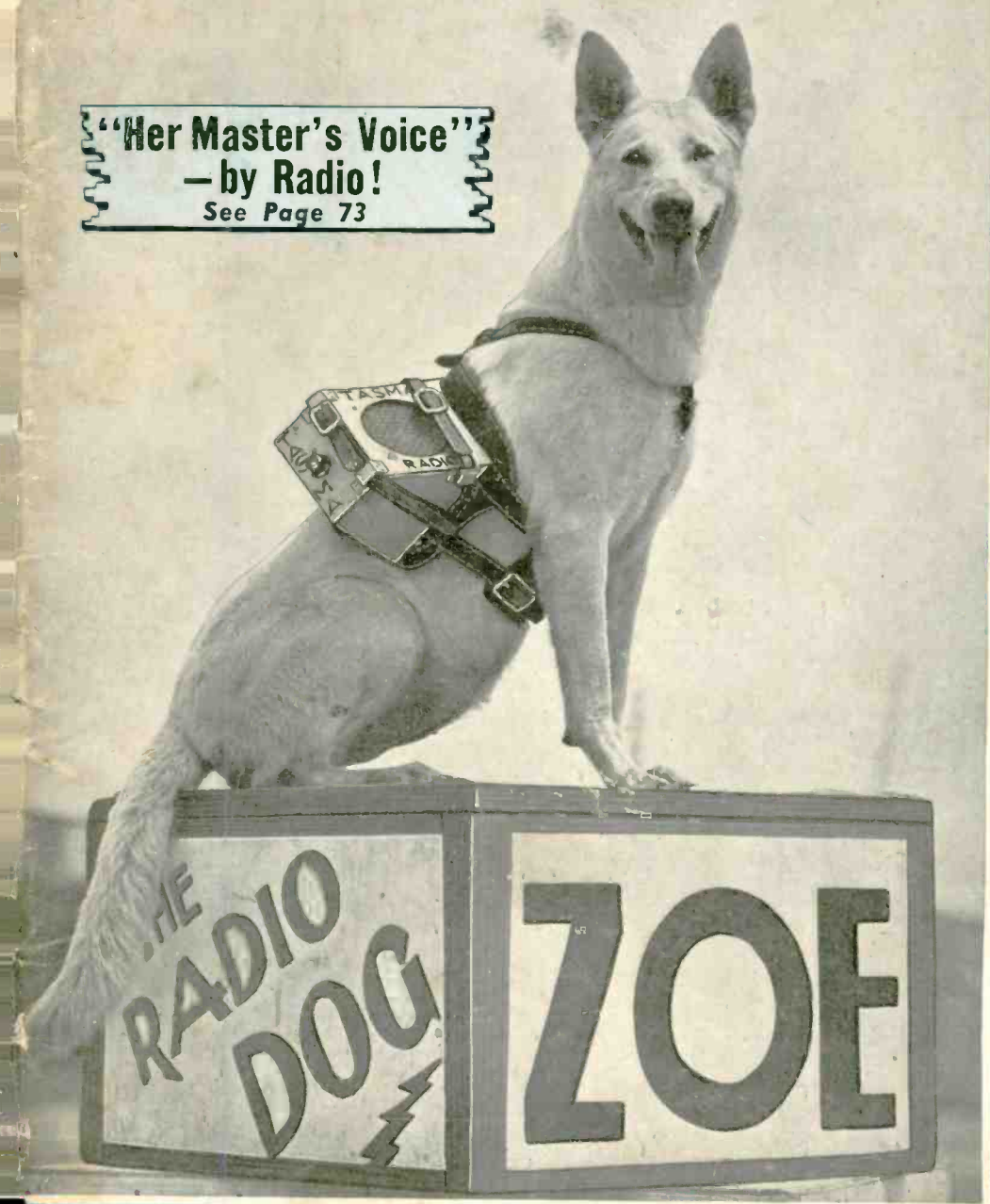
OVER 125 ILLUSTRATIONS

RADIO-CRAFT

HUGO GERNSBACK, Editor

"Her Master's Voice" —by Radio!
See Page 73



AMATEUR TELEVISION

RADIO-PILOTED BOAT

SCREEN TELEVISION

A. F. CLOCK!

AUGUST 25c IN U. S. AND CANADA

RADIO'S GREATEST MAGAZINE

BUILD AN F. M. ADAPTER • A CONSTANT-OUTPUT POWER SUPPLY
SIGNAL TRACER • BOOSTER AMPLIFIER • REBUILDING FOR PROFIT

Research is radio's road to progress

World wide radio communications; national and international broadcasting; radio usefulness in times of peace and in times of national emergency, are all the products of scientific research. Without such research, the American radio industry would be non-existent. Without it, radio's future usefulness would remain unexplored.

Radio research has been the keystone of RCA's operation since 1919. Today, this Company, which is engaged in every field of radio, is following its consistent policy of improving present-day radio services and pioneering in the development of the new.

Three new services in radio now beckon those who would expand radio's usefulness to the public and who would create employment of men and money. They are Facsimile, Frequency Modulation, and Television. Involved in these three new services are the transmission of printed matter and illustrations; the improved transmission of sound services; and the transmission of sight and sound simultaneously through the air. In other words, new and important communication services are now out of the laboratory and ready for use in the interests of education and entertainment, and for the service of industry and commerce.

Research continues, however, to explore the unknown frontiers of space where additional useful radio channels may be created for a thousand and one additional services in the interest of mankind.

RCA continues with 600 research specialists at work constantly improving the old and developing the new. Radio's road to the future is the research road, the road to progress.

RCA Radio Corporation of America

Be a RADIO Technician

Many make $30 $40 $50 a week

J. E. SMITH, President, National Radio Institute
Established 25 years
He has directed the training of more men for the Radio Industry than anyone else.

I will train you at home for many Good Spare Time and Full Time Radio Jobs

Set Servicing pays many Radio Technicians $30, $40, $50 a week. Others hold their regular jobs and make $5 to $10 extra a week in spare time.

Broadcasting Stations employ operators, installation, maintenance men and Radio Technicians in other capacities and pay well.

Loudspeaker System building, installing, servicing and operating is another growing field for well trained Radio Technicians.

Radio is a young, growing field with a future. It offers many good pay spare time and full time job opportunities. And you don't have to give up your present job, go away from home, or spend a lot of money to become a Radio Technician. I train you at home nights in your spare time.

Jobs Like These Go to Men Who Know Radio

Radio broadcasting stations employ Radio Technicians as engineers, operators, Maintenance Men and pay well for trained men. Radio manufacturers employ testers, inspectors, foremen, servicemen in good-pay jobs with opportunities for advancement. Radio jobbers and dealers employ installation and servicemen. Many Radio Technicians open their own Radio sales and repair businesses and make $30, $40, $50 a week. Others hold their regular jobs and make $5 to $10 a week fixing Radios in spare time. Automobile, police, aviation, commercial Radio; loudspeaker systems, electronic devices, are newer fields offering good opportunities to qualified men. And my Course includes Television, which promises to open many good jobs soon.

Why Many Radio Technicians Make $30, $40, $50 a Week

Radio is already one of the country's large industries even though it is still young and growing. The arrival of Television, the use of Radio principles in industry, are but a few of many recent Radio developments. More than 28,000,000 homes have one or more Radios. There are more Radios than telephones. Every year millions of Radios go out of date and are replaced. Millions more need new tubes, repairs, etc. Over 5,000,000 auto Radios are in use and thousands more are being sold every day. In every branch Radio is offering more opportunities for which I give you the required knