the need for corrections in grid-circuit constants) apply with especial emphasis in class B circuits.

(For additional data concerning use of the new tubes, see the article, "How to Use the New Tubes," RADIO-CRAFT, October 1934; also, the RADIO-CRAFT LIBRARY, 64-page book, "Bringing Sets Up-to-Date."—Editor)

CHARACTERISTICS OF NEW AND OLD TYPES AT TYPICAL OPERATING VOLTAGES

TABLE V

VOLTAGE AMPLIFIERS

Tube Type	Heater or Filament Volts	Heater or Filament Amperes	Amp. Factor	Grid-plate mmf.	Input mmf.	Output mmf.
1A6	2.0	0.06	*Conversion gain and capacities slightly*			
1C6	2.0	0.12	*higher in 1C6*			
01-A	5.0	0.25	8	8.1	3.1	2.2
37	6.3	0.3	9.2	2.0	3.5	2.9
99	3.3	0.063	6.6	3.3	2.5	2.5
30	2.0	0.060	9.3	6.0	3.0	2.1
22	3.3	0.132	270*	0.02	3.5	10
32	2.0	0.06	610*	0.015	5.3	10.5
34	2.0	0.06	360*	0.015	6.0	11.5

(*)—At 135 volts plate.

TABLE VI

POWER AMPLIFIERS

Tube Type	Filament Volts	Filament Amperes	Total Cathode Milliamperes	Output Watts	*Output Trans. Ratio
31	2.0	0.13	12.3	0.375	23:1
33	2.0	0.26	27.0	1.4	23:1

(*)—Step-down ratio of output transformer for 10 ohm voice-coil load.

*Research and Dev. Lab.—R.C.A. Mfg. Co.—R.C.A. Radiotron Div.

HIGH-FIDELITY REPRODUCTION FROM RECORDS

A resume of interesting facts regarding the manufacture and reproduction of lateral and hill-and-dale records.

M. HARVEY GERNSBACK

ELECTRICAL reproduction of present-day phonograph records is considered by many to be well-nigh perfect. Actually such a state of affairs is far from the truth. Even by employing the best of pickups, amplifiers, and reproducers it would be impossible to achieve "high-fidelity" reproduction as dictated by the R.M.A. standard (Frequency response flat within 10 db., from 50-7,500 cycles."), which is a very limited one for high fidelity. From a sound engineer's standpoint, the definition of high fidelity would probably be more like this: "A flat response within 2 db., from 20 to 13,000 cycles."

Returning to the phonograph record again, the maximum range possible with present-day equipment is about 50 to 5,000 cycles with less then 10 db. variation. Using ordinary equipment in use in the average home, the response is naturally much less. It is probably safe to say that the range of the "electric" machine in the average home is only about 120-3,500 cycles. That's quite a distance from our "high-fidelity" definition!

In this article we must assume, for our purposes, that the experimenter possesses an amplifier and loudspeaker system which is capable of high-fidelity reproduction since we are going to confine ourselves to discussions of records and pickup devices.

Today there are crystal-type pickups available which have a response characteristic substantially flat from 30-10,000 cycles with less than 5 db. variation. By simple methods, it is possible to tilt this curve so that an increase in response of the frequencies below 1000 cycles takes place (to compensate for the fact that the average record is deficient in frequencies below 1000 and particularly below 250 cycles). There are also available improved magnetic pickups with a response such that when used to reproduce standard records, a fairly flat response is secured from about 50-5,000 cycles. So much for the pickups.

The commercial record of today seldom contains any "material" higher than 5.000 cycles. In fact, it is only within the last year that record-makers have succeeded in recording satisfactorily frequencies this high. No matter how well designed our pickups may be, they will be of little help if the higher frequencies are not recorded.

All operators of electric phonographs are familiar with the problem of needle scratch. This problem is a stumbling block to the perfection of high-fidelity recordings. The very high frequencies, even if recorded, are lost in the unpleasant noise of needle scratch. Needle scratch filters eliminate scratch, certainly, but they also eliminate frequencies above about 3,000 cycles! The causes of needle scatch are intimately associated with the type of material used in the records, the weight of the pickup on the record surface, etc. As far as high-fidelity reproduction is concerned, it would seem that it is impossible of achievement at present.

"HILL-AND-DALE" RECORDINGS

Probably a great many readers are familiar with the old Edison acoustic-type phonograph which was so popular years ago. The records used in this machine could not be played on the ordinary phonograph as the grooves were in a vertical rather than horizontal plane (as is the case with the ordinary record). (In the ordinary pick-up, the needle vibrates from side to side when a record is being played; with the hill-and-dale type of record and pick-up, the needle vibrates up and down when a record is being played.)

The Western Electric Co. experimented with various recording systems several years ago, and as result of its experiments, brought forth a modernized "hill-and-dale" recording system, using electrical recording and reproducing methods. New methods of processing the finished master records were devised and a new type of record material was developed.

The results with this system of recording are remarkable. In the first place, it is possible to record and reproduce a frequency range of about 30-10,000 cycles with a variation of less than 5 db.! Due to improvements in record material, the use of a permanent diamond point as a needle, and also the fact that it is possible with this system to reduce the needle pressure on the record to about 2 per cent (or 40 milligrams!) of that employed on the standard type of record, needle scratch has been practically reduced to inaudibility. It is now possible to reproduce frequencies as high as 10,-

(Continued on page 692)

Fig. A
The application of the cathode-ray oscilloscope to waveform analysis in recording.

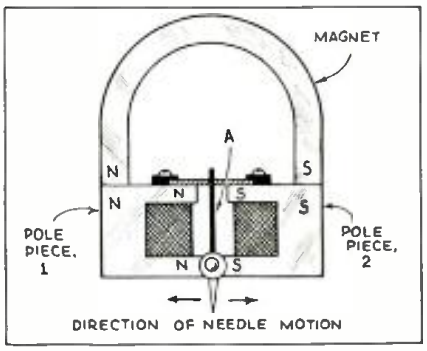


Fig. 1
The mechanical make-up of the magnetic pickup used for the common lateral-cut records.

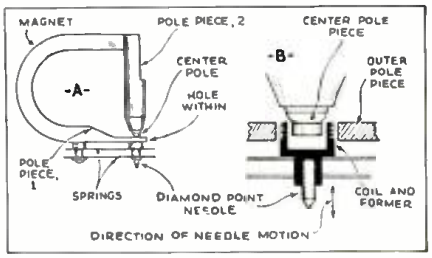


Fig. 2
Details of the W.E. dynamic hill-and-dale pickup which uses a permanent diamond needle.

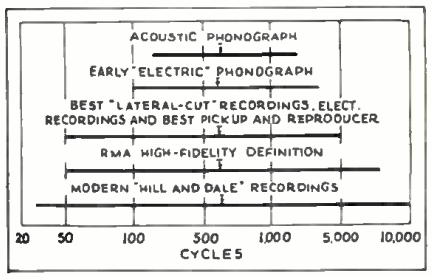
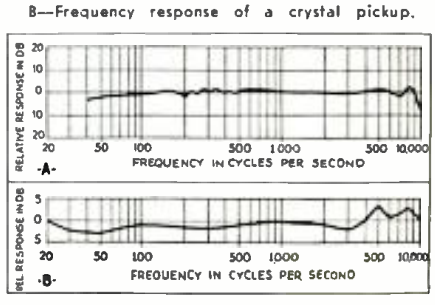


Fig. 3
A picture of the progress of phonograph recording and reproduction up to date.

Fig. 4
A—Response of W.E. hill-and-dale recording system (mike, amplifier, recorder and pickup).
B—Frequency response of a crystal pickup.



INTERNATIONAL RADIO REVIEW

RADIO-CRAFT receives hundreds of magazines from all parts of the world. Since the cost of subscribing to each of these would be prohibitive for most radio men, we have arranged with technical translators to prepare reviews of important items.

Fig. A. The new double-cone speaker for wide-frequency response. Note that the small metal cone is a part of the regular paper one.

NEW ENGLISH SPEAKER

THE high-fidelity bug has bitten engineers and radio fans abroad, as well as in the U.S., as the items this month prove.

The first shown is a new English speaker of the dynamic type (which appeared in WIRELESS MAGAZINE) but dressed up to secure a wide-frequency response. As you can see, it has an oval cone, mounted in a rigid oblong frame. The apex of the cone consists of a metal cone of small dimensions and having a sharper angle than the major portion of the cone. See Fig. A.

This metal cone is inserted to carry the high frequencies, where the paper cone would fail to radiate sufficient energy. The result is similar in action to the use of two reproducers, one for the low tones and a "tweeter" for the highs.

Fig. B. A radio-gram or combined radio and phonograph in a convenient cabinet.

A HANDY RADIO-PHONOGRAPH

COMBINATION radio receivers and phonographs have gained much more popularity in Europe, especially England, than they have in this country. There, convenience in the use of the phonograph is of much more importance, as exemplified by the cabinets of these combination sets.

A new cabinet style for a "radiogram," as they call them (taken from radio and gramaphone) is shown in Fig. B—an illustration taken from THE BROADCASTER AND WIRELESS RETAILER.

The phonograph turntable sets in the top, with a hinged lid to facilitate record changing, etc., the radio receiver and amplifier are fitted into the front of the cabinet while a convenient record storage compartment occupies the lower part. American sets in the lower price class having phonograph facilities of this variety are conspicuous by their absence.

A GERMAN RADIO TRAIN

PUBLIC address methods have been employed in a novel way in a railroad train in Germany to make traveling more comfortable for the passengers.

The illustration, Fig. 1, shows the installation, made by the Telefunken Co. and described in a recent issue of BASTELBRIEFE DER DRAHTLOSEN, a magazine published in Dusseldorf-Rath, Germany. One car of the train is fitted as a studio, containing a radio receiver, phonograph equipment, microphones and a suitable amplifier. The other cars are each equipped with two reproducers of the dynamic type. Then, entertainment either from records, radio, or original artists can be heard throughout the train. A P.A. amplifier makes the sounds sufficiently loud to be enjoyed by all.

AUSTRALIAN HI-FIDELITY AMPLIFIER

AN EXAMPLE of high-fidelity equipment developed in Australia is illustrated in Fig. 2. This is an amplifier using American tubes which has an unusually flat characteristic as shown in WIRELESS WEEKLY, the designer of the amplifier.

It consists of a type 55, the triode portion of which acts as a combined first stage and phase-reversing tube to feed the signal into the grids of the two type 56 tubes, connected in push-pull. By this means, no input transformer is needed, and a source of frequency discrimination is eliminated. The type 56 push-pull stage feeds into a power stage using the old reliable

(*Continued on page* 691)

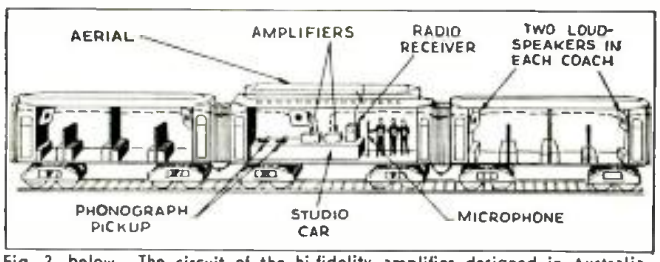
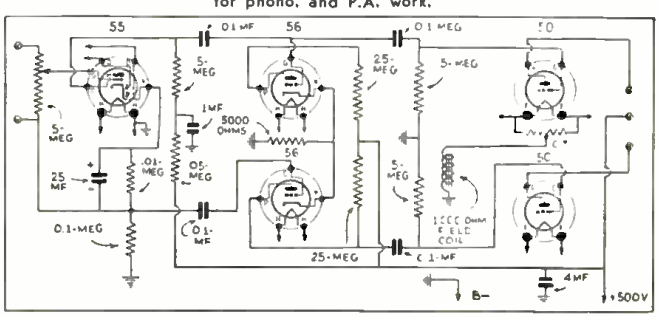


Fig. 1, left
A unique P.A. installation in a railroad train—to supply the passengers with entertainment.

Fig. 2, below. The circuit of the hi-fidelity amplifier designed in Australia for phono. and P.A. work.



Figs. C and D, below. A French mobile P.A. installation having several novelties. Amplifier and power unit replace a front seat.

NOTE: the only available information is that which is published; the experimenter must adapt the ideas to whatever equipment he has at hand.

THE ANALYSIS of RADIO RECEIVER SYMPTOMS

OPERATING NOTES

THE PURPOSE OF THIS DEPARTMENT

It is conducted especially for the professional Service Man. In it will be found the most unusual troubles encountered in radio service work, written in a practical manner, by Service Men for you.

Have you, as a professional man, encountered any unusual or interesting Service Kinks that may help your fellow workers? If so, let us have them. They will be paid for, upon publication, at regular space rates.

A FADING COLONIAL 33

THE above set was brought into the the shop labeled, "fades." A check of the tubes showed two 24s as very noisy when tapped due to loose elements. These two tubes were replaced and the set ran for an hour without a trace of fading. It was returned to the customer. Next day the same set came back to the shop with the same label, "fades." When hooked up and run for about 30 minutes it started fading, would fade nearly clear out and then back to full volume. A second check of the voltages with the set fading failed to show any variation in plate, grid, screen or filament voltages. Nevertheless each bypass condenser and each resistor was replaced one at a time, without results. Next the set was turned off and an ohmmeter check of all units made. During this test the primary of the first audio transformer showed an intermittent open. When this unit was replaced the set was O.K. See Fig. 1.

M. NELMS

A.V.C. ON THE KOLSTER K-80 AND K-82

ONE of the most aggravating jobs which I have ever encountered is the "time lag" feature in the Kolster K-80 and K-82 volume control.

A glance at the circuit diagram, Fig. 2, shows that the manual volume control functions in the grid-return circuit of the type 24 A.V.C. tube. Changing tubes is the first thought which occurs, but it just doesn't work.

An analysis of the circuit leads to the belief that the A.V.C. tube is losing bias due to the high resistance (2 megohms, R11) in the circuit. Following this idea, the thought occurred that it was also probable that the plate resistance (2 megohms, R12) was too high. Just how accurate the line of thought may have been is somewhat immaterial, for the fact remains that changing these two resistors for 1 megohm, 1 W. units, promptly cleared up the trouble.

JAMES H. SLEDD

BROAD TUNING COMPLAINT WITH ZENITH 705

THOSE who live in the south and own or service this model will find the most common complaints to be broad tuning and inability to get any stations other than locals in the daytime. The set has a small amount of Q.A.V.C. due to the bias resistor in the cathode of the 2A6 tube (5,400 ohms). Remove this resistor, and also the 5 mf. 20 V. condenser from the cathode, and ground the cathode of the 2A6, then peak the I.F. stage and R.F. condenser and you will find it to be an entirely different set. This also applies to the model 715 with the shadowgraph.

MOTORQLA MODEL 44

ON ALL these models that have a 500 ohm (green) resistor connected from cathode to ground of the 75 tube, you will increase the pickup and also give the set a better tone if you parallel another 500 ohm resistor across this one or remove it and replace it with a 250 ohm resistor. Note: Some models already have it that way.

HARRY L. CHANEY

WEBSTER TA3 THEATER AMPLIFIER

I WAS called upon to service a Webster type TA3 theater amplifier that had suddenly gone haywire. As can be seen from the diagram (Fig. 3) there are separate inputs from each soundhead and PE. cell. That is really a 1-tube preamplifier and a separate one for each machine.

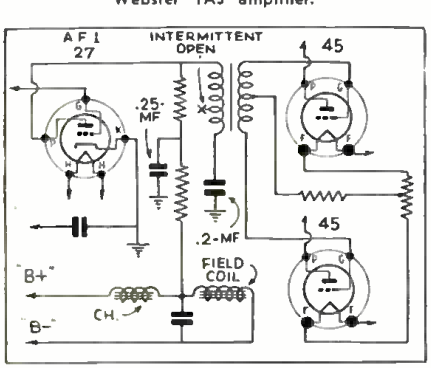
On one of the machines, the operator had to turn the volume on full and then it was distorted and not enough volume to fill the theater, whereas on the other machine the volume control was operated at normal, which was about one-third full volume. Here I might add that the Webster TA3 amplifier contains 7 tubes in all, two 57s as PE. cell amplifiers feeding into a 56 which feeds into another 56 feeding into push-pull, 2A3s with a 5Z3 rectifier, and has about 15 W. output.

I tested the 57 tubes and they were O.K., so I tried changing them but still the same. I then tested the amplifier from the grids of the 57s with a microphone and it was all O.K. with plenty of volume on either 57. So taking a look at the diagram I inspected the input coupling condenser from PE. cell to grid, having previously tested the PE. cell and its connections. I then dismounted the amplifier and took it to the shop, and unsoldered the coupling condenser from the PE. cell

(*Continued on page* 694)

Fig. 1, below. Intermittent "open" in primary of Colonial output transformer.

Fig. 3, right. Grid condenser replacement in Webster TA3 amplifier.



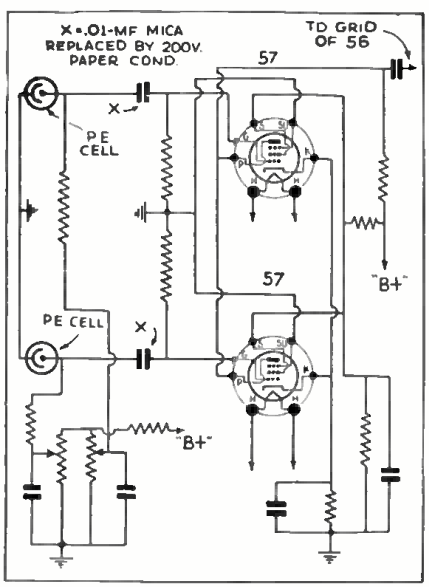
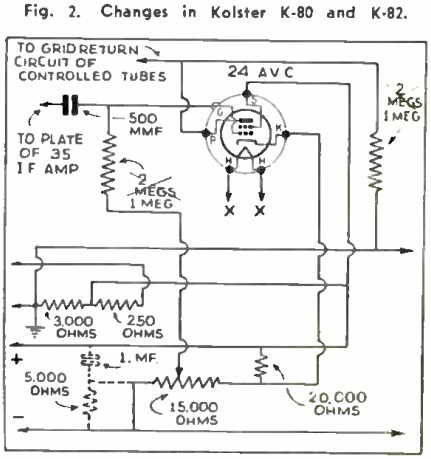
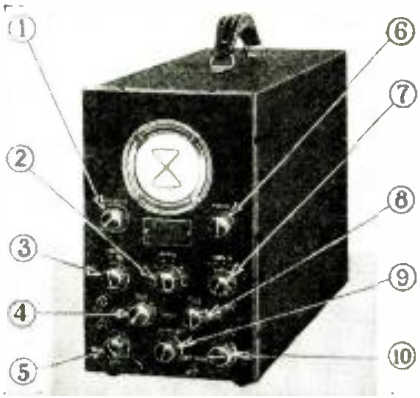


Fig. 2. Changes in Kolster K-80 and K-82.





The controls on a commercial cathode-ray oscilloscope: 1—Intensity; 2—Range; 3—Amplifier A, Sw.; 4—Vertical Timing; 5—Gain; 6—Focus; 7—Amplifier B, Sw.; 8—Horizontal Timing; 9—External Synchronizing; 10—Sync. Gain Control. (Photo: RCA)

A continuation of the history and fundamental study of the oscilloscope as a service and engineering measuring instrument. Some practical hints are included on operating and handling these tubes.

FUNDAMENTAL FACTS ABOUT CATHODE-RAY TUBES

E. B. PATTERSON*

PART II

A. WEHNELT in 1905 developed a *hot* cathode tube which was a distinct advance over the earlier type. It consisted of a line-spot source and contributed to the fineness and intensity of the stream by limiting the initial diameter of the stream and causing the effective part of the accelerating field to be parallel. Since a hot cathode created a copious supply of electrons, it was possible to use a lower potential on the tube, which greatly increased the sensitivity as the speed of the ray was reduced.

(The original cathode-ray tubes employed a *cold* cathode and a circular anode having a small hole in its center. Accelerating voltages from 10,000 to 20,000 were required, in order to produce the rays by bombardment. An explanation of just how this set-up could produce cathode rays is of interest.

A few gas molecules, positive ions, and free electrons are always found in the tube. Consequently, the application of a strong field causes the positive ions to be attracted toward the cathode. These ions, however, collide with neutral gas molecules and electrons are knocked out. The positive ions which strike the cold cathode in turn liberate electrons which constitute the cathode beam emanating toward the anode.)

*Engineer, RCA Mfg. Co., Inc., Victor Div.

OPERATING CONSIDERATIONS

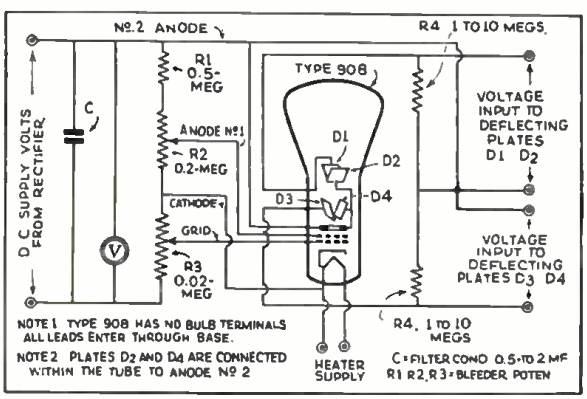
In dealing with modern cathode-ray tubes having brilliant spots (due to high anode voltage and improved screen fluorescence) there are certain precautions to be observed. One is that the beam should not be allowed to remain idle or it may cause deterioration of the screen (cause the screen to blacken).

A better idea of the tremendous impact of the electron stream against the screen is gained upon realizing that the electron stream bombards the screen much as machine-gun bullets would pepper a target, except that the latter projectile has a muzzle velocity of only about 2,000 miles per hour, against a velocity for the former "missile" (electron), at 1000 volts, of approximately 42 million miles per hour!

FUNDAMENTAL CIRCUIT

A typical diagram of a modern tube, and its fundamental connections are shown in Fig. 3. (An oscilloscope incorporating this tube and general cir-

(*Continued on page 701*)



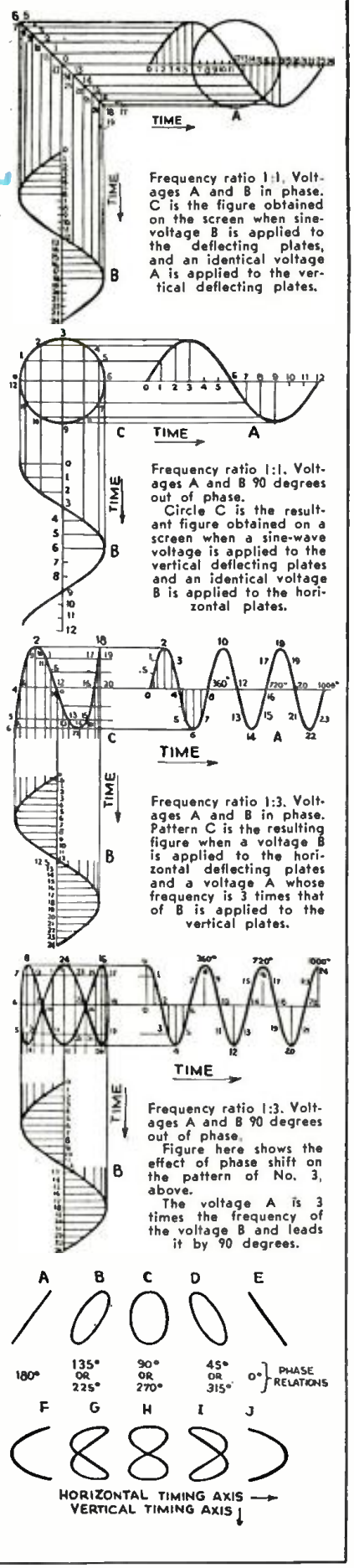
Left—

Fig. 3—A typical oscilloscope circuit showing the method of connecting the D.C. bias and the two A.C. potentials to be analyzed, that is, the sweep potential and the unknown.

Right—

Fig. 4—More of Lissajous figures upon which the comparison of wave forms depends. The radio man who contemplates the use of an oscilloscope should memorize these figures.

LISSAJOUS FIGURES



A MODERN PICTURE OF TELEVISION

The author continues here his interesting discussion of the developments and problems associated with television progress.

WILHELM E. SCHRAGE

PART II

A GREAT deal of money has been spent during recent years for the evolution of television receiving systems using mechanically moving parts, and it is understandable that the investors and inventors who spent their time and money for devices of this kind are not very well pleased about the idea of using the cathode-ray tube exclusively as image reproducer. The progress of television technique is working (at present—Ed.) without doubt in favor of the cathode-ray tube, not only because it operates without any moving parts, but also since it can be adjusted at much smaller expense for the reproduction of a larger number of lines (if changes should occur in the near future). That high prices are asked today for cathode-ray tubes means nothing. The history of the normal amplifier tube shows impressively that tremendous price reductions are possible if there is a market for large quantities.

HOW MUCH FOR A RECEIVER?

So far as known, only two American companies have given approximate quoted prices for their television reproducers, to date. The Peck Television Corporation, New York, announced recently that their television reproducer can be marketed for about $150. The reproducer screen has a size of 12x14 ins. and 60 to 120 lines are used. A tiny Kerr cell is applied as light valve, and a normal auto headlamp as light source. The light beam sent through the Kerr cell is controlled by the amplified impulses received from the television transmitter. By means of a disc (containing 60 small mirrors around its edge) rotated in synchronism with the disc of the transmitter, a modulated light beam is reflected to a screen and the image is built up. (See footnote 1.)

The National Television Corporation, New York, uses line scanning in their receiver by means of a so-called "mirror drum" covered with reflecting surfaces, which revolves in the light radiated by the "picture lamp." No lenses are used and according to a statement by the company, the image may be seen from a wide angle as well as from directly in front of the image reproducer. The company announced that it is prepared to market two types of receivers to retail under $200; one, a table model, is for vision and the other one is of the console type including complete sound equipment.

According to a statement recently made by Dr. Baker, general manager of R.C.A., the price of a television receiver might be approximately $300. Information about the construction and the kind of receiver was not given. (See footnote 2.)

The Plew Television, Ltd., London, England, offers a very simple television receiver for an image of only 30 lines, working with a Nipkow disc and a glow discharge lamp of special design which furnishes black and white pictures. According to an advertisement of the Plew Television, Ltd., in an English magazine, 12,000 of these receivers have been sold. The price for the standard television reproducer is quoted at about $100. (See footnote 3.)

During the last Berlin radio show the D. S. Lowe Company, Berlin, Germany, offered a television receiver with cathode-ray tube (screen dimensions 3.9x 5.9 ins.) including two complete sets to pick up the sound and the image broadcast, for about $270. (See footnote 4.)

All these quotations do not mean that these prices will be the regular ones if large quantities are manufactured and sold; they simply give an idea of the approximate sums which may be asked if television should be put on the air in the near future.

WHAT WILL BE SEEN OVER THE RECEIVER?

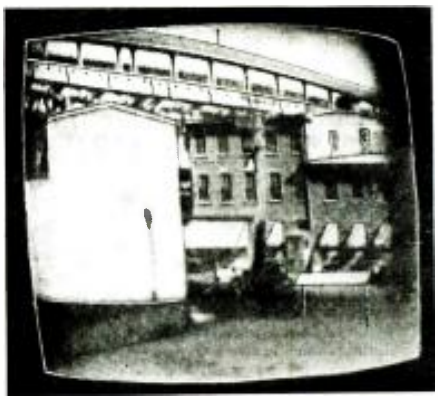
Despite the fact that a few television transmitters have been announced as available for "direct outdoor pickup" nothing has been demonstrated that makes it worth while to believe there will be, in the early regular television broadcasts, a chance to see direct transmissions. According to a statement made by Dr. Baker of R.C.A. during the last annual convention of the I.R.E. in Philadelphia, film will be a necessary medium in order to show daily events and entertainment.

He stated: "A radio broadcast station is likely to have 5,000 program hours a year. For a television station to show once, each of the 300 feature motion pictures produced a year in the United States, it would take up only 300 or 350 program hours. To broadcast once each of the new plays of a year shown on New York stages, would take up only another 300 hours. Shorts and newsreels would bring the total only to 2,000 hours, and not all events would be within reach."

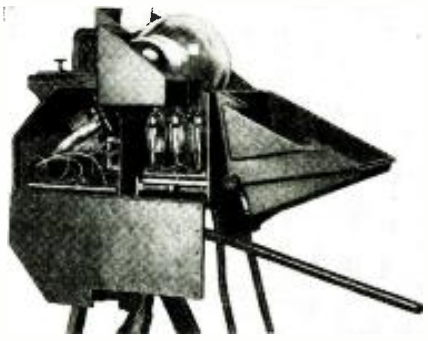
Contrary to this declaration we cannot expect at once a 5,000 hour television program. "The Crossley survey" for the Association of National Adver-

(*Continued on page* 684)

Experimental model of a cathode-ray type of television receiver. Tomorrow's set? (R.C.A.)

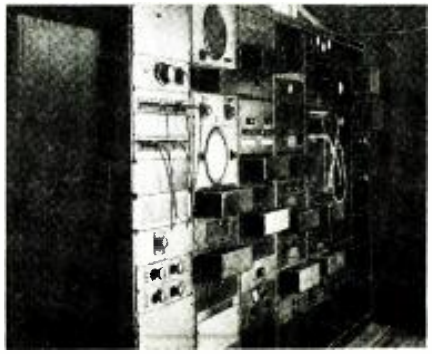


A sample of 180-line outdoor scanning. (R.C.A.)



Iconoscope television camera; (RADIO-CRAFT, 1933, "New Television Tubes," p. 206). (R.C.A.)

A television amplifier with a frequency range up to 500,000 cycles. (R.C.A.)



STEWART-WARNER MODEL R-125 CHASSIS 5-TUBE DUAL-WAVE SUPERHET.

(Receiver models 1251 to 1259. Range, 530-1,740 kc., and 5.6-18 mc.)

Slight variations from the schematic circuit shown may be encountered in some early production chassis. For instance, condensers C1 of 250 V. rating were used; one of these was placed from "B+" to chassis instead of to the 6A7 cathode. Condenser C2 had a 100 V. rating.

The detail illustration of socket voltages shows the underside of the tube sockets. Use a high-resistance voltmeter. The voltage drop across the field coil, when warm, is 73 V. D.C.

Note A. The actual bias on V1 is—16½ V., measured from point A to ground. The grid bias of V3 is—1½ V., measured from point B to ground.

Note B. The oscillator plate voltage with the range switch on "broadcast," and with the dial at 530 kc. should be approximately 172 V.

The oscillator grid voltage under similar conditions should be approximately—22 V. This chassis is extremely selective; no attempt should be made to align it except by means of an output meter and an accurately calibrated service oscillator. Connect the output meter across the primary (center and blue wires on the terminal strip) of the output transformer. Turn the volume control to maximum volume.

I.F. Alignment

Set the service oscillator at 456 kc. and connect it to V1 control-grid and ground. Set the range switch to "broadcast" and make certain that no station is tuned in. Align for maximum output. Duplicate the I.F. trimmer adjustments.

Broadcast-Range Calibration

Check the position of the dial on the condenser shaft by *pushing* the rotor plates of the band condenser to full mesh. The dial should then read 530 kc. (Note that the plates should be *pushed* with the fingers and not *turned* by means of the dial for this check.)

Turn the range switch to the maximum clockwise position (broadcast setting.) Calibrate the set at the high-frequency end; you may use a broadcast station signal between 1,300 and 1,420 kc.—or, a 1,400 kc. oscillator signal. Resonate the receiver to this frequency and align trimmer C3.

Broadcast-Range Alignment

Connect a 400 or 500 ohm, 1-W. carbon resistor in series with the service oscillator connection to the antenna post. This resistor *must* remain connected during the broadcast and short-wave aligning adjustments in order to secure correct alignment of the antenna stage. Ground the receiver chassis; and connect the service oscillator ground lead to the chassis. Tune the receiver to a service oscillator signal of 1,400 kc. and align broadcast detector and preselector trimmers C5 and C6, respectively, for maximum output. Retune the receiver and check; (do not again adjust C3). Tune the receiver to a service oscillator signal of approximately 630 kc. and adjust padding condenser C4 for maximum output. Retune the receiver for peak output and readjust C4.

Note that the above aligning procedures must be repeated until no further increase is indicated by the output meter.

Short-Wave Range Calibration

Turn the receiver range switch counter-clockwise to the short-wave band and supply to the set a service oscillator signal of *exactly* 1,600 kc. Set the receiver dial at 16 mc. and adjust short-wave range oscillator calibration trimmer C7 for maximum output. Note that usually there will be two peaks; the correct one is obtained with the trimmer screw farthest out.

To be sure you have not adjusted trimmer C7 to the image frequency of approximately 15.1 mc., set the receiver to the image frequency and note that the image signal can be heard. (The image frequency is always the signal frequency minus twice the I.F.; in this instance, the signal frequency is 16,000 kc., from which is subtracted 912 kc., which leaves 15,088 kc. or approximately 15.1 mc. as the image frequency.) If no signal can be heard at the 15.1 mc. dial setting even with greatly increased service oscillator output, but can be heard at a 16.9 mc. dial setting, trimmer C7 is evidently incorrectly adjusted to the image frequency and so must be reset to the correct peak with its adjustment screw farther out. After readjusting trimmer C7, again check to see that the image comes in at 15.1 mc. and not at 16.9 mc. on the dial.

Short-Wave Range Alignment

Tune the receiver very carefully to the service oscillator output at 16 mc. and adjust the second short-wave range detector shunt trimmer C8 for maximum output meter reading. After this is done try to increase the power input reading by detuning C8 and retuning the receiver dial; continue this procedure until maximum output deflection is secured.

Important: Antenna coupling condenser C9 is adjusted at the factory and should not be readjusted unless it is found that trimmer C8 will not peak, or if maximum output is obtained with C8 either all the way out, or in. Condenser C9 may be adjusted by first turning the adjusting screw all the way in and then turning it out just far enough to give a satisfactory peak on C8 when the adjusting screw of the latter is almost all the way out. Always adjust C8 *after* C9.

Recheck trimmer C8; the signal should be much stronger at the 16 mc. signal-frequency dial setting than it is at the 15.1 mc. image-frequency dial setting.

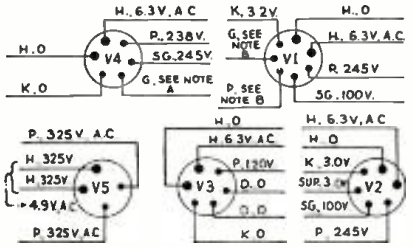
(Apply a little cellulose cement to the trimmer screws.)

The operating voltages of the condensers are indicated on the schematic circuit. These values should be adhered to in making replacements, as an underrated unit may cause more confusion, ill will, and expense than it is worth. The resistors, too, come in for their share of comment; observe the power rating of existing units and use replacement units with at least the same rating, if not higher.

A caution such as the above is advisable in connection with *any* radio set, but it is especially true where the use of multi-purpose tubes is concerned. (The 6A7 is a pentagrid converter, and the 75 serves as combined second-detector, A.V.C. and first A.F. amplifier.)

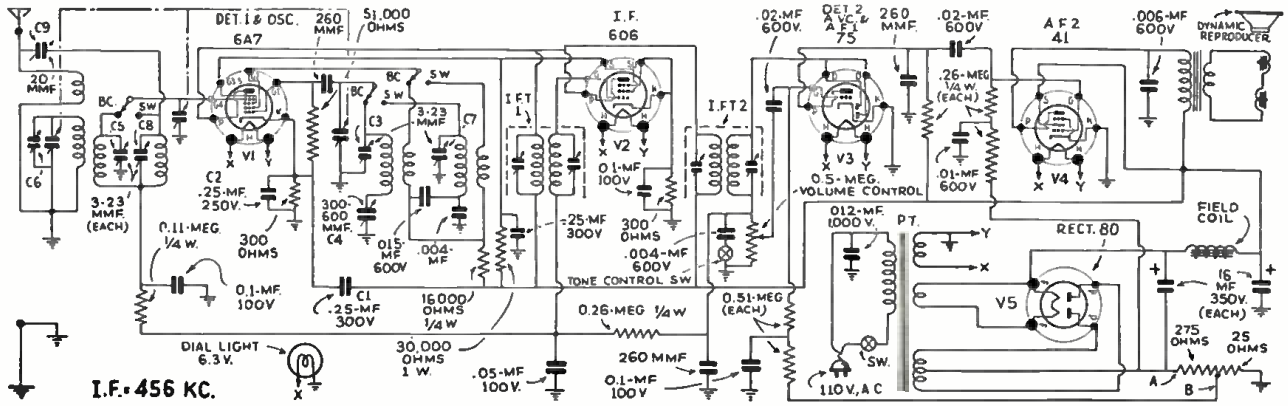
The Service Man should bear forcibly in mind that the efficiency of a short-wave (and broadcast) receiver, once it has been properly aligned at the factory and shipped out, is primarily dependent upon its handling in subsequent servicing. If the Service Man will only follow, implicitly and without deviation or scrimping of effort to save time or reduce service charges, the detailed servicing directions furnished by the manufacturer, the biggest obstacle to lowered efficiency in the receiver, as compared to its reception performance when first purchased, will have been mastered. It is such little things as full regard for tolerances in replacement units, and repeated re-checks of calibration and alignment, that do the trick.

In order to secure high efficiency in the most-used section of the short-wave band, this chassis has been designed on the "skip-band" plan, and consequently only the most common of the DX overseas broadcasters will be heard—to hear the limited number that operate outside the "international" band would necessitate a far more extensive design than is shown here.



Above, voltages at prongs (underside).

Schematic circuit of Stewart-Warner model R-125 dual-wave super. Circuit incorporates A.V.C.



RADIO-CRAFT'S INFORMATION BUREAU

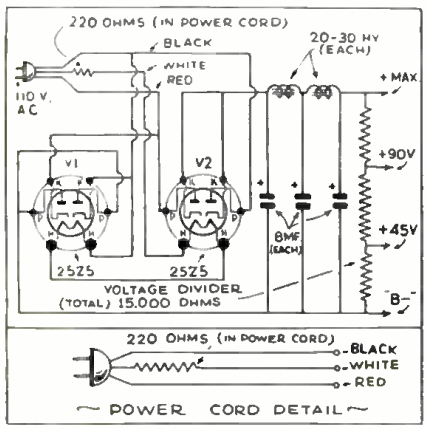


Fig. Q321—"Power-cord" supplying heater voltage.

DETERMINING IMPEDANCES OF TRANSFORMER WINDINGS

(320) Mr. Jean Fortier, Montreal, Canada.

(Q.) What is a simple method of determining the impedance of output transformer windings? We may know the turns-ratio, but have no way of knowing the impedance at either end. At what frequency are such impedances determined?

(A.) Audio transformers usually are rated at 1,000 cycle operation. If transformers of known impedance are handy, it is a simple matter to determine quickly the approximate impedance of stock units. Set your service A.F. oscillator at 1,000 cycles, and connect it with a low-range milliammeter in the circuit of a transformer of known impedance. Note the meter reading. Do this for every type of output transformer you have on hand. Then, when one of unknown impedance comes in, you merely hook it up and note the reading. Compare it with the former standard readings and the corresponding one gives you the answer. This is by no means accurate. But, since impedances are more or less standard, the result is close enough to allow you to tell for which one the coil was designed.

SELECTING "POWER CORDS"

(321) Mr. Marion Scribner, Albany, N.Y.

(Q.) In converting several small A.C. jobs to A.C.-D.C. operation, I have been uncertain as to the exact type of "power cord" to use. Is there an easily understood formula to use in such cases?

(A.) We have been receiving many inquiries regarding voltage-dropping resistors for both radio and industrial purposes, with particular reference to calculating values.

One use for a voltage-dropping resistor is in the universal A.C.-D.C. radio sets in which a resistor is used to cut down the line voltage to that needed for the tube filaments. For example, we will consider the transformerless "B" supply system shown in Fig. Q321.* Here a "power cord" (line cord and resistor combined) is used to drop the 115 V. of the line down to 50 V. which is needed for the two 25 V. filaments connected in series. The resistance of the "power cord" is calculated by subtracting 50 from 115 and then dividing the remainder (65 V.) by the current drawn by the tube filaments (0.30-ampere) which gives a resistance value of 217 ohms. (The stock value, 220 ohms, was chosen.)

Let us consider also a "power cord" for use with a 5-tube A.C.-D.C. set which has two 25 V. tubes and three 6.3 V. tubes. The sum of all the filament voltages is 68.9 V. Subtracting this from 115 and dividing by 0.30 gives us 153 ohms as the correct value; the nearest stock value, 160 ohms, would then be selected for this set.

*Courtesy "The Ohmite News"

CRYSTAL MIKE AND PICKUP AMPLIFIER

(322) Mr. Edwin Hoefer, Glenside, Pa.

(Q.) Will you kindly furnish a schematic circuit diagram of a high-fidelity amplifier, using piezo-electric microphone and phono. pickup?

(A.) Refer to Fig. Q.322.** The schematic shown in Fig. Q.322A makes an excellent P.A. system, where frequency response must extend over very wide ranges. Due to its high impedance (approximately 80,000 ohms at 60 cycles) the crystal microphone can be connected directly to grid and ground of the first amplifying tube. The pickup connects to grid and ground of the second tube. A 1. megohm, center-tapped variable "fader" allows either microphone or pickup to be used at will. Figs. Q.322C and D show alternative methods of connecting the microphone.

**Diagram courtesy Astatic Microphone Laboratory, Inc.

BINAURAL TRANSMISSION AND RECEPTION

(323) Mr. Howard Gates, Chicago, Ill.

(Q.) Recently I attended a demonstration of "binaural transmission." Unfortunately, I did not have the opportunity of getting the hookup used. Can you furnish same, and comment in condensed form on the theory of such transmission and reception?

(A.) The following quotation from "The Shure Technical Bulletin" contains the answer.

"A literal example of the use of the microphone as an 'electric ear' is found in systems for binaural or 'two-ear' transmission. The principles involved are so simple and the results so surprising that undoubtedly many will wish to experiment along these lines.

"A great deal of the naturalness of reproduction, which appears to be lacking in conventional transmission systems, is undoubtedly due to the fact that the auditory system gains its impressions of sound 'perspective' through the use of two ears. In a certain sense, the ears function as a sort of 'direction finder,' although *no conscious effort is involved.*

"Apart from any consideration of the acoustic nature of surroundings, the conventional broadcast or public address reproduction definitely lacks acoustic 'perspective' because it is essentially a 'one-ear' system. The relative pressure and phase relations at the listener's ears cannot possibly be the same as would exist were the listener standing at the microphone position. If, however,

(*Continued on page* 690)

SPECIAL NOTICE

Those questions which are found to represent the greatest general interest will be published here, to the extent that space permits. (At least 5 weeks must elapse between the receipt of a question and the appearance of its answer here.) Mark such inquiries, "For Publication."

Replies, magazines, etc., cannot be sent C.O.D. Back issues of RADIO-CRAFT prior to December, 1932, are available at 50c per copy; except the following issues: 7/29, 1, 2, 3, 4, 6, 7, 9 and 11/'30; 5, 8 and 9/'31; and 7/'33, which are out of print. Succeeding issues are still available at the regular price of 25c per copy.

Inquiries to be answered by mail MUST be accompanied by 25c (stamps) for each separate question; answers are subject to subsequent publication if considered of exceptional interest.

Furnish sufficient information (in reference to magazine articles, be sure to mention issue, page, title, author and figure numbers), and draw a careful diagram (on separate paper) when needed to explain your meaning; use only one side of the paper. *List each question.* Be SURE to sign your name AND address.

Enclose only a STAMPED and self-addressed envelope for names and addresses of manufacturers; or, in connection with correspondence concerning corrections to articles, as this information is gratis.

Individual designs can be furnished at an additional service charge. The fee may be secured by addressing the inquiry to the SPECIAL SERVICE department, and furnishing COMPLETE specifications of desired information and available data.

TUBE DATA

Many of the inquiries received by this department are written by readers of RADIO-CRAFT who desire information about new tubes and their applications to various circuits. Most of the tube manufacturers have prepared the required information in either book or chart form. A small charge is made for a book, while the charts are supplied gratis. Why not send for one or all of those listed under "Questions About Tubes"?

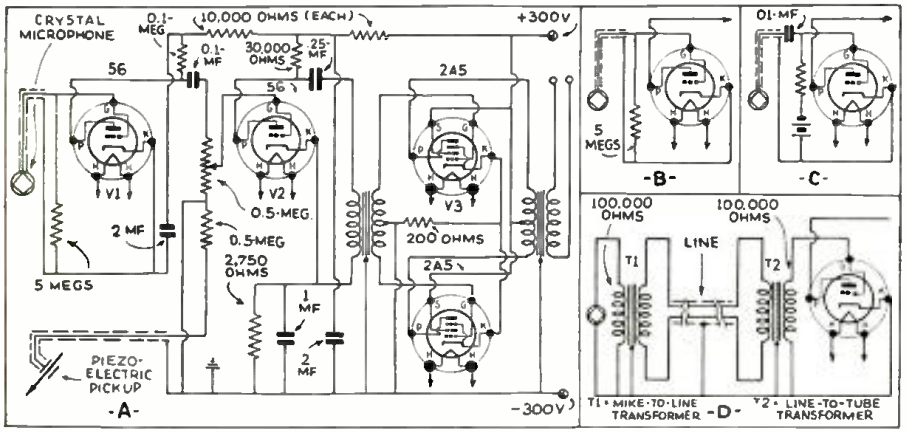
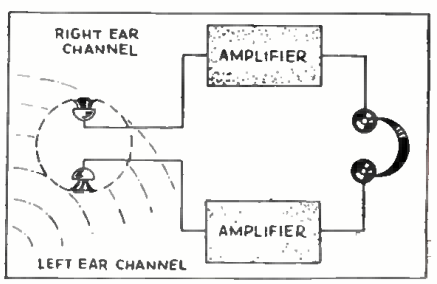


Fig. Q322, left
Schematic circuit of amplifier for crystal mike and crystal pickup.

Fig. Q323, below
Twin amplifiers and mikes for binaural effect.



EMERSON MODELS 38, 42 AND 49, 6-TUBE A.C.-D.C. DUAL-WAVE (AND 38-LW TRIPLE-WAVE) SUPER.

(Chassis model U6D; circuits models U6D-1 and U6D-3. Incorporates a "signal filter" (image-frequency wavetrap); also, A.V.C. Range, 540-1,760 and 5.5-15.5 mc.)

The short-wave range of this receiver covers the 19-, 25-, 31- and 49-meter international tuning bands.

Operating voltages as measured to ground with a high-resistance voltmeter are given below, with line voltage of 117.5 V., A.C. (field coil drop, 125 V.)

Tube Type	Plate Volts	S.-G. Volts	Cath. Volts	Sup.-G. Volts
V1	70	50	3	0
V2	70	50	3	–
V3	100	100	3.5	3.5
V4	60	—	1	–
V5	100	100	12.5	–

By using a set-oscillator frequency lower than the signal frequency an improved signal-noise ratio is secured. The distributed capacity of coil L3 serves to tune this unit to the image frequency. Unit R.F.C. is a short-wave choke.

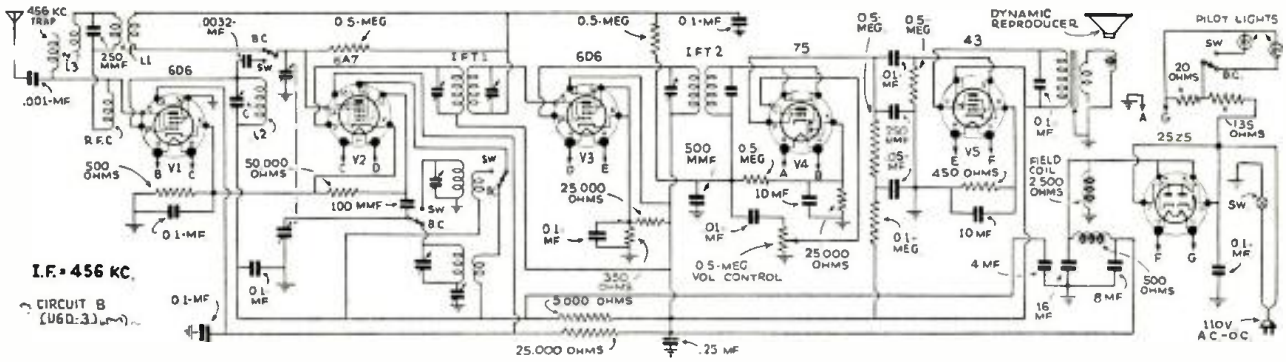
Coil unit L2 is a broadcast-range R.F. transformer with a high-impedance primary.

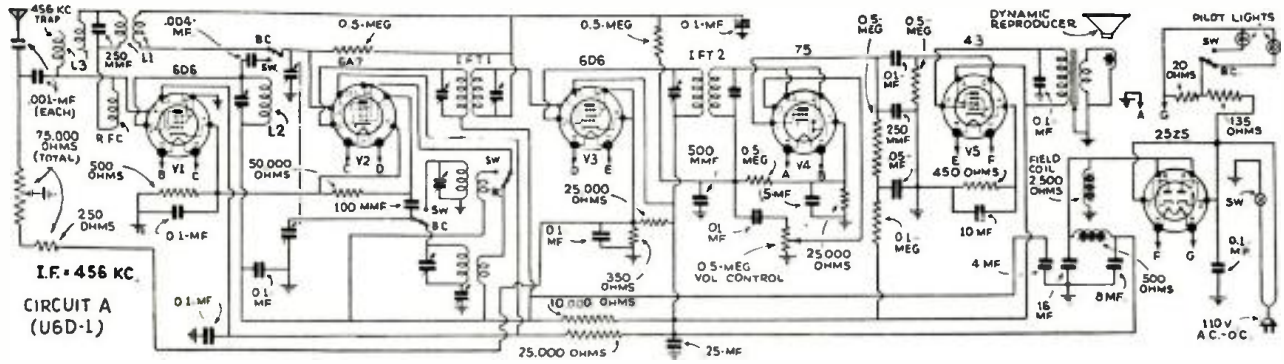
Tube V1 acts as a T.R.F. stage at the broadcast range; and as an untuned buffer or coupling tube at short waves.

(Model 38-LW incorporates same fundamental circuit; however, a third, long-wave range of 150-350 kc. is added.)

Alignment procedure. Ground the set-oscillator variable condenser stator during I.F. alignment. Before aligning the broadcast band, check dial calibration; trim at 1,600 kc. and pad at 600 kc. At short waves, trim at 15 mc. (the S.W. oscillator trimmer is nearest the oscillator coil). Trim coil L2 by adjusting C, from minimum, for the noise peak at which the trimmer has least capacity when the noise disappears upon further adjustment.

Emerson model 38 dual-wave set.





ECHOPHONE MODEL 110 4-TUBE A.C.-D.C. T.R.F. RECEIVER

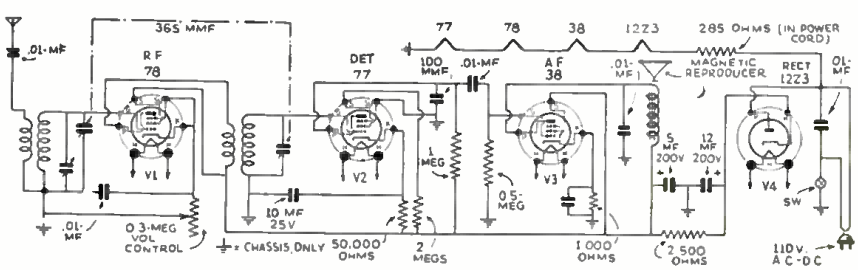
(Utilizes one stage of R.F. amplification incorporating a variable-mu R.F. pentode; this is followed by the detector stage, incorporating a non-variable mu R.F. pentode; the final stage utilizes a type 38 A.F. pentode. A magnetic reproducer is used for maximum sensitivity.)

Although the circuit of this T.R.F. receiver is "conventional," high efficiency has been achieved through careful attention to component characteristics and values.

Operating voltages are given below. Use a high-resistance voltmeter.

Tube Type	Cath. Volt.	C.-G. Volts	S.-G. Volts	Plate Volts
V1	1.8	1.8	90	95
V2	0.8	0.8	15	11
V3	6.7			85

It is recommended that the antenna supplied with the set be used. However, in some locations it may be desirable to increase the antenna length, or perhaps use an outdoor pick-up; in the latter instances it is advisable to realign the antenna circuit. When aligning the entire receiver, use a service oscillator frequency of 1,712 kc., applied to the antenna post of the radio receiver.



THE SERVICE MAN HAS THE WHIP HAND!

Charles Golenpaul*

THE LION is frequently placed at the mercy of the mouse in our intricate economic life. It's that way in the radio industry; for the Service Man, working in the small community and with a capital measured in two or three figures can make or break the giant set manufacturer so far as local sales are concerned. All the initiative and energy and investment that have gone into the building up of a radio set to the end of making not only this year's sale but the replacement sales of the future, may be dashed to the ground by the sheer carelessness of the Service Man, to his own detriment as well as the dealer's and jobber's and manufacturer's.

Let's have a bird's-eye view of the making of a radio set sale. Back in the factory or laboratory, research engineers evolve a new or refined circuit capable of still better performance. *Sets are delivered to the jobber who in turn delivers them to dealers.* Each dealer gets busy demonstrating and selling the new model. It's not a matter of an hour or a day or a week. Frequently it requires months to coax the prospect into the final sale.

So far, so good. But now something happens—really trivial, but fraught with grave danger to all concerned. Some little thing goes wrong with the radio set. The Service Man is called.

Right at this point the fate of manufacturer, jobber and dealer lies in the hands of the Service Man. If the Service Man comes to the troubled household with cigarette drooping from the side of his mouth, shabbily dressed and without regard for his person, plus poor speech and worse manners, the confidence of that household built up through the long process already mentioned, begins to wane. All that is required for a climax is for the Service Man to ask, "What's wrong with the set?" And to heap insult to injury, "How long have you had this set?"

To the buyer of a radio set, *that is the only set in the world* that counts.

Perhaps the situation is best understood by considering the parallel found in dental practice. When you visit the dentists office, he does not ask what ails you or how long you have had your false teeth or what work he must do in your mouth. His secretary hands him your "case card." He glances at it and knows your case thoroughly from that moment on.

The Service Man might well run a "case history" file on all radio sets sold in his territory and serviced from time to time. Such a case history serves to make you intimately familiar with the set you are about to service—the only set in the world, so far as that household is concerned.

The case history serves another important function, and that is to keep your customers sweet. Don't let them assume for a moment that you are paving the way for further calls—making much work for yourself. Let us take the case of an old set which, upon examination for some, is found to have one or more weak tubes. Perhaps the customer does not want those tubes replaced just now. Just the necessary repair is to be made. So the thing to do is to indicate on the case history card the condition of the tubes as found on this call.

Once a set leaves the factory, it is in the hands of the Service Man. He is responsible for the proper functioning of that set throughout its active life. He can do work solely to a bargain price basis, using the cheapest of parts and the least amount of labor. But in the long run the average household is paying for radio entertainment. If the set fails to deliver good entertainment, the servicing is not worth the price no matter how cheap.

In conclusion, just bear in mind that you as the Service Man have the whip hand once the set leaves the factory. You are the judge of what parts to use. You are like an usher showing the audience to their seats in the vast theatre of the air. Surely it is good practice to give your audience worthwhile seats from which they can enjoy the show, without annoyance.

*Aerovox Corporation.

TECHNICIANS' DATA SERVICE

JOSEPH CALCATERRA DIRECTOR

The literature listed in this department contains a wealth of very useful information.

A special arrangement between RADIO-CRAFT magazine and the publishers of this literature, which permits bulk mailings to interested RADIO-CRAFT readers, eliminates the trouble and expense of writing to each individual organization represented in this department.

2. HAMMARLUND 1935 CATALOG. Contains 12 pages of specifications, illustrations and prices on the new line of Hammarlund variable, midget, band-spread and adjustable condensers; trimming and padding condensers; R.F. and I.F. transformers, coils and coil forms; sockets, shields, chokes and miscellaneous parts for ultra-short-wave, short-wave and broadcast operation.

3. HOW TO GET A HAMMARLUND 1935 SHORT-WAVE MANUAL. A circular containing a list of contents and description of the new 16-page Hammarlund Short-Wave Manual, which contains construction details, wiring diagrams and lists of parts of 12 of the most popular short-wave receivers of the year.

4. THE "COMET PRO" SHORT-WAVE SUPERHETERODYNES. Describes the outstanding features of the standard and crystal-type Hammarlund "Comet Pro" short-wave superheterodynes designed to meet the exacting demands of professional operators and advanced amateurs for a 15 to 250 meter code and phone receiver, but which can be adapted by anyone for laboratory, newspaper, police, airport and steamship use.

5. ELECTRAD 1935 VOLUME CONTROL AND RESISTOR CATALOG. Contains 12 pages of data on Electrad standard and replacement volume controls. Truvolt adjustable resistors, vitreous wire-wound fixed and adjustable resistors and voltage dividers, precision wire-wound non-inductive resistors, center-tapped filament resistors, high-quality attenuators, power (50- and 150-watt) rheostats and other Electrad resistor specialties.

25. LYNCH NOISE-REDUCING ANTENNA SYSTEMS. Complete descriptions and instructions issued by Arthur H. Lynch, Inc., for making all kinds of antennas for broadcast and short wave reception, with a special supplement covering Ham Antenna Design for transmitting as well as receiving on all the amateur bands, including the ultra-high frequencies.

26. LYNCH AUTO RADIO ANTENNAS, FILTERS AND NOISE SUPPRESSORS. This folder describes a complete line of Lynch antennas, filters and ignition noise suppressors designed for auto radio installations. The antenna system is of the under-the-car type for easy installation. It includes data on Hi-Gain matched-impedance transmission lines which make the under-car antenna highly desirable for use with the new "Turret-top" cars.

28. LYNCH SUPER-FILTASTATS FOR AUTO RADIO INSTALLATIONS. Describes and illustrates, with instructions for using, the new Lynch Super-Filtastats which do away with the need for suppressors in auto radio installations, giving better performance in operation for both the car and radio set.

34. SERVICE MAN'S 1935 ELECTRAD REPLACEMENT VOLUME CONTROL GUIDE. A 52-page vest-pocket size booklet containing a revised, enlarged and complete list, in alphabetical order, of all old and new receivers showing model number, value of control in ohms and a recommended Electrad control for replacement purposes. Contains specifications and volume-control circuits for over 2,000 receiver models.

57. RIBBON MICROPHONES AND HOW TO USE THEM. Describes the principles and operating characteristics of the Amperite velocity microphones. Also gives a diagram of an excellent humless A.C. and battery-operated preamplifier.

65. SUPREME 1935 LINE OF TESTING INSTRUMENTS. A 20-page catalog which gives complete information on the entire Supreme line of testing instruments, including the new 5-in. Supreme fan-shape meter, the new Model 333 De Luxe and low-priced analyzers, the improved Model 85 tube tester, the Model 61 oscillator and the Model 180 precision multi-wave signal generator.

66. A SUPREME *A.C.-D.C.* TESTER WHICH CAN BE BUILT AT HOME AT LOW COST. Gives complete information about the Supreme 5-in. fan-shape meter, rectifier and resistor kit for the home construction of an inexpensive A.C.-D.C. tester.

67. PRACTICAL MECHANICS OF RADIO SERVICE. Information, including cost, features and outline of lessons of the Frank L. Sprayberry course in Radio Servicing, and list of Sprayberry Data Sheets for modernizing old radio equipment.

68. HOW TO MODERNIZE THE SUPREME 400-B. This is Data Sheet No. 4 of the Frank L. Sprayberry series of data sheets on how to modernize obsolete test equipment and receivers.

69. CASE RECORDS OF BROADCAST RECEIVER REPAIRS. Gives plan, contents and price of the Capitol Radio Research Laboratories' loose-leaf case records of 1,500 service jobs showing how actual troubles were corrected. Serves as a guide in correcting troubles in all types of receivers and power-supply units.

70. DATA SHEET ON BUILDING AN ANALYZER ADAPTER. Compiled by the Capitol Radio Research Laboratories to show Service Men how any analyzer may be brought up to date; or how to build a complete, modern analyzer out of spare parts and the use of only a multimeter.

(Continued on page 698)

Radio-Craft Technicians' Data Service
99 Hudson Street,
New York City, N.Y. **RC-535**

Please send to me, without charge or obligation, the catalogs, booklets, etc., the numbers of which I have circled below

2 3 4 5 25 26 28
34 57 65 66 67 68 69
70 72 73 74 75 76

My radio connection is checked below:

( ) Service Man operating own business.
( ) Service Man for manufacturer.
( ) Service Man for jobber.
( ) Service man for dealer.
( ) Service Man for servicing company.
( ) Dealer.
( ) Jobber.
( ) Experimenter.
( ) Professional Set Builder.
( ) Amateur Set Builder.
( ) Licensed Amateur.
( ) Station Operator.
( ) Radio Engineer.
( ) Laboratory Technician.
( ) Public Address Worker.
( ) Manufacturer's Executive.
( ) Student.
( ) .....

I am a:
( ) Subscriber ( ) Newsstand reader.

I buy approximately $.....of radio material a month. (Please answer without exaggeration or not at all.)

(Please print name and address)

Name .....

Address .....

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

Avoid delay. The catalogs and booklets listed are now in stock and will be sent promptly as long as the supply lasts.

NEW WAYS TO SELL P.A. EQUIPMENT

(*Continued from page 650*)

plane could reach a wide audience by traveling over highways in the country districts where innumerable motorists would be subjected to the persuasive tones of well-written sales talks.

Another useful application which should prove to be a profit-maker is the use of P.A. equipment for "rubberneck" busses.

"Momentary" P.A. applications are numerous. A time-delay relay controls the playing time of speech and music records started upon momentary contact (as arranged within a drinking-fountain handle, for instance). This application is not limited to drinking fountains, of course. Buildings, gasoline service stations, railroad stations, subway trains and stations— these are only a few of the possible places where they may be installed.

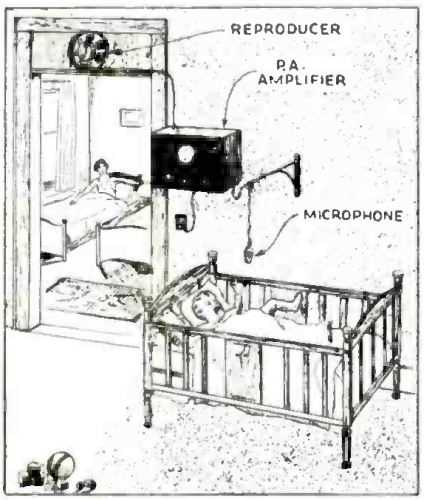
At fairs, circuses and carnivals, the barker will find yet another application of P.A. equipment. Here the system is of inestimable value in telling of the wonderful things to be seen within the show—and the P.A. apparatus can then serve the double purpose of aiding the ring-master in presenting the performers and their acts.

Although not a new idea, the application of P.A. methods to protecting children in their cribs from the fear of kidnaping is one which can be used advantageously at this time by P. A. men to bolster their sales and installation profits. The amplifier, in this case, amplifies any sound in the child's nursery and will warn the parents—who may be several rooms away, on another floor, or even outdoors—that the child is crying, ill, or uneasy.

The P.A. field is not reaching the saturation point by any stretch of the imagination. IT IS A GROWING BUSINESS WHICH CAN BE CULTIVATED INTO A STEADY AND DEPENDABLE SOURCE OF INCOME. IF A LITTLE INGENUITY AND FORESIGHT ARE APPLIED.

Above, "P.A." in circus ballyhoo.

Below, "P.A." helps mama watch baby.



MONEY-MAKING WITH THE ALL-STAR JUNIOR

(*Continued from page* 666)

to replace any parts in the twelve sets I have built so far. Only two have attempted to build the sets themselves and, while they did pretty good jobs, they called me in to test the completed receiver after they finished it. In each case I sold the idea of having a doublet aerial installed for $15.00, besides my service fee.

"Counting commissions, service fees, and actual labor charges, I've made about $160.00 extra the last month on this set! I know the circuit so well now that I can put one together in about two hours.

"Fellows in the radio service game bring their sets to have me fix them up. Every one which comes in has been tampered with and knocked out of adjustment. If they don't hear Australia the first time they tune in, they think something is wrong and try to adjust the I.F. coils without an oscillator. I have a GOOD oscillator, and that's all it takes to bring the set into alignment."

A UNIVERSAL-TYPE 52-W. RACK-AND-PANEL AMPLIFIER

(*Continued from page* 660)

THE PREAMPLIFIER

This unit illustrated in Fig. A (second panel from the bottom) and diagrammed in Fig. 1 is used only for low-level devices such as ribbon or dynamic microphones, etc.

The input transformer is bilaterally wound—a constructional feature which provides for the automatic cancellation of induced hum voltages without interfering with the normal coupling functions of the transformer.

THE SUPERHETERODYNE RADIO

For the distribution of radio programs our system must naturally include a radio tuner which can be seen in Fig. A (top panel) and its circuit studied in Fig. 1. It will be observed that a special triple-winding coil (L1) tuned by two sections of the 4-gang condenser employed provides for preselection—a feature which eliminates image-frequency responses and suppresses "repeat spots" while tuning.

THE PHONO-MOTOR AND TURNTABLE

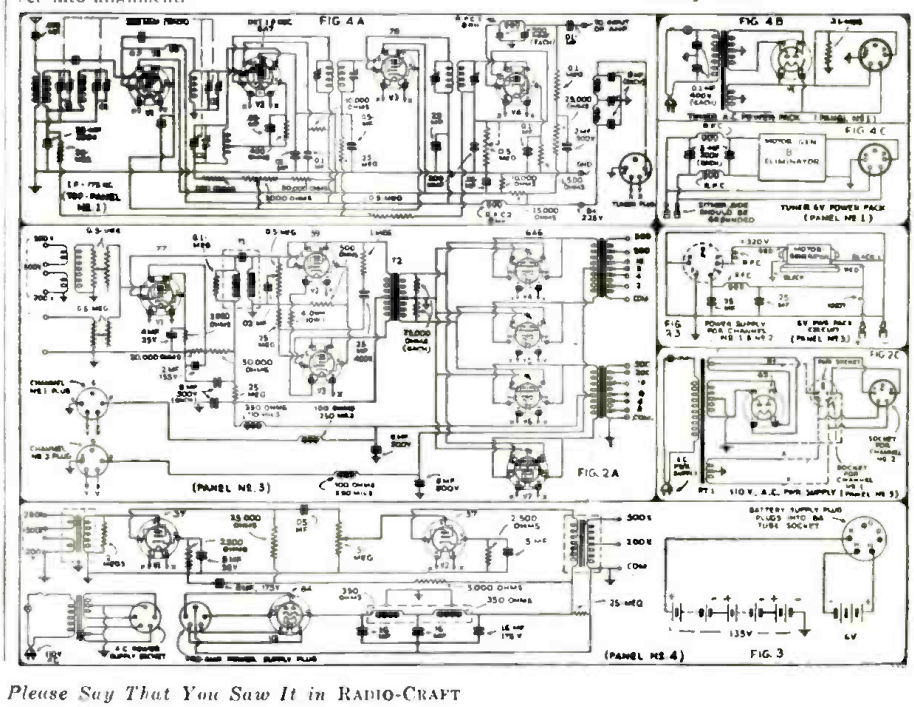
For the reproduction of phonograph record programs, a phono. motor and phono. pickup are included. The phono. motor is designed to operate from either a 6-volt storage battery or a 110 V. A.C. power line through a special power supply system. As in the case of the radio tuner and preamplifier, changing from one mode of operation to the other is simply a matter of removing the phono. motor plug from one socket and inserting it into another.

THE MONITOR SPEAKER

This unit, illustrated in Fig. A (bottom panel), acts as an audible gauge for measuring the output of the amplifier and adjusting the master volume control to enable the operator to maintain any desired level at distantly located speakers regardless of the variations in levels of the performers, or of the input devices used. This speaker is permanently connected to one of the taps of the output transformer without any auxiliary volume control connected to it. If a separate volume control is necessitated (only when full output of the amplifier brings

Fig. 1

Circuit details—by panels. (An enlarged diagram is available; send 10c in stamps to RADIO-CRAFT for mailing costs.



Please Say That You Saw It in RADIO-CRAFT

the volume of the monitor speaker up to an uncomfortable level) it should be carefully calibrated. (If this is not done, it will be impossible for the operator to gauge the output level of remotely placed speakers.)

THE AMPLIFIER

Now we come to the most important unit of the outfit—the 52-watt Amplifier. In selecting a suitable amplifier for our rack and panel P. A. system we kept the following thoughts in mind. (1) *High power output*, suitable for most P. A. applications; (2) *Economy of operation*, for practical economical applications to sound trucks and other storage battery (or 110 V. A.C.) operated applications; (3) *High gain* so that additional preamplification will not be necessary for all ordinary applications; (4) *High quality output*, for equaling the performance of amplifiers selling at considerably higher prices; (5) *Versatility of control*, to enable the mixing and fading of two or more signals so that one may be used as a background for the other; (6) *Universal operating feature*, to double the number of applications normally possible with conventional type amplifiers which operate from only 110 V. A.C. or from 6 V. D.C.

To meet the requirement for high power output it was decided to utilize an amplifier capable of delivering at least 52 watts of audio power as this is sufficient to adequately cover 45,000 square feet of outdoor area or 18,000 to 25,000 people assembled indoors. By referring again to Fig. 1, it will be noted that two output channels are provided, each utilizing two 53s in a push-push class B circuit.

Universal operation is of course made possible by employing common power supply plug leading from the amplifier proper, and which may be inserted into suitable sockets wired to their respective 110 V. A.C. or 6 V. D.C. power supplies. The rack which houses all of these P.A. components measures 63x21½x13 ins. deep. It is finished in a black crystalline lustre which presents a distinct professional appearance.

LIST OF PARTS

One Coast to Coast rack and panel complete with all shelves;
One Coast to Coast rack-panel superheterodyne tuner;
One Coast to Coast 6 volt tuner power supply;
One Coast to Coast 110 volt A. C. tuner power supply;
One Remington phono. motor and pickup;
One Coast to Coast 110 V. A.C. phono. motor power supply;
One Coast to Coast rack-panel dynamic monitor speaker;
One Coast to Coast 110 V. A.C. speaker field power supply;
One Coast to Coast rack-panel high-gain preamplifier;
One Coast to Coast 110 V. A.C. preamplifier power supply;
One Coast to Coast rack-panel 52 watt universal amplifier;
One Coast to Coast 110 V. A.C. amplifier power supply;
Two Coast to Coast 6 volt amplifier power supplies.

Amplifier Parts List

One Remington balanced input transformer;
One Remington driver transformer;
Two Remington output transformers;
Two Remington 100 ohm filter chokes;
One Remington 350 ohm filter choke;
Two Solar dual 8 mf. electrolytic condensers;
One Solar 4 mf. 25 V. electrolytic condenser;
One Solar .02 mf. 200 V. paper condenser;
One Solar .25-mf. 400 V. paper condenser;
Two .5-meg. "L" pad controls;
One .5-meg. potentiometer;
One Centralab 500 ohm, 2 watt resistor;
One Centralab 2000 ohm, 1 watt resistor;
One Centralab 25,000 ohm, 1 watt resistor;
Two Centralab 30,000 ohm, 1 watt resistors;
One Centralab 50,000 ohm, 1 watt resistor;
One Centralab .1-meg., 1 watt resistor;
Two Centralab .25-meg., 1 watt resistor;
One Centralab 1 meg., 1 watt resistor;
One Coast to Coast drilled and stamped chassis;
One assortment of necessary hardware, sockets, shields, wire, solder, etc.;
One set of wiring diagrams, blueprints and operating instructions.

"CRYSTAL MIKES" AND AMPLIFIERS

(Continued from page 663)

also be shielded as well as the lead to the grid of the tube. This shielding is of vast importance. If well done, no noise will be introduced into the grid and consequently not amplified.

The frequency response of the crystal microphone depends a great deal on the resistor R1. Five megohms is the correct value and a good one to stick to. A good 1/5-watt carbon resistor is small and easily shielded in a small piece of brass tubing. A lower value of R1 will reduce the low-frequency response.

The output level from this amplifier will be considerably above carbon microphone level. Using the crystal mike and 20 ft. of low-capacity microphone cable, the output at full gain will be approximately zero level.

A NEW TYPE CRYSTAL MICROPHONE

A totally new type crystal microphone has just been announced, as shown at the right in the photograph, which employs principles entirely different from anything previously used. Instead of a single diaphragm, this unit employs several crystals and a multiplicity of diaphragms, two for each crystal. The crystals which are of the rochelle salt type are connected in a series-parallel arrangement, the series scheme for the purpose of raising the voltage output from the unit and the parallel arrangement to raise the over-all capacity of the unit. The diaphragms are less than half the size of a postage stamp. This construction places diaphragm resonance outside the audio band.

As the crystal itself acts as a condenser, the impedance rises at low frequencies, permitting the construction of a microphone without a low-frequency cutoff. The entire unit is flat within 4 db. from 50 to 10,000 cycles;—these are conservative figures. The microphone has nondirectional qualities and is not at all sensitive to physical shock. Output level is—70db.

CENTRALIZED SOUND FOR SCHOOLS

(Continued from page 661)

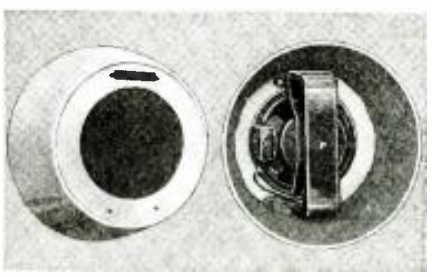
tion or the student body in many cases is raising funds to acquire such a sound system.

The elaborate two-channel system shown here and costing several thousands of dollars was purchased from funds raised by the student body in a large high school.

Due to the varying size of school buildings, school officials and dealers have been unable to obtain information on systems with a flexibility to meet the varying conditions encountered. RADIO-CRAFT bulletin No. 709 supplies this information for systems covering 10, 20, 30, 40, 50, 60, 70, and 80 rooms—write for your copy of this interesting free booklet.

The school sound system is a popular topic of discussion at all educational meetings and conventions and there is little doubt that every school will be equipped with such a system within a short time. It would be impossible to find any other school appliance so popular with teachers and students alike that *they will take the initiative to raise funds for such a system without the aid of public funds!*

School-type permanent magnet speaker.



A VERSATILE PORTABLE P.A. AMPLIFIER

(*Continued from page* 664)

rarily install, or hastily set up a P.A. system. By housing in this one compact carrying case a velocity (ribbon) microphone, a universal input control panel, a combined preamplifier, voltage amplifier, and power amplifier, universal power supplies, two dynamic speakers, and all necessary extension cables, the owner has before him a *complete* P.A. system that will undoubtedly surmount any emergency encountered in the P.A. field. 8. *Economy of operation* by utilizing two separate output transformers, the entire 25 watts output of the entire system is divided into two output channels. When less than 12½ watt output is required, one of the channels (No. 2), may be disconnected with a subsequent saving of operating power (27 watts). Approximately 48 watts are consumed with single channel (12½ watt output) operation, and 75 watts required for dual channel (25 watt output) use. (Power consumption practically the same with both the 110 volt A.C. and the 6 volt D.C. power supplies.) 9. *Low cost* was a predominating factor in the design of this system.

Hum has been practically eliminated from the amplifier by adhering to approved wiring procedure, correct placement of stray electromagnetic field producing units, and the complete and thorough shielding of both input transformers in thick high-permalloy castings. Of course, special hum cancelling input transformers are employed. These units are wound in two symmetrical primary and secondary sections and phased in such a manner that all *externally* induced voltages are 180 degrees out of phase in both primaries and secondaries—a condition which causes complete cancellation, although the primaries continue to induce input voltages (from microphones, phono. pickups, etc.) into the secondaries in proper phase relation for subsequent impression upon the grids of the input tubes.

In order to place into the hands of P.A. men an amplifier of unlimited utility it was decided to include a combined high- and low-frequency attenuater which does not affect the reproduction when set in the neutral (midway) position, but can be so adjusted to cut off high frequencies (for elimination of otherwise unavoidable audio feedback) or remove low frequencies as extraneous hum or other disturbances.

In order to bring the gain of the amplifier within the operating scope of the input device used, two double-throw switches (Sw1 and Sw2) are provided to furnish gains of 72 to 75 db., 91 to 94 db., and 123 to 126 db., by placing three, four, or five stages into the amplifier circuit respectively. Chart II shows the approximate level of various output devices as well as the amplifier gain required to bring their output up to 12½ or 25 watts.

As will be noted, two universal output transformers are provided for coupling additional speakers to the amplifier. As many as 50 magnetic speakers may be connected to the output terminals if an unusually difficult sound distribution problem presents itself.

TABLE I

Operating Combinations	*Operating Power*	*No. of Stages*	*Gain db.*	*Power Output Watts*
1	6 V. D.C.	3	72	12½
2	110 V. A.C.	3	72	12½
3	6 V. D.C.	3	75	25
4	110 V. A.C.	3	75	25
5	6 V. D.C.	4	91	12½
6	110 V. A.C.	4	91	12½
7	6 V. D.C.	4	94	25
8	110 V. A.C.	4	94	25
9	6 V. D.C.	5	123	12½
10	110 V. A.C.	5	123	12½
11	6 V. D.C.	5	126	25
12	110 V. A.C.	5	126	25

TABLE II

Input Device	*Approx. Output Level*	*Approx. Gain To Bring Level To 12½ W.*	*Approx. Gain To Bring Level To 25 W.*
Ribbon Mike	—89 db.	+122 db.	+125 db.
Condenser Mike	—85 db.	+118 db.	+121 db.
Dynamic Mike	—80 db.	+113 db.	+116 db.
Crystal Mike	—57 db.	+ 90 db.	+ 93 db.
Double-Button Carbon Mike	—30 db.	+ 63 db	+ 66 db.
Crystal Pickup	—17 db.	+ 50 db.	+ 53 db.
Magnetic Pickup	— 9 db.	+ 42 db.	+ 45 db.

LIST OF PARTS

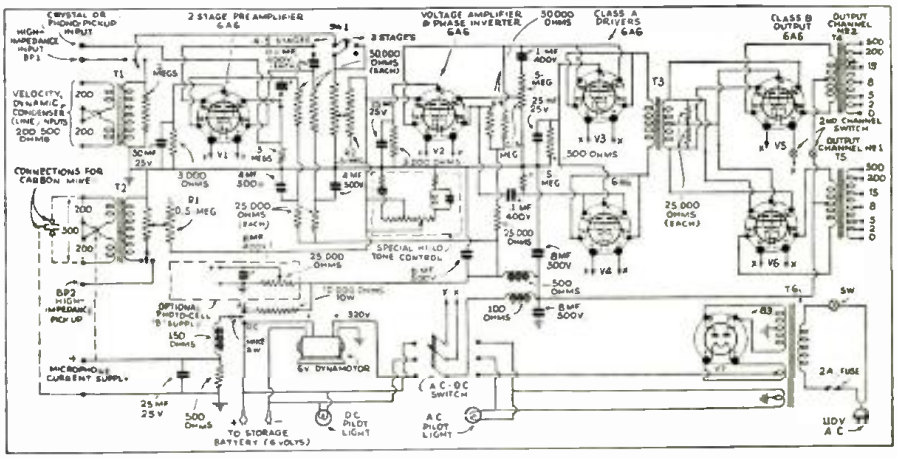
Two Columbia balanced input transformers;
One Columbia class B driver transformer;
Two Columbia universal output transformers;
One Columbia power transformer;
Three Columbia filter chokes;
One Columbia dynamotor;
One Columbia tone control;
One Solar triple 8 mf., 500 V. condenser;
One Solar dual 4 mf., 500 V. condenser;
One Solar single 8 mf., 400 V. condenser;
One Solar 50 mf., 25 V. condenser;
Three Solar 25 mf., 25 V. condensers;
Four Solar .25-mf., 400 V. condensers;
Two Centralab 500 ohm resistors;
Two Centralab 3,000 ohm resistors;
One Ohmite 10,000 ohms, 10 W., resistor;
Five Centralab 25,000 ohm resistors;
Four Centralab 50,000 ohm resistors;
One Centralab .15-meg. resistor;
Two Centralab .5-meg. resistors;
One Centralab 2 meg. resistor;
One Centralab 5 meg. resistor;
Two .5-meg. "L" pads;
One 25,000 potentiometer;
One complete kit of switches, sockets, fuses, terminal strips, chassis, and hardware;
One set of wiring diagrams, instructions and pictorial layout.

Accessories

One set of tubes (6-6A6s, 1-83);
One carrying case;
One velocity (ribbon) microphone;
Two 11-inch dynamic speakers;
One A.C. field exciter;
One microphone stand;
One 100 ft. speaker extension cable;
One 50 ft. microphone cable.

Additional Optional Equipment

One portable phono. motor and crystal pickup;
One double-button microphone;
One crystal microphone;
Two 11-inch dynamic speakers (in one two-section case).



A high-quality amplifier for use with any type of microphone on the market.

(An enlarged diagram is available from RADIO-CRAFT. Send 10c in stamps to cover mailing costs.)

VARIABLE-FIDELITY A.F. TRANSFORMERS

(Continued from page 661)

trated in Fig. 1. It is readily apparent from its curve that both the low and high frequencies are entirely lacking, particularly when we compare this with the high-fidelity receiver curve shown in the same figure.

THE TONE-CONTROL TRANSFORMER

Quite recently a new method of equalization, which is comparatively inexpensive, has been developed. The principle of operation of this type of equalizer is termed "varitone control."

If we take an interstage transformer as in Fig. 2C and place a tertiary (third) winding on it, shunting this tertiary winding with a resistor and condenser connected in series, it gives us the same effect as that indicated in Fig. 2, at A and B, due to the reflected action of the transformer. Similarly, a tertiary winding can be used with a reactance and resistance across the secondary to equalize the high frequencies.

However, audio transformers have inherently a certain leakage flux which results in what is technically termed "leakage reactance." Therefore, if we arrange a tertiary winding so that the leakage flux between it and the primary winding is high, the leakage reactance which is effected has the same effect as an external reactance. This means that the reactance L1 shown in Fig. 2C can actually be obtained in the transformer structure without the use of an external coil. This leakage reactance may further be augmented by the use of an additional external reactance. If a reactance and a condenser are connected in series, and then in turn shunted across an amplifier circuit, the impedance of these series-connected units is very low at a frequency at which they resonate. Consequently, a considerable shunting of power is obtained at the resonant frequency but not very much at the other frequencies. A particular range of frequencies, therefore, can be depressed with reference to both lower and higher frequencies.

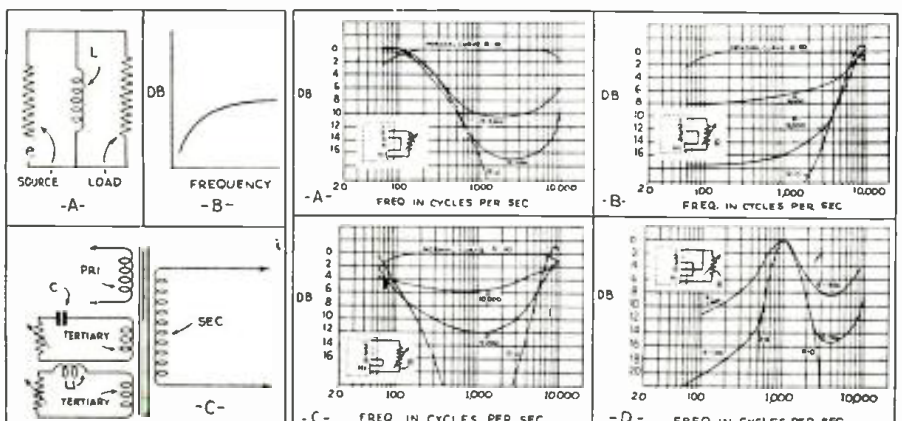
The amount of equalization obtainable in the above control circuits can be controlled through a very wide range by the use of a series variable resistor. Fig. 4 illustrates a complete amplifier using this type of control incorporated with the input transformer. This input transformer is universal in character.

With the control circuit as shown in Fig. 4, the control potentiometer when set at one end will equalize the high frequencies as in Fig. 3A; when set at the other end, it will equalize the low frequencies as shown in Fig. 3B. If the bridging connector from one side of the high winding to terminal 3 is changed to terminal 4, the potentiometer arm as it bridges one end will give the frequency response of Fig. 3C in which both the high- and low-frequency responses are augmented. This latter connection is most desirable for improving radio receiver and amplifier fidelity. The curve of Fig. 3D, which is also obtainable, is of great interest to the amateur operator and the DX fan. With resistance cut out completely, a sharp, single-frequency filter is effected which eliminates practically all frequencies but 1000 cycles. This is ideal for the reception of code using a 1000-cycle note, as voice, heterodyne, and other disturbances are eliminated. This sharp 1000-cycle circuit is also useful with A.C. bridges for the elimination of harmonics in the output.

If some resistance is added to the control circuit shown in Fig. 3D, the frequency range can be reduced to any degree of fidelity desired. This means that when a DX fan is trying to get distance and static whistles and other noises are bothering him, he can reduce the fidelity to the point where these interfering sounds are eliminated and just the essential frequencies for intelligible speech can be retained. Much greater intelligibility and accuracy of reception are possible.

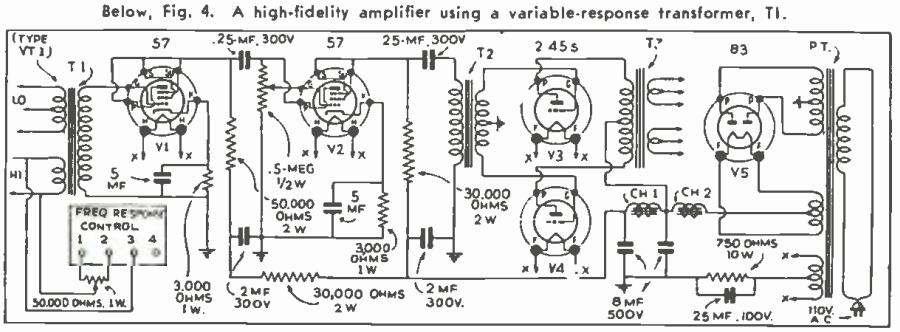
The amplifier shown in Fig. 4 is standard in its general nature. The "variable flux" audio transformer operates into a single 57 which is used as a triode. This is, in turn, resistance-capacity coupled to another 57 triode which is coupled to two 45 tubes operated self-bias in A prime. The available power output is 10 watts and the over-all gain approximately 75 db. with no equalization. As previously stated, most phonograph records, microphones and some broadcast stations are not as yet up to true high fidelity standards. The use of the equalization provided on the amplifier of Fig. 4 brings a veritable new life to these sound sources.

If an ordinary phonograph record is equalized at both the high and low end, the castanets and cymbals and French horns which are rarely heard in their true form will come out in their actual brilliance of tone. This unit is an excellent device for the Service Man, for whom this system effects an opportunity to modernize present radio receivers, amplifiers, and phonograph combinations.



Above, Figs. 2 (left) and 3. Equivalent electrical circuits and frequency curves.

Below, Fig. 4. A high-fidelity amplifier using a variable-response transformer, T1.



A MODERN PICTURE OF TELEVISION

(*Continued from page* 673)

tisers has indicated that between 7:00 p.m. and 10:00 p.m., the radio audience is 60.9 per cent of the total. To reach a really great audience for the chief parts of the television program, only 1,000 hours yearly are therefore necessary.

MOVIES VS. TELEVISION?

If we quote a recent interview by Dr. Goldsmith who stated that about 800 one-hour motion pictures a year are made (features and shorts), and if only 50 per cent of the pictures are available for television broadcasts, a daily program of more than one hour could be covered only by showing brand new films.

There are now some very interesting industrial shorts available, for example the famous Ford picture, "Rhapsody in Steel" and many similar ones, which will find much applause.

An important part of the television program can be lectures given by scientists and famous travelers, etc., who could use pictures or diagrams to explain a certain point of their lecture. Interesting parts of the great museum collections could be shown and explained over the television transmitter without too great expense. There are, further, thousands of excellent pictures made in recent years which could not be shown again in movie theaters without protests but would find great interest by people during the late afternoon hours, to extend the programs.

The movie theater owners will, of course, have objections to such a television program. It is well known how much objection the phonograph industry showed against radio broadcasting, and how they afterwards made an excellent business of advertising obtained through playing their records over the radio. Television gives the movie theater owner a chance to enlarge the theater's audience by showing previews in some enlarged form. It seems, therefore, that television is not a danger for the movie industry but, by means of certain agreements, a valuable help to put hundreds of unemployed artists to work, through manufacturing of industrial shorts which in future will probably be much in demand.

WHEN WILL TELEVISION START?

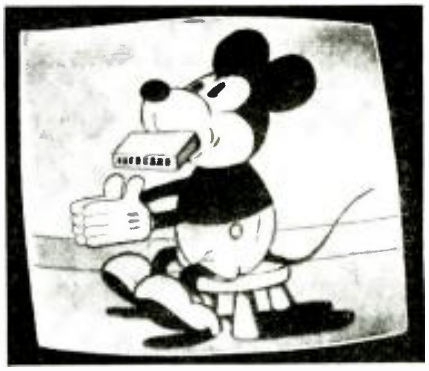
There are two different opinions among experts. One is wishing to make television available to all the people at once, because otherwise the radio business will be killed in those cities anticipating the coming of television service already in use elsewhere. The other believes the time is only ripe to begin broadcasting television pictures in a few large cities, and some experience should be collected before starting to build (with the expense of about 40 million dollars) the projected television station network consisting of 80 transmitters to be erected all over the country. But right now no private capital is available for this project and the negotiations to obtain Federal funds for it have not shown the slightest progress. However, it is not unthinkable that the negotiations will be successful.

For the past few weeks there has been much talk about "wired television." By this is not meant the direct connection between the different television transmitters, but a television broadcast direct through normal telephone lines into the houses of the radio listeners. The entire project indicates a remarkable lack of knowledge about the principles of television technique, and no attention should be paid to such a complicated project, because it is well known that television, with its broad frequency band, cannot be transmitted over normal telephone lines without great expense.*

Another question often mixed up with the above-touched project is the layout of a line network of special design to connect the different television transmitters. Also this project is technically not so simple as it seems at first glance, and it is not surprising that the cost for such a network has been estimated at about 40 million dollars.

*Television is as much a technical problem as a financial one, as these conclusions indicate.***

However, while there is no doubt that a great many important technical questions have to be solved before starting with actual transmissions, it seems that at least a small beginning with television broadcasts could be accomplished in this year if the financial question could be settled.



The 180-line definition of a cartoon movie.

*(Even the new "coaxial transmission line"—RADIO-CRAFT, April 1935, page 583—would require a long time for installation if anything like nation-wide service could be furnished. —*Editor*)

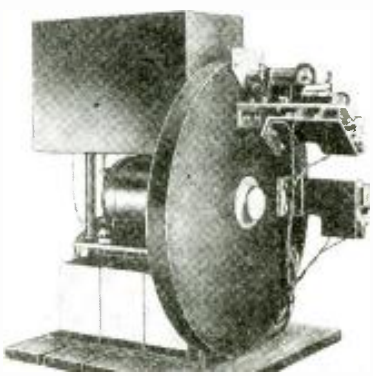
(**See "What About Television?", RADIO-CRAFT, February 1934.—*Ed.*)

(1) (The "Latest in Television," RADIO-CRAFT, December 1934.)

(2) (A cathode-ray television system is described in the article, "The New Cathode-Ray Television Tubes," RADIO-CRAFT, October 1933.)

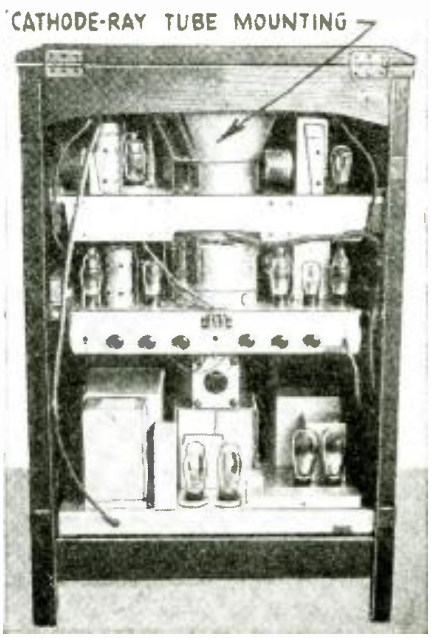
(3) (See "Television in Europe," RADIO-CRAFT, January 1935.)

(4) (See "Radio Pictorial," RADIO-CRAFT, October 1934.)



Above, A modern disc scanner used at W6XH

Below, Interior of cathode-ray receiver. (R.C.A.)



THE GROWTH OF "PUBLIC ADDRESS"

(*Continued from page 654*)

peared, there was the usual amount of scoffing which comes when anything new is introduced and there were publications that even went so far as to exert their power to kill sound in theatres by writing articles of how objectionable it was. Theatre-owners who were bitter about sound had signs hung in front of their theatres stating, "Silent Pictures Only." But all this propaganda could not stop progress.

It wasn't long before sound was recognized as a necessity for any building in which speeches were to be made. So all the large auditoriums began to be equipped with sound.

It is rather difficult to mention the different stages of sound from then on, because people generally were becoming aware of the many different uses for sound installation. The rapid development in the improvement of sound helped to increase its many uses.

Sound trucks appeared on the streets in such quantities that some cities were forced to pass laws prohibiting them from broadcasting except at certain times during the day.

Some idea of the tremendous advancement in sound can be realized when you consider that it is possible today, with a battery of six or more speakers at one end of a large stadium, to broadcast football announcements during the game which tell exactly what the players are doing, so that these announcements can be easily understood by everyone in the stadium, even though there are 80,000 or more people present.

Have you attended any large dance lately, where dynamic reproducers were not used to amplify the orchestra? I am sure you have not. There is hardly a well-known dance orchestra today which has not sound equipment for amplifying its music when playing in good-sized dance halls. Or if it has not this equipment, its program is reinforced by a rented P.A. system.

There are so many uses for sound today that it would be impossible to name them all. But a few are being listed, just to give you some idea of the tremendous advancement in sound during the last few years.

Now as to the future of sound, I am sure any one at all familiar with this business will agree that the surface hasn't even been scratched. I am going to cite just one opportunity for sound installations, which, in itself, will be much larger than anything we have seen so far. Today, there are quite a number of educational programs being broadcast over different networks, but we all know that it will only be a short time before steps are taken by the United States Government to see that educational programs are broadcast at certain times during the day, so that all schools equipped with sound will be able to take advantage of them. The air classes in schools throughout the country will be conducted by our most able professors. Think of this tremendous advance and what a great help it will be to the students, especially in the rural schools.

It is easy to imagine what will happen when the schools wake up to the fact that they must have sound in order to even be considered first class. The scramble by the theatre-owners for sound will be simply "a drop in the bucket" and many industries will again start working overtime!

Editorial Note: Further details in analysis of the "sound" field may assist the average reader to more fully realize just where public address fits into the mosaic of the pattern we call Radio.

Public-address systems have undergone a phenomenal change in the last 5 years. Microphones, amplifiers, and reproducers have been vastly improved; the manner of assembling these major components has been in a continual state of flux.

"Believe it or not"—with the possible exception of the 845 *not a single tube utilized for public-address work was designed especially for this service*—they were *all* engineered for use in the audio system of radio receivers! The list of "radio" tubes used in the P.A. field is now quite extensive.

Circuits have contributed greatly to P.A. development—such arrangements as class B and A prime fixed-bias circuits, and "universal" power supply are examples.

TABLE I

101 APPLICATIONS OF PUBLIC ADDRESS EQUIPMENT

(*Continued from page 654*)

46. System to supply chimes from recordings instead of using bells.
47. Portable system to be used during patriotic ceremonies.
48. System installed in cemetery chapels.

In Theatres

49. System to supply organ music.
50. Special system to supply sound effects.
51. Ordinary P.A. for stage singers, etc.
52. Music system in lobbies.
53. Music system to accompany silent movies.
54. Attachments to allow proprietor, organist, etc., to talk over the talkie apparatus.
55. Low-level paging systems for patrons which would not interfere with program.

On Boats

56. Paging system for guests.
57. Amplification for dance orchestra.
58. Amplification to ballyhoo along shores.
59. Centralized radio in staterooms.
60. Music system for dining rooms, etc.
61. On boats or on docks, system to direct loading and unloading of freight.
62. System to supply music for dancing on smaller boats.
63. P.A. to direct crews on large ships.
64. P.A. for instruction on training ships.
65. In showboats special systems as previously indicated.

At Filling Stations

66. Music system for ballyhoo.

In Corn (kernels, on a numbered square) Games.

67. System to call numbers.
68. Music and speech system for ballyhoo.

For Cook Houses and Other Concessionaires

69. Ballyhoo.

In Circuses and Side-shows

70. For ballyhoo at gate.
71. P.A. for announcer in main top.
72. P.A. for educational talk in menagerie tent.
73. Sound truck to ballyhoo territory.
74. Amplified music system to accompany acts and take place of band.
75. Ballyhoo at side-shows.
76. Centralized P.A. system with stations at various freaks and novelties.

Carnivals and Fairs

77. Ballyhoo at gate.
78. Sound truck to ballyhoo territory.
79. System to amplify program to grandstand and to adjoining buildings.
80. Sound truck ballyhoo.
81. System to supply entire musical program.
82. System to bring important speeches over radio or telephone wires.
83. System to supply music in exhibition building, etc.
84. P.A. to amplify livestock judging, etc., in judging lots or in livestock buildings.

Tent Shows

85. Portable system to ballyhoo in front of tent or auditorium.
86. Portable system for tent or auditorium.
87. Music system for special acts.

Commercial Clubs

88. System to supply music at ice-skating rinks sponsored by clubs.
89. P.A. for festivals, etc., sponsored by commercial clubs.
90. System for paging and music within clubrooms.

American Legion Posts and V.F.W. Posts

91. P.A. to amplify sponsored program events.
92. P.A. for music at sponsored skating rinks.
93. Permanent installations at fairgrounds and amusement buildings which they lease.

Commercial Ice-Skating Rinks

94. To supply music.
95. To amplify band music at far ends.
96. P.A. for announcement of hockey players' names, decisions, scores of other games, etc.

Roller-Skating Rinks

97. To supply music.
98. To amplify band music at necessary spots throughout rink.

Baseball Parks

99. P.A. system to announce scores of other games, explain decisions, etc.
100. Music system for entertainment between innings.

Local Entertainment Committees

101. Fake broadcast systems to be leased by local dealer.

HOW TO READ GRAPHS AND CHARTS IN RADIO WORK

(Continued from page 658)

is read as: x equals K times y plus C; a multiplication sign being understood to exist between those letters that have no sign placed between them.

These two equations are applied in practice in drawing calibration curves for voltmeters and various other instruments, in correcting for constant percentage errors (K), constant difference errors (C), or both together.

Let us suppose that we have a resistance of 20 ohms and we wish to plot a curve for current flow for voltages ranging from zero to 200 volts. By Ohm's law E=RI, or E=20I, which is of the same type as the general equation, x=Ky. Hence we can make the values of E the abscissas, and the values of I the ordinates, while 20 is the constant.

EXPONENTS AND GRAPHS

Curved lines require a more complex treatment than the above. These frequently represent algebraic *exponentials*, such as $y=x^2$, $y=x^3$, $y=x^4$, etc., or more involved variations on this form. (These equations are called exponentials because they contain x with the exponents 2, 3, 4, etc.)

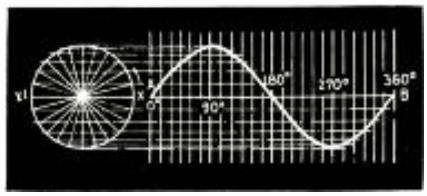
We might experiment with an exponential in the form of the equation, $y=x^2$. We'll have x vary from 1 to 10 and make up a table such as Table I consisting of the values of y for the given values of x. Thus, when we let x equal 1, y (in reality x^2) will equal 1; when x=2, y=4; when x=3, y=9; and so on. Having the various points determined by their x and y values we draw the curve (A) shown in Fig. 2, using the scales on the left and bottom of the chart.

It is known that the intensity of sound at given points varies *inversely* as the squares of the distances of these points from the source of the sound. An inverse square curve will represent this condition; that is to say; as x increases uniformly, y *decreases* as the square of x. Curve B of Fig. 2 illustrates this law. Here the energy received at a distance of one foot from the source was arbitrarily taken to be 100 units and the equation $y=\frac{100}{x^2}$ was used to make up Table II, from which the curve was plotted. Check the table by substituting whole numbers from 1 to 10 for x in the equation and then solving.

Let us now discuss a curve with which designers of P.A. systems are concerned. It is the "logarithmic curve," a special form of exponential. Consider Table III for the equation y=log x. In the first column we have a series of numbers (x) and in the second column their corresponding logarithms (y). It is seen that as we increase x in equal steps (from 1 to 10), y increases, but in gradually diminishing steps or increments. Notice that as we increase x from 10 to 100, y increases by the same amount as when x was increased from 1 to 10. Likewise when x is increased from 100 to 1,000, from 1,000 to 10,000, etc., y continues to increase by the amount of 1.0. This is a relatively smaller increase as x increases in magnitude. Figure 3 is a graph made from this table.

SEMI-LOG. GRAPH PAPER

Now we shall observe the manner in which the graph sheet of Fig. 4 is scaled off. The ordinates (y intervals) are uniformly divided but the abscissas are divided into decreasing intervals (as far as intervening distances on the graph paper but not the represented values are concerned) and the graph sheet appears to suffer an increasing compression as we read from left to right. These intervals are logarithmic—in other words, they are in proportion to the numbers in the right-hand column of Table III. This is called a semilogarithmic graph sheet, because one of the two coordinate axes is logarithmically divided. The curve plotted in this figure is



The formation of a sine "curve."

identical with the one in Fig. 3 but has been straightened out by virtue of the action of the logarithmically scaled abscissas.

We may ask wherein the value of this system of coordinates lies. We have already seen that one coordinate is compressed into smaller space; therefore, for a given space the graph sheet will embrace a bigger range of values in this coordinate without cramping the end of the curve containing the lower values. The log. system straightens out the more severe curves and often permits a clearer analysis of these functions. In these respects note Fig. 5, which is a transformation of curve B in Fig. 2 into this system.

For those who are interested in public address work a problem in both graph reading and construction is suggested. It is to draw the curve for the response of the ear to sound at various distances from the source. This can be done by a combined table from Figs. 4 and 5.

The procedure is as follows: In Fig. 5 read the sound intensities for different distances, and then in Fig. 4 (keeping the distances in mind) read the ear responses for these intensities. It is best to make a table of three columns in constructing the new curve, namely: (1) distance from source; (2) sound intensity; and (3) ear response. Columns 1 and 3 will then fix the points on the curve. Columns 1 and 2 are already given in Table II and column 3 can be made up by reading in Fig. 4 the ear responses corresponding to the intensities given in column 2.

We have noticed in Fig. 4 that a pure logarithmic function becomes a straight line in this coordinate system; and hence we may surmise that in plotting certain occasional performances approximating logarithmic functions on the semilog. sheet, that the variations in the curve from the true log. proportion will be more sensibly brought before our eyes.

Figure 6 is an example of a graph with a wide range put into a very compact but nonetheless legible form by plotting to semilog. coordinates.

This is a typical curve for the fidelity of reproduction of a vacuum tube amplifier.

THE DECIBEL AND EAR RESPONSE

This more recently applied unit known as the "decibel," or "db." so often applied in connection with radio and public address equipment, is a result of the phenomenon of ear sensitivity which we have just discussed. (Past issues of RADIO-CRAFT contain discussions of the decibel.—Ed.) Because the actual doubling of sound energy is not *heard* as though doubled, it is not usually practical to make comparisons of sound levels directly in terms of energy—the decibel is used instead. The definition of the decibel gives the reason for its use. Expressed in equation form, it is: $D=10 \log. \frac{Po}{Pi}$, where $\frac{Po}{Pi}$ is the ratio of power output to power input of an amplifier, this being converted into log. form to make the ratio proportional to ear response, and then multiplied by 10. D is the gain in decibels (db.). The decibel might, therefore, be thought of as a physiological unit.

Suppose we try to plot a curve for the formula, $D=10 \log. \frac{Po}{Pi}$, in order that we can tell at a glance the relationship between amplifier output, input, and the decibel gain. At first it would seem as though we had three variables to deal with, Po, Pi, and D, while the ordinary graph embraces no more than two. What is $\frac{Po}{Pi}$ but the *ratio* of output to input? Let us call this ratio x and make it variable, treating it as a separate unit. The result is

an equation in two variables that is easily plotted: D=10 log. x. This is similar in form to the equation for ear response, except that the factor 10 is introduced. This makes the ordinates (formerly y and now D) ten times as large as before; or, if you prefer, it makes the numbers in the scale of the ordinates ten times as large as formerly. Thus the graph is exactly like Fig. 4 except that the ordinate scale ranges from zero to 20 and is labeled "gain in decibels," while the abscissa scale simply has its label changed to "amplification" (ratio of output to input).

Try drawing the graph by passing a straight line through two points computed from the equation. Consider the ratio $\frac{Po}{Pi}$ as the variable, x, and its use will be entirely independent of whatever specific values go to make up the ratio numbers to be chosen for the abscissas of the two points. If any of the numbers shown in the left-hand column of Table III should be used, their logs. will be found opposite them. These multiplied by 10 will give the values of D corresponding to the ratio numbers chosen.

We might work out an example in plotting a point. At what value of db. gain will a point lie where the power output of an amplifier is 9 watts and its input is 3 watts? First, $\frac{Po}{Pi}=\frac{9}{3}=3$; then, log. 3=0.477; and consequently 10 log. 3=4.77, the value we desire. For values not shown in Table III refer to log. tables "to the base 10" as found in engineering handbooks or in the neglected algebra book hidden in the attic.

LOG.-LOG. GRAPHS

There are occasions in graph plotting, when both the abscissas and ordinates range between vastly extended limits. In such cases space can be saved by plotting the curve on full logarithmic paper. In this type both ordinates and abscissas are spaced at logarithmic intervals and this condition will cause no distortion of the curve as does the semilogarithmic.

The radio experimenter at times may wish to construct a sine curve, and do so without recourse to sine tables. Figure 7 illustrates how this is accomplished. First a circle is drawn with a radius equal to the height of the peak of the curve (maximum ordinate). Next the circle is divided into four quadrants and these subdivided by radial lines into any number of equal angles—the more angles, the greater accuracy obtained. Then line AB is drawn to the length in which one wishes to include one cycle, this line being an extension of the diameter, X¹X, and is divided into a number of equal parts, each division representing one of the angles into which the circle was divided. Draw perpendiculars through these dividing points and from the intersections of the radial lines on the circle draw lines parallel to AB. Starting from X and working around the circle in a counter-clockwise direction we note where these successive parallels intersect the successive perpendiculars as read from A to B. These points of intersection determine the path of the sine curve.

TABLE I

x	y(=x²)
1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100

TABLE II

x	y(=100/x²)
1	100.0
1.25	64.1
1.5	44.5
2	25.0
3	11.1
4	6.25
5	4.0
6	2.78
7	2.04
8	1.56
9	1.23
10	1.0

TABLE III

x	y(=log.x)
1	0
2	0.301
3	0.477
4	0.602
5	0.699
6	0.778
7	0.845
8	0.903
9	0.954
10	1.0
20	1.301
30	1.477
40	1.602
50	1.699
60	1.778
70	1.845
80	1.903
90	1.954
100	2.0
200	2.301
300	2.477

A COMPLETE, MODERN TUBE CHECKER

(Continued from page 663)

large and small base 6-prong tubes. The panel can be housed in an attractive manner convenient for use in a counter-type frame case as illustrated.

OPERATING INSTRUCTIONS

The circuit illustrates top views of the sockets showing standard R.M.A. numbering arrangement of contacts for various tube elements.

A. Connect plug to 60 cycles A.C. line. Turn tube selector switches to position MY. Turn filament switch to proper setting shown in the column. Insert tube in socket.

B. For short and leakage tests first turn Tube Selector switches to MY. Then turn Short Test switch through various positions. Positions designated 1-2; 5-6; etc., indicate that the test is being made between tube elements or socket terminals 1 and 2, or 5 and 6, etc., respectively. The neon light will glow brightly when a short occurs at any of the positions of the switch. A high-resistance leak is indicated by a dim glow.

Cathode leakage is tested by turning Tube Selector switches to AY and Short Test switch to "REG"; set shunt to O.

C. 1. For regular test turn Short Test switch to "REG." position.

2. Set Tube Selector switches to positions.

3. Adjust line voltage control.

4. Adjust shunt knob to charted position.

5. Press test switch. Meter will then indicate Poor-?-Good, depending upon tube condition.

6. Each complete set of elements may be tested individually in the combination type tubes. The chart shows two listings (a) and (b) for such tubes.

D. Rectifier tubes are listed on the chart with a prefix (R) for half-wave and (RR) for full-wave types. Test switch is *not* operated for rectifiers. The "2nd plate" switch is operated for full-wave rectifiers.

E. Diode sections are indicated as (d) in the chart. A single reading beyond the line marked "Diodes O.K." shows a good diode.

*Do not use the control-grid cap that extends through the panel. Use the special cap connector and plug it into terminal No. 2 of any socket.

**Use special cap connector and plug it into terminal No. 5 of any socket.

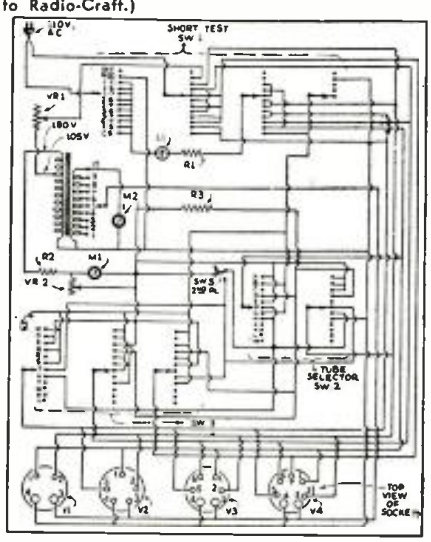
Note: S after number on any tube simply designates spray-shield tube.

LIST OF PARTS

One Dependable 305 panel, etched and dulled;
One Dependable 3¼ in. D'Arsonval meter, English-Reading Scale, M1;
One Dependable transformer, T1;
One line voltage meter, M2;
One rheostat, 500 ohm, VR1;
One tapered rheostat, 250 ohms, VR2;

Fig. 1

The complete wiring diagram. (An enlarged print of this circuit, and another illustration showing parts layout, is available; send 10c in stamps to Radio-Craft.)



Two insulating centering washers for rheostats;
One Dependable 412S selector switch, Sw1;
One Dependable 312 selector switch, Sw2;
One Dependable 212 selector switch, Sw3;
One Dependable 110 selector switch, Sw4;
One momentary S.P.D.T. toggle switch, Sw5;
One neon lamp and socket, L1;
One carbon resistor, .1-meg. R1;
One wire-wound resistor, 2,300 ohms, R2;
One insulated control-grid cap and lead;
Four molded sockets, V1, V2, V3, V4;
Six Dependable bar-type indicator knobs;
One cord and plug;
One external cap connector with resistor;
One case-counter or portable as desired;
Screws, nuts, washers, wire, as needed.

TABLE I

TUBE TYPE	FIL. SW.	SEL. SW.	SHUNT SETTING
00A	6	B	0
01A	6	B	50
(R)1-V	7	B	80
10	8	B	75
12A	6	B	80
14	9	AN	30
15	3	AN	0
17	9	AN	92
18	9	AN	80
19(a)	3	AN	90
(b)	3	MS	90
20	5	B	70
22	5	A	60
24A	4	AN	30
26	2	B	50
27	4	AN	91
29	4	AN	90
30	3	B	50
31	3	B	80
32	3	A	40
33	3	AN	87
34	3	A	60
35	4	AN	60
36	7	AN	0
37	7	AN	91
38	7	AN	80
39	7	AN	40
40	6	A	87
41	7	AN	80
42	7	AN	80
43	10	AN	90
44	7	AN	40
45	4	B	87
46	4	BO	85
47	4	AN	91
48	10	AN	92
49	3	BO	80
50	8	B	87
51	4	AN	60
52	7	AN	92
53(a)	4	AN	92
(b)	4	MP	92
55(a)	4	CN	50
(d)	4	DQ	0
55AS(a,	7	AN	40
(d)	7	DQ	0
56	4	AN	91
57	4	AN	0
57AS	7	AN	0
58	4	AN	60
58AS	7	AN	40
59	4	AN	80
64	7	AN	0
65	7	AN	40
67	7	AN	85
68	7	AN	90
69	7	AN	90
71A	6	B	85
*75(a)	7	CN	85
(d)	7	DQ	0
76	7	AN	91
77	7	AN	0
78	7	AN	65
**79(a)	7	AR	91
(b)	7	MO	90
(RR)80	6	F	75
(R)81	8	G	80
(RR)82	4	F	75
(RR)83	6	F	75
(RR)84	7	FN	80
85(a)	7	CN	70
(d)	7	DQ	0

TABLE I (Concluded)

TUBE TYPE	FIL. SW.	SEL. SW.	SHUNT SETTING
*85AS(a)	7	CN	90
(d)	7	DQ	0
87	7	AN	40
(RR)88	7	AN	75
89	7	AN	80
95	4	AN	80
(RR)98	7	FN	80
99	5	B	40
183	6	A	91
401	5	B	60
482A	6	B	85
484A	5	B	90
485	5	AN	91
486	5	B	80
586	8	B	87
841	8	B	0
864	1	B	40
*866	4	....	50
950	3	AN	87
951	3	A	40
(RR)985	6	FN	80
*1A6(a)	3	EO	75
(b)	3	CO	75
2A3	4	B	90
2A5	4	AN	75
*2A6(a)	4	CN	90
(d)	4	DQ	0
2A7(a)	4	AN	70
(b)	4	MS	91
6A4	7	AO	91
6A6(a)	7	AN	92
(b)	7	MP	92
6A7(a)	7	AN	70
(b)	7	MS	90
12A5	8	AR	80
12A7(a)	9	AN	75
(R) (b)	9	MV	80
2B6(a)	4	AN	70
(b)	4	BS	92
2B7(a)	4	AN	40
(d)	4	MQ	0
6B7(a)	7	AN	40
(d)	7	MQ	0
1C6(a)	3	EO	75
(b)	3	CO	75
*6C6	7	AN	90
*6C7(a)	7	BN	90
(d)	7	MQ	0
6D6	7	AN	70
6D7	7	AN	0
6E7	7	AN	70
2F7(a)	4	EQ	90
(b)	4	AN	60
6F7(a)	7	EQ	40
(b)	7	AN	50
6H7S(a)	7	AN	75
(b)	7	EQ	75
89RS(a)	7	AO	85
(RR) (b)	7	GU	80
25S(a)	3	CO	90
(d)	3	DQ	0
(RR)6Y5	7	HT	80
(RR)25Y5	10	GT	80
(RR)5Z3	6	F	85
(R)12Z3	9	B	85
(RR)6Z4	7	FN	80
(RR)6Z5	7	HT	80
(RR)12Z5	7	GT	80
(RR)25Z5	10	GT	80
(R)AD	7	B	80
AE	9	AN	93
(RR)AF	4	F	75
(RR)AG	6	F	75
GA	6	AO	90
G2S	4	DN	0
G4S(d)	4	DN	0
KR-5	7	AO	93
KR-20(a)	4	CN	60
(d)	4	DQ	0
KR-22(a)	7	CN	60
(d)	7	DQ	0
KR-25	4	AN	95
LA	7	AO	91
PZ	4	AO	91
PZH	4	AN	75
Wund A	4	AN	90
Wund Auto	7	AN	90

THE LISTENING POST FOR ALL-WAVE DX-ERS

(*Continued from page 667*)

HB-9B. The club asks for reports which should be sent to "Radio Kluh von Basel, Postfach Nr. 1, Basle, Switzerland."

THE NEW NICARAGUAN STATIONS

Two new short-wave stations in Nicaragua, our sister republic in Central America, have recently been heard. The first is YN-10P, owned by E. H. Andreas of Managua, Nicaragua, and announcing as the Voice of the Lakes, or La Voz de los Lagos. This station was heard approximately on 6.380 kc. This station seems to be on nightly although at times it has very poor signal strength. Announcements are always made in Spanish.

The second station was heard at 7:15 p.m., E.S.T., tinkling out a little tune on an old-fashioned music box, after which the announcer plainly stated in perfect English that this was station YNE, located at "Bragmans Bluff," in Puerto Cabezas, Nicaragua. This station came in higher in frequency than YN-10P or about 6.400 kc. Puerto Cabezas is a small port in the heart of the mahogany forests of Nicaragua.

CP9 A SELDOM HEARD STATION

Station CP9 is one of the group of short-wave commercial stations owned by the "Compania Radio Boliviana, of La Paz," and is located at Oruro, Bolivia. This station is on from 7:30-8:30 p.m., E.S.T., on a frequency of 5,550 k.c., 54 meters. It has a power of 200 W.

CT2AJ CHANGES FREQUENCY

Station CT2AJ, located at Ponta Delgada, in the Azores islands, a real DX catch, has changed its frequency to 4002 kc. to avoid the code QRM on its former frequency. It now broadcasts from 5:00-7:00 p.m., E.S.T., on Wednesdays and Saturdays, which should make it considerably easier to pick up, at least along the Atlantic seaboard.

Stations RNE and RKI, 12,000 and 15,000 kc. respectively, of Moscow, U.S.S.R., are testing early in the mornings quite frequently of late.

THE DX-ERS CONTEST RULES

Here are the simple rules to follow in competing for the valuable awards given each month for the DX-ers Contest.

1—Send your written verification from the greatest distance on any wavelength to DX Contest Editor, RADIO-CRAFT.

2—Send a clear glossy photo of your listening post with your verification.

The following conditions will be weighed by the judges in awarding the prizes: (1) The most recent date of verification received; (2) The greatest distance from transmitter to receiver; (3) The power of the transmitting station at the time when reception was recorded. The decision of the judges will be final. Verifications will be returned, but we assume no responsibility for their loss. Register your letter and send stamps to cover return registration, to avoid chance of loss.

In this month's contest the first prize will include a complete complement of tubes for your particular set model (if a manufactured receiver) up to eight tubes. If your set uses less than eight tubes, duplicates of the types used will be supplied to make up the total of eight. If the winning set is homemade, tubes specified by the winner for his set will be sent.

The second prize, a doublet antenna kit, includes the standard layout supplied by the donating company.

HAVE YOU A RADIO-CRAFT INDEX?
Covering the issues from July 1929 to June 1932—this index will save you considerable time and money. Send 25c in stamps or coin for your copy.

NEW HIGH-QUALITY REPRODUCERS

(*Continued from page 662*)

reproduction. The load capacity of this type speaker is 10 watts and the field requires 18 watts excitation. Models are available with and without input transformer and with various field resistances both D.C., and A.C. with rectifier.

The larger type, with 13¼ in. cone, is available for large area service. This design is for all types of P. A. service where the finest reproduction and the utmost efficiency are necessary requisites. This larger type will withstand peak inputs up to 25 W.; field excitation is 30 to 35 W. With the incorporation of the special bass compensation device in this speaker, an over-all response is obtained superior to others at the same power handling capacity, with an exceptionally fine audio balance. Models are available with or without input transformers and with various field resistances both D.C., and A.C. with rectifier.

RADIO-CRAFT'S INFORMATION BUREAU

(*Continued from page 675*)

the transmission system were arranged with two 'electrical ears,' in approximately the same relative position to each other and to the source of sound as for a listener standing at the particular point, and the electrical counterpart of the sound transmitted to the corresponding ears of the remote listener in the proper phase and pressure relation, then the listener would have the sensation of actually being located at the point of sound pick-up.

"The schematic diagram, Fig. Q.323, shows the essential elements of the system. The listener uses headphones, but each receiver is connected to the corresponding channel. The microphones are located 6 to 10 ins. apart with the diaphragms facing outward. Preferably there should be some acoustic insulation between the microphones. Microphones, amplifiers, and receivers must be accurately balanced as to over-all gain and phase relationships. Substantially identical amplifiers may be constructed by the experimenter without a great deal of difficulty and in all probability commercial microphones and receivers of the same type will be sufficiently alike to cause no difficulty. Repeating the same sentence at a specified distance from each microphone in turn, while observing the output of the channel on a volume indicator or rectifier-type voltmeter, is a satisfactory test for volume balance."

QUESTIONS ABOUT TUBES

The following should answer any and all questions about tube characteristics and applications: "Technical Tube Manual," published by Hygrade Sylvania Corporation, Emporium, Pa., 100 pages, completely illustrated. Price 10c.

"New Technical Data (Tubes)," a complete characteristic chart, with socket connections, of all tubes, 23½x11 ins. For wall mounting or file. Furnished gratis by Raytheon Production Corporation, 30 East 42 Street, New York City; 55 Chapel Street, Newton, Mass.; 555 Howard St., San Francisco, Calif.; or 445 Lake Shore Drive, Chicago, Ill.

"RCA Cunningham Radiotron Tube Manual," a 154-page book with separate 22x17 in. chart, fully illustrated, with complete characteristic and application data. Published by RCA Manufacturing Company, Radiotron Division, Harrison, N.J. Price 25 cents.

"National Union Characteristic-Interchangeable Chart." A most remarkable compilation of data on over 200 tubes, regardless of make, competition, or age. An "unbiased" replacement chart which should be in the hands of every Service Man. Size 16x28 ins., with holes punched for insertion in a binder. Published by National Union Radio Corp. of N.Y., 600 Madison Ave., New York City.

(Be sure to enclose postage when asking for gratis literature.)

INTERNATIONAL RADIO REVIEW

(*Continued from page* 670)

type 50 tubes. Resistance coupling is employed here, also, so that the only transformer in the entire amplifier is the speaker coupling unit.

In some independent tests made by a research lab. for the above-mentioned magazine, it was found that the phase angle of the potentials fed to the 56 tubes was extremely close to 180 degrees over the entire A.F. spectrum, that the potentials applied to the grids of the 56 tubes by the phase-reversing circuit were also identical within very close limits, and the response of the entire amplifier was really flat over a band from 30 to 10,000 cycles (the variation between 50 and 7,500 cycles—the American standard of high fidelity—was less than 1 db.)!

This amplifier, using class A methods throughout is a fine standard for P.A. experimenters to follow. We wish to compliment WIRELESS WEEKLY on their fine engineering job.

A P.A. CAR INSTALLATION

PORTABLE P.A. installations, in cars, trucks, etc., have found many uses for advertising and other purposes.

A commercial P.A. unit for installation in a standard sedan-type car is shown in Figs. C and D. This unit is of French origin, having appeared in MACHINES PARLANTES ET RADIO.

As shown in the illustrations, it consists of a double bell type speaker, mounted on the roof of the car, two cabinets, one containing the amplifier and phonograph turntable and the other the complete power supply, and a microphone with a long flexible mounting (similar to the goose-neck lamps) which is secured to the roof beams or the molding over the windshield.

This installation is particularly suited to the coach-type of car, in which the right-hand front seat is easily removed. The amplifier and power boxes then occupy this space.

A NEW 20-WATT HIGH-QUALITY AMPLIFIER

(*Continued from page* 665)

ohm plate load, but as this condition is not usually encountered in practice, the rating may be considered as 16 watts with a 500-ohm load, having only 5 per cent harmonic distortion.

Because of the absence of interstage transformers, the frequency characteristics of this amplifier are unusually good. With the permalloy type output transformer, the response varies less than ½-db. from 30 to 15,000 cycles, being down only .7-db. at 17,000 cycles and 1-db. at 20 cycles.

A LOW-COST PREAMPLIFIER

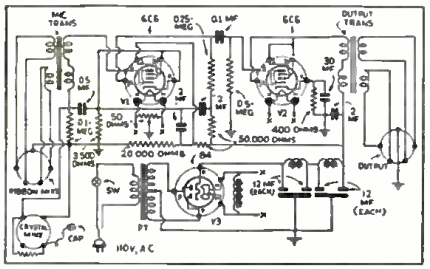
(*Continued from page* 662)

Electrons flowing along a wire jostle each other and create a noise level of about —140 db. Electrons flow through vacuum tubes with far greater turbulence creating a noise source much higher. The maximum gain that may be employed in a preamplifier is determined by the electron noises in the tube circuits. Since to handle a microphone of —90 db. requires a preamplifier gain of about 40 to 50 db., the designer is compelled to work on the verge of the tube noise, and his problem is to obtain economically the utmost quiet in tube circuit performance.

When A. C. is used, the problem of hum is introduced. While its solution in most cases heretofore has resulted in a separately located power supply, in this amplifier the power supply is self-contained. This has been made possible by use of special audio transformers that are balanced against external fields both magnetically and electrically, but which nevertheless are double-shielded with special transformer iron boxes nesting within each other to form a double barrier to external fields. The net result is an A.C. amplifier that is far quieter than any battery amplifier the writer has ever heard, when the battery amplifier is placed in the vicinity of other apparatus which is A.C. operated. The measured output noise level is equivalent to —120.93 db. at the input, assuming zero level as 6 miliwatts. The gain is 51.1 db. at 1,000 cycles. That this quietude may be obtained without sacrifice of fidelity is evident from the fact that the response curve is flat within 1 db. from 50 to 12,000 cycles; is up only 1 db. at 13,000 and down only 3 db. at 30 cycles.

Incidentally, provision for a crystal microphone will be noted on the circuit diagram and the general shape and compactness make it ideal for any class of P.A. or broadcast work either as a studio or remote amplifier.

"Bilaterally-wound" transformers in this preamplifier eliminate hum.



HIGH-FIDELITY REPRODUCTION FROM RECORDS

(Continued from page 669)

000 cycles without the annoyance of needle scratch.

Long-playing records, making use of slower turntable speeds and closer spacing of the grooves on the records, have been available in the old type records for several years. They have never been successful due to several factors.

First of all, the lower frequencies were severely attentuated on them due to the close spacing of grooves. The high frequencies were also attentuated due to the slower speed of playing. The general volume level of these records was lower, too. (It is necessary to turn up the volume of the reproducing equipment to get the same sound level as with the shorter playing records.)

The net result of this is the introduction of a higher needle scratch level. With so many objections, it is no wonder that these records never met with great favor.

Hill-and-dale recordings due to certain fundamental differences suffer from none of these disadvantages. It is possible to make a slow-speed, closely-grooved record without impairing the high or low frequencies. The volume level of the record can be just as high as with the short-playing record and there will be no more record wear than with ordinary records. With the old style short-playing lateral cut record there are about 98 grooves per inch. With the hill-and-dale system it is possible to increase this figure to somewhere between 125 and 150 grooves per inch, and at the same time record at a higher level than was used on the short-playing lateral-cut record!

By recording at the same level as used on the lateral-cut record it is possible to record 200 grooves per inch with no loss in fidelity of response. This means that a 10-inch record played at 33 r.p.m. will play for 10 to 12 minutes on each side. A 12-inch record will play for 15-20 minutes per side.

Due to the fact that it is feasible to record at higher levels with the hill-and-dale system it follows that a much greater volume range can be handled. It is not so necessary to monitor musical performances to an even level of sound when recording. As a result recordings can be made in which the contrasts between loud passages and soft are more lifelike than is the case with lateral-cut records.

A further advantage of these records due to the light weight of the pickup and the fact that a permanent needle is used is that they can be played thousands of times with no appreciable wear on the records. The recording material generally employed is cellulose acetate.

The pickup employed is of the "magneto-dynamic" type; the same principle is utilized in this pickup as in the common dynamic speaker for this pickup has a voice coil in place of the usual balanced armature arrangement found in the ordinary lateral-type pickup, and a permanent magnet supplies the field flux. (See Fig. 2.)

It is unfortunate that so little commercial use has been made of this vastly superior recording and reproducing system. It exceeds the R.M.A. high-fidelity standard and does not miss by very much the *real* high-fidelity standard (mentioned in the first paragraph of this article), and even exceeds the range (30 to 8,000 cycles) encompassed by modern so-called "high-fidelity" *film* recordings.

So far, the only commercial use being made of it is in the field of electrical transcriptions for broadcast purposes. The World Broadcasting System, a producer of these transcriptions is the only concern employing this system.

In closing, comment is made concerning the "telegraphone" (as it is generally called) system of recording sound on a moving metal strip susceptible to magnetic influences. In the past, radio programs from England utilizing the "Blattnerphone" represented the finest that could be offered in "magnetic wire" recordings—yet, fidelity was low and noise-level high; recently, the writer has noted B.B.C. magnetic-wire programs of *greatly* improved character.

A WIDE-FREQUENCY MAGNETIC PHONO. PICKUP

(*Continued from page 664*)

frequencies have a greatly reduced amplitude. For standard recording at 78 R.P.M., the maximum safe amplitude is considered .002-in., and if this occurs at 250 cycles, the amplitude at 5,000 cycles would be .0001-in. for constant voltage output. Since for very low frequencies on the order of 40 or 50 cycles per second, the amplitude would be greater than .002-in., it is necessary to reduce the amplitude to prevent cutting side walls between adjacent grooves, and the result is a decreased voltage output for frequencies below 250 cycles. In order to compensate for this deficiency, it is necessary either to peak the amplifier used for reproduction, or to so design the reproducing pickup that it in turn is more efficient at the lower frequencies.

Since the recordings are made in such a manner that, inasmuch as is possible, constant velocity is maintained for all frequencies, then in order to reproduce in the same manner it is essential that a magnetic generator be used as the pickup. This is true because the voltage output of any magnetic generator is proportional to the velocity of movement of the armature. This condition is not true of any other type pickup whose voltage generated depends entirely upon the amplitude of movement. Therefore, for ultimate results insofar as constant voltage output is concerned, a magnetic generator is best.

An important consideration is the length of record life possible. The two essential requirements for a pickup to insure long life is a needle pressure as light as possible, and very low mechanical impedance of the needle point. Directly concerned with the two last-named requirements is the natural resonant period of the armature assembly.

"NATURAL RESONANT PERIOD"

The armature assembly consists of the armature proper which is pivoted in some manner, the needle, and the needle screw. All moving objects have a frequency at which they move with great ease. This is known as the "natural resonant period," and this fact accounts for the high peak usually found in pickup designs which occurs at 3,000 or more cycles. It is desirable to so design this armature assembly that the resonant period will be as high in frequency as possible. It is extremely difficult, however, to get so high that it is beyond 5,000 cycles, and therefore is well within the reproducing range.

The result of this resonant period is a greatly increased voltage at the resonant frequency, and a greater voltage for 1,000 or 2,000 cycles on either side of the peak frequency. The result to the ear is a very unnatural, unpleasant hissing, and is especially bothersome on voice reproduction where certain screeching effects are noted. The background noise of the record is also greatly increased, making itself evident by high unpleasant hiss.

In order to reduce this resonant peak as much as possible, it is necessary to apply some dampening material to the armature, and in addition to the function of dampening, this material must center and maintain the armature blade in the magnetic gaps. It has been found that the greater the needle pressure applied to the record, the higher in frequency the resonant period becomes. It is also true that the greater amount of dampening applied to the armature, the less bothersome this peak becomes. However, the direct result of both of these attempts at improvement is excessive wearing on the records due to the greater needle pressure and increased mechanical impedance. For good performance and minimum record wear, the needle pressure should not exceed 3½ ounces, and the mechanical impedance should be low enough so that the pickup rides without hesitation the lowest frequencies recorded.

Another portion of the completed pickup which is usually given little consideration is the arm and base design. Ordinarily the greatest thought is given to appearance and finish, but the arm should primarily be designed as an integral part of the reproducing mechanism, since it does have a very pronounced effect on the reproduction. Just as the armature assembly has a resonant period, the arm assembly also has one which occurs at a much lower frequency, however, usually well below 200 cycles.

It is also important that a material be used in the arm construction which is in itself dead and nonresonant. Such materials are copper, aluminum, and zinc or lead. In addition to using material of this type, it is essential that the arm be well braced to further increase its rigidity. As in the case of the armature assembly, when an arm is highly resonant the voltage output at that frequency is greatly increased, and in addition, a resonant arm at low frequencies is exceptionally wearing on the records themselves. The reproduction also is impaired since the bass response is not as smooth as it should be.

HIGH FIDELITY SERIES

These desirable qualifications have been incorporated in this new pickup design. The design of the armature assembly at 3½ ounces needle pressure is such that the resonant period occurs at a high frequency. In addition to this feature, a dampening material is used which effectively reduces the natural period to a degree wherein it is no longer bothersome in the output voltage.

The use of a braced aluminum arm design is responsible for increased bass response, as well as the absence of any resonant effects usually obtained. The arm is constructed entirely of aluminum and is well braced to prevent any marked resonant effects. The dampening material is such that even though the armature is well dampened and the peak removed by it, the mechanical impedance at the needle point is very low and this pickup rides and reproduces faithfully all frequencies from 46 cycles up, at 3½ ounces needle pressure. This pressure is suitable for both 33⅓ and 78 R.P.M. records.

An additional advantage is the fact that the pickup is inherently light and this needle pressure is not obtained by counterbalancing. A counterbalanced pickup, while maintaining a proper needle pressure, offers a very great inertia effect to the vertical rise and fall of a turning record. This is not desirable, since it in turn causes a wavering in the intensity of the background noise.

VOLUME CONTROLS

In the majority of present-day audio circuits the input device, such as the pickup, is worked directly into the grid circuit of the first audio tube. This is highly desirable because it eliminates an otherwise troublesome factor of properly controlling volume.

Where a transformer is used to couple the pickup to the audio tube input circuit, in order to obtain an evenly attenuated frequency response at any volume level, it is necessary to use a potentiometer across the secondary of the transformer, connected so that there is constant impedance reflected to the pickup, or a constant impedance pad of some type across the pickup and transformer primary. The latter is expensive and seldom used for ordinary purposes. Where a potentiometer is used across the secondary, in order to reflect a proper impedance value to the pickup, the value of this control must be high and this fact, in addition to the use of a transformer invariably induces hum difficulties due to the picking up of stray magnetic fields. Where a pickup is worked directly into the grid circuit, a potentiometer is satisfactory and should be connected so that it gives constant impedance to the pickup winding.

The total resistance of such a control is usually approximately 10 times the impedance of the pickup itself at 1,000 cycles. In other words, if the pickup has an approximate impedance of 10,000 ohms at 1,000 cycles, the potentiometer should be 100,000 ohms. A smaller value than this will result in reduction of the higher frequencies, and a greater value increases the high-frequency response.

The use of a shunt rheostat, either with pickup direct to grid circuit, or transformer, always attentuates high frequencies out of proportion to low, and is not recommended. A potentiometer, likewise when used on the primary of a transformer, will decrease bass response at low volume levels. A potentiometer, to function properly, must be connected so that the total impedance offered by it be worked into by the pickup or transformer secondary, and the variable impedance section go direct to the grid and cathode.

OPERATING NOTES

(*Continued from page* 671)

that was giving the trouble, put it on the leakage tester—and there was all the trouble. This condenser is a mica bakelite-cased unit, capacity .01-mf. I replaced it with a 400 V. paper condenser and it was once more doing nicely but in about a week the same trouble developed on the other machine and that one was also replaced with a paper condenser and everything has been going smoothly ever since.

And by the way, this amplifier was a new unit having only been installed about 30 days. Of course the sales company paid the service charges on the two jobs.

The only reason that I can think of for those two condensers to break down, is because of the heat dissipated in the steel cabinet housing the amplifier. I wouldn't vouch for the truth of that statement, though.

WILBUR M. JACKSON

A 7½ W. P.A. AMPLIFIER

(*Continued from page* 662)

sponse from 50 to 10,000 cycles is part of the regular equipment furnished with the system.

The speakers, one of which is shown in the illustration here, are equipped with aluminum flares which act as both baffles and projectors to throw the sound into the room. Convenient, adjustable brackets are also provided with the reproducers to permit easy mounting on a wall and to permit adjustment of the direction of projection. This is important in keeping down acoustical feedback.

The flexibility and ease of handling this equipment should make it particularly attractive for any small- or medium-size installation, whether it is permanent or just a "rental."

A "BOOM-SOCKER" AMPLIFIER

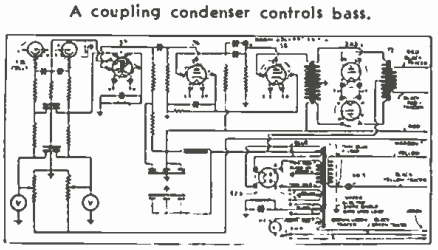
(*Continued from page* 662)

speaker, and the output line will handle from one to six speakers, including "Woofer" and "Tweeter" units for wide range, high fidelity sound.

Among the new and exclusive features of this amplifier is dual volume control, which automatically regulates the photo-cell voltage and which provides independent volume control for each projector. This serves to equalize the output from both projectors so that, despite any differences in the projector soundheads, there will be no difference in volume when changing over from one projector to the other. Built-in meters indicate the photo-cell voltage applied to each photo-cell, and serve as visual volume indicators for each projector.

A new "boom socker" tone control circuit (see diagram) is used which enables the operator to emphasize the base or low-frequency response without cutting down the high-frequency response, as is done in the usual type of tone control used in amplifiers and radio sets. This is accomplished by changing the coupling to permit greater transfer of low-frequency energy and by the very liberal use of high-capacity condensers and filter circuits to prevent attenuation of any portion of the frequency spectrum due to degeneration or impedance mismatch.

A coupling condenser controls bass.



MEMBERS' FORUM

(*Continued from page 644*)

33, 46, 47, PZ, Socket 1, Sw1 in pos. 2.
19, 79 Socket 3, Sw3 in pos. 2, "X."
53, 6A6 Socket 2 Sw1 and Sw2 in pos. 2.
5Z3, 80, 82, 83, 83V, 84, G2S, G4S, tested in Socket 3, "X."
81 Socket 3.
12Z3 Socket 3, Sw4 in pos. 2.
"X" indicates that to obtain a reading of the opposite part of the tube it is necessary to snap the "2ND PLATE TEST" switch to position 2.

LEO ZIMMER
63 Russell Street
Canisteo, N.Y.

AN ODD CASE

RADIO-CRAFT, ORSMA *Dept.*:

I have just finished a repair job that I believe is most unusual.

The set is a General Electric, Model T41, which would go dead if a light was switched on or if anyone walked near it. It would crackle and sputter before going dead just as if it had a loose connection.

Yet after a rigid inspection of the wiring, nothing was found wrong, not even a stray strand of wire. I checked the tubes and speaker and noticed while checking the tubes that there were no breaks in any of the power circuits. I bent the wiring cables back and forth while checking which, of course, proved that the trouble was in a circuit carrying no current.

I then gave the tuning circuits and all other circuits carrying no current another close inspection and found nothing. I was beginning to get discouraged when I saw a gleam of light reflected from the variable condenser. Bringing a light closer, I discovered what caused it. Every plate on the four section condenser was covered with a fine steel or iron powder, evidently chips from drilling or filing. After cleaning them out with a pipe cleaner and a vacuum cleaner, the set worked normally.

The customer claims that the set has acted like that from the time he bought it. I was also told that other Service Men were called at different intervals and could not account for it. They had gone over the set closely, as I did, but did not locate the trouble because the chips were invisible unless you happened to look at the condenser from a certain angle, being the same color as the plates.

In my estimation, the fault was the manufacturer's. As I look at it, the condensers have a thin coating of oil on them when new, and the condenser was probably drilled for the compensators. The chips falling inside were held fast by the oil film and as the oil dried out the vibration of the speaker and cabinet scattered them into the plates where they caused intermittent short circuits.

I have never heard of a similar case but perhaps other members of the ORSMA have encountered the same problem.

RAY GOLDING
1722 Decatur Street
Brooklyn, N.Y.

HOW SPEAKER FIDELITY IS INCREASED BY AN "ACOUSTICAL LABYRINTH"

(*Continued from page 665*)

ing absorption of the conduit walls at the higher frequencies.

By thus preventing discharge of sound into the interior of the cabinet, the usual boomy effect of cavity resonance is eliminated and other advantages are gained, one such being an increase of power-handling ability at low frequencies due to the better diaphragm loading afforded by the conduit. The response characteristic of this system over the frequency range, when mounted in a cabinet, *is superior to that of the same speakers in a flat baffle of equivalent size!*

As pointed out by Mr. Lurie in this issue, the "acoustical labyrinth" or "infinite baffle" system of reproducer operation has extensive application in not only radio but also "P.A."

COYNE SCHOOL CELEBRATES

It may surprise many that one of the oldest institutions of its kind, the Coyne Electrical School, celebrates its 35th birthday this year. President H. C. Lewis celebrates the occasion by announcing a new course in electrical refrigeration and air conditioning to round out many specialized courses in radio and electricity.

Starting purely as an electrical school, 35 years ago, Coyne took on successively radio, then television, and all the allied radio arts during the past ten years. During the course of its existence, Coyne has turned out thousands of successful men. It has graduated as many as 25,000 students a year.

MODERNIZING STANDARD P.A. AMPLIFIERS

(Continued from page 666)

The reason for placing it in this position is to secure quiet signal control.

The second tube is a 77 connected as a triode. (Its plate, screen-grid, and suppressor-grid are tied together to function as the third element of the triode arrangement.) This surprising circuit secures a voltage amplification of 35 with a relatively low plate impedance. An output transformer with a tapped secondary permits coupling this tube to a 200-, 400-, or 500-ohm line. A capacity coupling to a high-impedance grid circuit is also provided. When using the high "Z" connection the output transformer functions as a plate resistance.

A stage-by-stage analysis indicates an over-all gain of 70 db., resulting from a voltage gain of 100 in the first tube multiplied by a gain of 35 in the second tube; 20 x log of 3,500 indicates a db. gain of 70.9, for all practical purposes 70 db. With the input circuit shorted and the volume control on full the hum level is 1 per cent of the total gain. The power supply utilizes a type 80 tube, 2 chokes, and 26 mf. filter capacity. In addition to the chokes, series resistors are used to help filter the plate current. The chokes are mounted with their cores at right angles and beyond the magnetic field of the power transformer. A 50,000-ohm resistor serves as a bleeder across the plate supply to the 77 tube—a function which greatly stabilizes the amplifier. The cathode bias resistors of each tube are bypassed with 25 mf. electrolytic condensers. These large condensers further prevent any tendency of "motor-boating," which is common in amplifiers having an extremely high gain.

The frequency response varies less than 3 db. from 40 to 9,000 cycles. A 4-prong tube socket serves as an input jack. A 5-prong socket is used as an output jack. Hence, when the proper connections are made to a plug for a microphone input and the desired output, there is no further possibility of error in making the connections.

The volume control carries the power switch and a ruby pilot light glows while the pre-amplifier is operating.

This unit opens up an excellent market for P.A. men who wish to sell new microphones and a preamplifier to their clients who now have a good standard amplifier. This type of unit is easy to demonstrate and shows a marked improvement in the output tone and volume of any amplifier to which it is connected.

HATRY & YOUNG, INC.

Of interest to our Connecticut Yankee readers is the recent announcement that those old-timers in radio, Hatry and Young, have opened a branch store at 86 Meadow St., New Haven, Conn. Well, here's wishing them lots of well-deserved good luck!

TECHNICIANS' DATA SERVICE

(Continued from page 678)

72. HALLICRAFTERS' SKYRIDER SHORT-WAVE RECEIVERS. Descriptions of the Skyrider tuned R.F. and Super Skyrider superheterodyne short-wave receivers designed and built by Hallicrafters, Inc. Features: range of 13 to 200 meters (with broadcast or 10-meter band optional), automatic wave-change switch, continuous band-spread, built-in monitor, speaker and power supply (or batteries), high-fidelity audio, and other refinements.

73. HETRO HOME AND AUTO-RADIO RECEIVERS AND ACCESSORIES. A folder containing descriptions, illustrations, list and net prices of the Hetro Electrical Industries, line of console, phono-radio and table-model home radio receivers, auto-radio sets, phonograph automatic record changers and motors, antenna systems and D.C. converters.

74. SPRAGUE 1935 ELECTROLYTIC AND PAPER CONDENSER CATALOG. Gives specifications, with list and net prices on a complete line of wet and dry electrolytic, and paper condensers made by the Sprague Products Co. for radio Service Men, set builders, experimenters and engineers. Information on the Sprague Capacity Indicator, for making capacity tests on condensers and in servicing receivers, is included.

75. SPRAGUE TEL-U-HOW CONDENSER GUIDE. A valuable chart, compiled by the Sprague Products Co. which tells the proper types, capacity values and voltages of condensers required in the various circuits of radio receivers and amplifiers, and how to locate radio troubles due to defective condensers. Includes data on condenser calculations.

76. FACTS YOU SHOULD KNOW ABNUT CONDENSERS. A folder, prepared by the Sprague Products Co., which explains the importance of various characteristics of condensers, such as power-factor, leakage, capacity and voltage in determining the efficiency or suitability of a given condenser to provide maximum filtering and safety in operation.

A 6B5-TUBE AUTOMOBILE P.A. AMPLIFIER

(Continued from page 660)

convenience of the amplifier.

One very important feature, which lowers the nominal operating current consumed by the amplifier when not in actual service, is the use of two power switches, one controlling the filament circuits, and the other controlling the input side of the genemotor which supplies the "B" power for the plates of the amplifying tubes, both switches are equipped with pilot lights. Thus, during a period when no records are being played, and the microphone is not in use, it is a simple matter to put the generator switch to the "off" position, the pilot light will go out, and the drain of the generator will be removed from the battery. At the same time, the filaments will remain heated and be in condition for immediate operation as soon as the generator switch is thrown.

CIRCUIT

The circuit is very interesting from the standpoint of simplicity and efficiency in operation. (Mechanically, this amplifier will stand up under conditions which would cause even good automobile radio receivers to fail.) Four tubes are used, but in operation they are equivalent to 8 tubes. The voltage and power amplifier stages are resistance-capacitively coupled, and the circuit is a true push-pull arrangement throughout, both as to voltage amplifiers and as to the power stage. (This type of circuit was pioneered several years ago by the writer, and has been widely copied, as the real advantages of such an arrangement have proved their worth in commercial type equipment many times over.)

The first tube is a voltage amplifying tube using a 6A6 in push-pull, resistance-capacitively coupled to another 6A6 tube also in push-pull arrangement. The output of this second amplifying stage is coupled to a pair of the new 6B5 output power tubes. (This output stage by the way, is one of the most interesting

HOW TO MAKE A P.A. BEGINNERS' A.C.-D.C. PUBLIC ADDRESS ADAPTER

(Continued from page 653)

sistor results in maximum life for the electrolytic condensers.

The most difficult feat in an arrangement of this sort is to prevent an undue amount of hum component appearing in the output of the adapter.

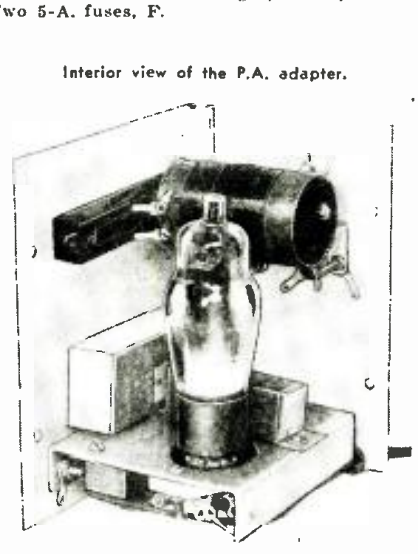
Consequently, a "crystal" (bi-morph crystals of Rochelle salt) microphone was selected as it could work directly into the grid of the pentode section of the 12A7 without need for a matching transformer (the use of which would tend to cause hum-coupling due to the leakage-field of its iron core).

For D.C. operation from a 110 V. power line the two ganged S.P.S.T. switches Sw. 2 are closed, thus completing the circuit to the rectifier section of the 12A7; this connection serves to eliminate the strong D.C. ripple voltage that exists on the average D.C. power line. Unfortunately, the 12A7 tube as at present made does not here permit use of the rectifier section during A.C. operation. Therefore, if the P.A. adapter is to be operated in conjunction with an A.C. radio set, switch Sw. 2 is turned to "off," and the "B" voltage is then obtained by running a lead from adapter post "B+" to a high-voltage D.C. source (usually, a screen-grid tap secured by means of a wafer adapter) within the radio set. For operation on batteries, switch Sw. 2 remains open; a "B" battery supply of 90 to 135 volts connects to terminals "—" and "B+" in the adapter; and a 12 V. "A" battery is connected to posts "+" and "—".

LIST OF PARTS

One Blan aluminum cabinet, 5x6x4 ins. deep;
One Blan R.F. coil, center-tapped, L1;
One National Union type 12A7 tube;
One socket for type 12A7 tube;
One Ohmite 5-meg. resistor, R1;
One Ohmite 3,000-ohm, 1 W. resistor, R2;
One Ohmite 500-ohm, 1-watt resistor, R3;
One power cord, 365 ohms, R4;
One variodenser, 500-mmf. size, C1;
Two Aerovox paper condensers, 0.1-mf., C2, C6;
One Aerovox dual electrolytic condenser, 2-8 mf., C3;
One Aerovox electrolytic condenser, 50 mf., 35 V., C4;
One Aerovox mica condenser, 100 mmf., C5;
Two press-type binding posts, "Ant." and "Gnd.";
Three press-type binding posts, "B+", "+", "—";
Two tip-jacks, "Mic.";
One Turner crystal microphone, with banquet stand;
One off-on switch, Sw. 1;
Two S.P.S.T. switches, ganged, Sw. 2;
Two 5-A. fuses, F.

Interior view of the P.A. adapter.



GOOD NEWS ABOUT THE 1935 OFFICIAL RADIO SERVICE MANUAL

—this new volume is now ready for delivery. Turn to the announcement on page 694 of this issue, and read full particulars about this book.

developments in the line of new tubes to appear in the last two years.) It was possible to increase the overall sensitivity by using a voltage gain tube in the second audio stage without worrying about considerations as to input power loss, grid current, and other factors which would increase the cost and perhaps decrease the operating efficiency of the amplifier as a whole. (See RADIO-CRAFT, April 1935, page 590.)

How well this system of push-pull amplification in conjunction with triode tubes resistance-capacitively coupled, works out, is shown in Fig. 2, where the frequency characteristic covering the spectrum from 40 to 10,000 cycles is indicated. It will be noted that this curve is made at the approximate maximum power output level of the amplifier, thus indicating the operating frequency characteristics at high power level. It will be noted that this is not actually the maximum power output because the amplifier can be driven to greater power level with a slightly higher percentage of distortion.

The input plates of the two 6B5 tubes hook into a specially-designed output transformer having a primary impedance of 10,000 ohms, center-tapped. The two secondary windings, one with a 500 ohm impedance, and a universal low-impedance tapping arrangement, permits the matching of speaker impedance at 2, 3, 4, 6, 7, 8, 10, 12, 13, and 15 ohms. This very flexible feature enables the use of a 500-ohm transmission line with auto transformers, or suitable line-to-voice coil transformers mounted on speakers, or permits direct lines to be run at low impedance to the speakers used with the amplifier. All of these connections can be obtained from the terminal strip mounted on the front of the amplifier, between the two power control switches, thus making all speaker connections easily available at all times. Directly above the terminal strips, as will be noted in the photograph of the amplifier, is located the tone control which is so useful in microphone work, and also serves the purpose of a scratch filter for record reproduction,

CONTROL BOX

The control box is a very compact affair, housing the microphone transformer, volume control, mike current battery, microphone cable plug receptacle, phonograph pickup, tip jack connector, and phonograph microphone throw-over switch. The volume control is located on the short end of the case, which is mounted on the steering column directly under the right-hand driving position of the driver.

The small toggle switch enables the operator to throw from microphone to phonograph instantaneously and as the distance between the control knob and the switch is approximately 1 in., it is at once apparent that it is easy to make any volume level adjustments necessary with great ease. The control box cable consists of two wires in a shield, with a male receptacle plug on the free end of the cable which, in operation, is plugged into the three-way female receptacle on the side of the amplifier.

The high voltage gain of 80 db can be traced to the use of the high-mu triodes and the excellent power sensitivity of the 6B5 output tube. Needless to say, there is more than ample voltage amplification to drive the amplifier to its rated output from any good single or double carbon microphone. There is more than ample voltage gain available to bring the level of even the poorest low level recordings up to a satisfactory value, and due to the use of the tone control, sufficient attenuation can be obtained at the higher frequencies to minimize surface noise.

Tests in the field have indicated that the use of up to 6 trumpet type speakers, or cone type speakers mounted in suitable baffles can be used with extraordinary coverage and satisfactory sound level at distance up to 250 ft. away from the car. Another advantage of this unit can be traced to the fact that it is equally applicable to the small sound truck of the radio Service Man, where he combines his radio servicing business with the rental of sound equipment for advertising purposes, etc., or it fits just as readily in the pleasure car, where, due to its compact size and the possibility of placing it in an out of the way position which of course will be found highly desirable, enables the P. A. engineer or the radio Service Man to install an outfit that will really give him service and a degree of convenience unheard of in auto amplifier design.

FACTS ABOUT THE INFINITE BAFFLE

(Continued from page 652)

frequency reproduction will reproduce the low frequencies and if, in addition, the proper use is made of dual and triple reproducers, remarkable performance can be obtained. However, though the low frequencies will be reproduced by the proper size baffle, *the attenuation of the low frequencies is very high with any kind of a baffle unless the back wave is almost completely suppressed.*

This means, that if gain measurements were made on any particular low frequency such as 40 cycles, with a suitable baffle designed to reproduce 40 cycles, indications would show that 40 cycle tones were actually being emanated from the speaker. If, then, the entire back wave was suppressed from any possibility of getting around to the front wave, the 40 cycle response measurement would instantly boost itself to an almost unbelievable value.

SUPPRESSING BACK PRESSURE

This indicates conclusively that if it were possible to completely suppress or absorb the back wave and at the same time eliminate cavity resonance, good low-frequency response would be obtained without the necessity of a huge baffle. Of course, in addition to the above, it is imperative that the resonance of the material used as a support for the loudspeaker and the material used to house the assembly, be taken into consideration. One excellent idea used by the author for dampening, is to weight down the housing with a sheet-lead bottom.

Also, the pressure of the back wave must be released through some venting means but the freed air must necessarily be delayed sufficiently so that on release it will not affect the front wave. The air release should be quite large so that the instantaneous pressure developed internally will not affect the resonance of the cone and thereby produce the distortion effects previously mentioned.

From this discussion and theory it can be readily understood that the problem of back wave elimination lends itself to a possible solution by means of absorption, and it is true that *excellent results can be obtained by using this means alone.* The author's articles mentioned before were written around this method and for further details it would be wise to refer to those articles. However, it is necessary to delay the back wave release as long as possible and therefore the method to be described was used in the monitor speaker for the new master control room, recently completed by the author, at the Hotel New Yorker.

THE INFINITE BAFFLE

Referring to Fig. A, it will be seen that the control desk faces the amplifier rack equipment and that the racks in turn are so arranged that the window light is applied directly at the rear of the equipment where servicing is greatly facilitated. The position of the monitor loudspeaker is thus through necessity over the center of the racks, facing down and directly in a line with the operating desk position.

The wall upon which the monitor speaker is mounted is the outside wall of the hotel and, therefore, cannot be used as a baffle by inserting the speaker into it. Consequently, the speaker was mounted on a short flare and then temporarily hung in position by brackets while measurements were made of the cross-angles between the ceiling, sides and uprights. (Fig. 1) This was then developed into the odd-looking housing (which was constructed of special, well-seasoned, soft pine ply-wood). (Fig. B) The entire assembly was tested for resonance and loose sections, and after corrections were made by the labyrinth principle, developed by Ben Olney for Stromberg-Carlson (see page 665 of this issue), was applied as shown in Fig. 2. The sections in the labyrinth can be made either of rock-wool or ozite, preferably, the former.

As shown previously, absorption alone is excellent, but if Fig. 2 is observed closely, it will be found that the sound of the back wave is divided into two parts and then is made to weave itself through the labyrinth chambers

until it is finally released by the vents. The rock-wool is very highly absorptive and for all practical purposes completely absorbs the sound vibrations in the back wave and as the sound is made to travel over such a long path, what is left of it can never be in opposite phase to the front wave when released through the vents.

At the same time, the vents will release instantaneous high-pressure peaks that may develop. The vents are *very important* and should be made in all labyrinths *regardless of published information to the contrary!*

The labyrinth principle, in the opinion of the author, will undoubtedly be used by almost all set maufacturers and its application in the public address field is of course unmistakable. By means of the labyrinth, speakers can be installed in comparatively small cabinets and through the elimination of the internal cavity resonance and the back wave, very good low-frequency response can be obtained. Of course, the principle can be applied perfectly for the elimination of sound from one room into another where one room has the front wave operating into it and the back wave is released into the labyrinth which is in the second room. Still another use of the labyrinth, is its application to the theatre where the speaker unit can be mounted on a directional flare operating into the audience and the back with its labyrinth, safely protected against feedback. With such an arrangement feedback should be reduced tremendously even though the microphone is quite close.

ANOTHER TYPE OF INSTALLATION

In the grand ballroom of the New Yorker a very peculiar condition was encountered. The room is exceptionally "live" and had a very large reverberation factor with the result that the use of the P.A. system was difficult because of high feedback and the impossibility of increasing the gain on account of this item. Therefore, sound treatment was applied to the room by stripping the plaster from most of the walls and applying a sound-absorbing plaster. During this procedure the author decided that for two reasons it would be an excellent idea to incorporate in the room, a P.A. "low-level distribution system" instead of a high-level system. The difference between the low-level and high-level methods is that with a low-level system, reproducers are placed all over the room and sectionalized—that is, each speaker is designed to cover only a very small area. No matter how large, or how bad acoustically the room is, it can be treated in this manner if sufficient locations are available for the speakers.

On the other hand, high-level distribution is to use one or two speakers operating at high level to cover the entire room. Listeners close to the speakers are blasted with sound, while those at the extreme end of the room, hear little if anything.

With this low-level system, the volume level is kept low to avoid reverberation and interference with other reproducers. The system must be so designed that no matter where a person sits he must necessarily be in the range of at least one loudspeaker. Thus excellent hearing is obtained.

In the previously mentioned ballroom the problem of installation of such a system was intricate in that an interior decorator had to be allowed to work his handicraft into the picture. However, after a little persuasion the work progressed quite nicely.

Eleven out of about 14 locations for loudspeakers were chosen. The room as originally constructed, had murals beautifully painted on the west wall. Between each mural was an indentation or section cut in the wall of perhaps two feet in width and running up to the top of the room from the bottom. This cut was, however, only 6 ins. deep. By carefully cutting into the wall beyond the 6-in. cut, it was found that sufficient room was available to mount any of the large 12-in. dynamic loudspeakers and, therefore, a special type of mounting was made to hold these units. The mounting, in addition to acting merely as a support, had to be arranged so that the speaker could be tilted and focused at any angle and then, after once being focused and adjusted for the individual area, the speaker had to be made fast to the mounting and held very rigidly in this position. Then, a very short directional baffle was made to fit exactly between the front of the speaker and the wall, on top of which the interior decorator applied his "knitting" in the form of a grille to fit the decorative scheme of the room.

Now the elimination of cavity resonance in this case was most important. The inside walls of the section cut were lined with "hair-wool" or "ozite" from the top to the bottom of the cut. In addition, streamers of ozite were suspended. At the extreme top, a vent was made for pressure release. Four reproducers were mounted in this fashion on the west wall, (Fig. B) and as the dais or head table is often placed along this wall, two speaker units were placed in the two center cuts. The mounting arrangement of one of the reproducers showing the baffle removed is illustrated in Fig. C.

On the east wall, a section of which is shown in Fig. D, five more loudspeakers were located and mounted. In this case it was possible to eliminate the back wave directly, by mounting the speakers into the air chambers of the walls. Resonance was eliminated by hanging large areas of ozite mats in the walls directly in back of each speaker.

When tests were made upon completion of the installation it was found that the low-level theory of distribution is excellent and especially so when the loading effect due to large crowds is encountered. For under these conditions, many people in the group can talk among themselves and develop considerable background noise, yet the rest of the people in the room can hear very well without the background noise overriding the P.A. system.

●

FUNDAMENTAL FACTS ABOUT CATHODE-RAY TUBES

(*Continued from page* 672)

cuit is shown in the pictorial illustration.) For simplicity, the circuit is shown without the details of power supply, or plate-deflecting voltages.

This tube utilizes electrostatic deflection plates and each set of plates is separated from the other—there being no internal connection to ground between the horizontal and the vertical plates, as found in some of the earlier (as well as some present) types. This permits greater freedom in the use of the tube for measurement purposes.

In Fig. 4 are shown additional Lissajous figures to those shown last month. The Service Man, and the technician who is keeping abreast of the times, will do well to study these figures as they hold the key to an understanding of the more complex patterns that appear in making circuit adjustments, and in testing various pieces of apparatus.

The cathode-ray oscilloscope (illustrated) and oscillograph are powerful tools, superior to other forms of wave-form analysis devices since this class of instrument utilizes an electron stream which acts on and obeys the same laws as a flexible conductor with the current flowing toward the cathode. It is reasonable to suppose that this new tube, now produced at very low cost, will soon be on the same plane of general usage as ordinary meters, thus removing this academic instrument from the laboratory and placing it in the hands of the average radio technician.

(Credit is here given to BROADCAST NEWS and RCA Radiotron for the use of reference material and illustrations.)

THE LATEST RADIO EQUIPMENT

(Continued from page 657)

KITS OF POWER WIRE-WOUND RESISTORS (705)

(International Resistance Co.)

POWER-TYPE, wire-wound resistor kits of 12 units, ratings 10, 20 and 30 W., are now available to the trade. They are small in size, yet designed to avoid the most common causes of resistor failure such as breakdowns due to poor contact, oxidation and open circuiting of wire due to imperfect protective coatings and resistance-wire connections.

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VOLT-OHM-MILLIAMMETER IN KIT FORM (706)

(The Triplett Electrical Instrument Co.)

THE popular "No. 1200" volt-ohm-milliammeter is now available in kit form and is designed for use with built-in shop equipment. This announcement will be of interest to Service Men who desire to build their own instruments, or who want instruments to meet special space and installation requirements. The kit includes all shunts, resistors, condensers, coils, drilling template, blueprints, etc.

NEW 16 MM. SOUND PROJECTOR (707)

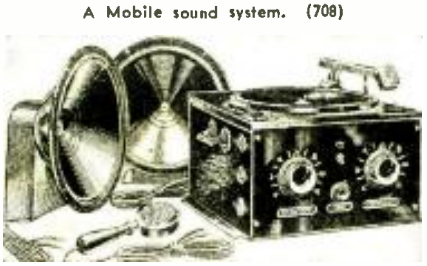
OF CONSIDERABLE interest to schools, clubs, hotels, and to Service Men everywhere, is a new 16 mm. sound-on-film outfit with many desirable features. Two speeds permit silent pictures to be shown. The entire equipment is contained in two compact "suitcase" grips, and weighs only 70 lbs. One unit contains the projector, while the speaker and a "class A prime," 10 W. amplifier are housed in the other.

MOBILE SOUND SYSTEM (708)

(Allied Radio Corp.)

A DISTINCTIVE advance in mobile public address design utilizes a completely self-contained unit operation entirely from a 6 V. storage battery; it requires but the addition of reproducers and microphone for complete operation. Output, 20 W.; frequency range, 40-8,000 cycles; genemotor unit delivers 300 V. D.C.; a 2-speed phonograph operates on 6 V. The volume and mixing circuits, and tone control are incorporated. Units of this type are available in output ranges of 4 to 50 W. Available from the same manufacturer is a new line of permanent-type P.A. units; also, microphones, pickups, recording equipment, preamplifiers, mixers, etc.

A Mobile sound system. (708)



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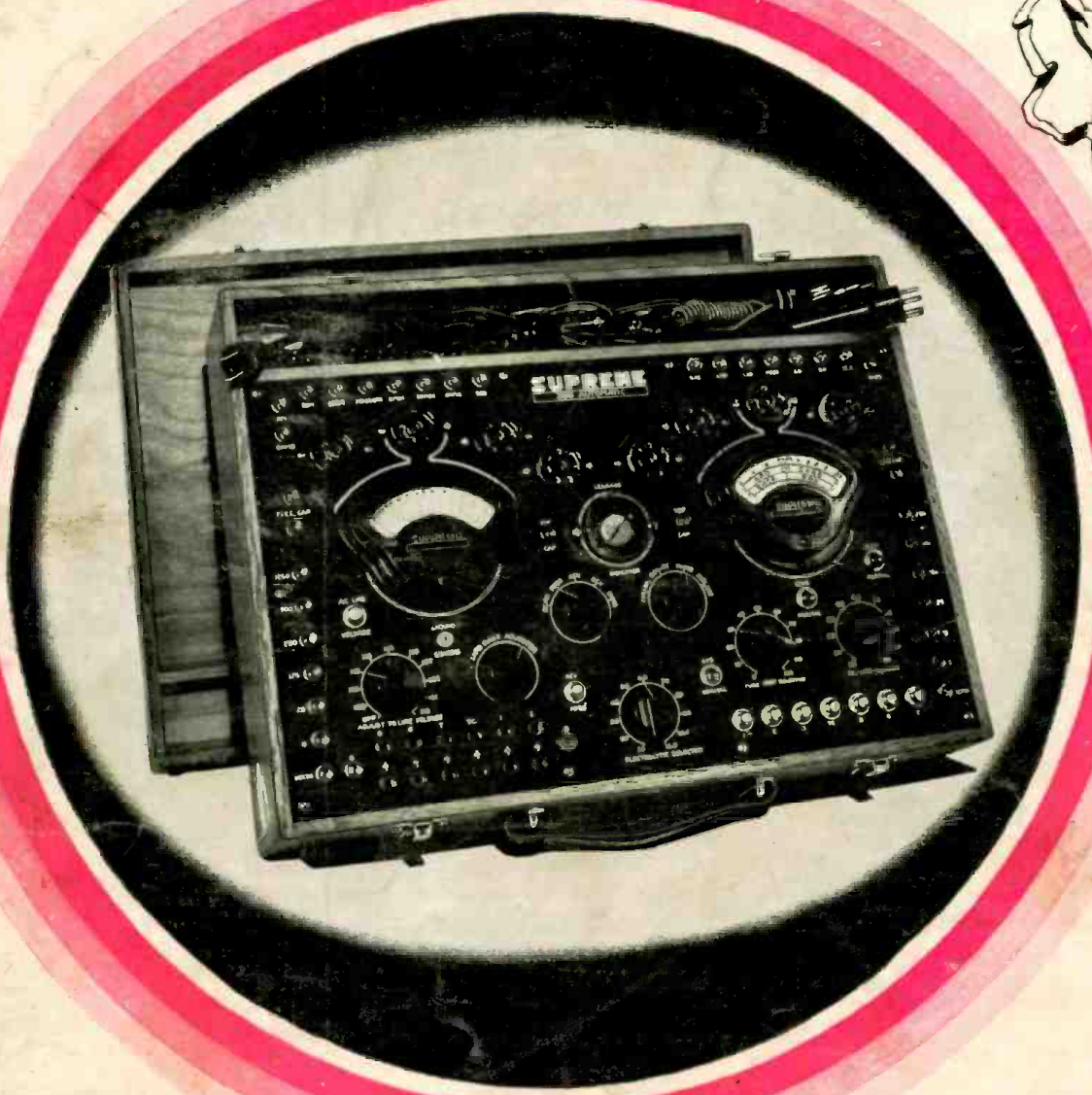

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Presenting the Supreme "385 Automatic" - - marking another Supreme trail-blazing achievement - - "UNI-CONSTRUCTION." Go to your jobber to see the "385 Automatic" and prepare yourself to expect not only a new standard of value made possible by uni-construction, but an instrument sure to revolutionize radio service procedure. Built on an entirely new principle the "385 Automatic" is the most complete, easiest handled, and the fastest instrument ever built - - - AUTOMATIC in its diagnosis.

In addition to retaining the many popular features of the famous 333 DeLuxe Analyzers and 85 Tube Testers, the "385 Automatic" has PLUS features such as two separate ohmmeters. One with a low range of 0/200 ohms the lowest division of which is 1/4 ohm. The other with intermediate ranges of 0/2,000/20,000/200,000 ohms and high ranges of 0/2,000,000/20,000,000 ohms. All with self-contained power supply.

One of the most interesting of the new Supreme developments in the "385 Automatic" is the improved condenser tester with six direct reading capacity ranges, neon condenser leakage test for non-electrolytics indicating leakages, shorts and opens PLUS THE FIRST ENGLISH READING ELECTROLYTIC CONDENSER TESTER. Just set the "condenser selector" to the value of the condenser to be tested and the meter will read directly in terms of "GOOD" or "BAD." Condensers will read in the "BAD" area when leakage is more than 1 milliampere per mfd.

Here is something actually NEW. See your jobber and write today for the complete descriptive booklet "385 Automatic." See for yourself how Supreme inventive Engineering and Supreme uni-construction make possible the finest radio service instrument in the world at a price so pleasantly interesting.

SUPREME INSTRUMENTS CORPORATION

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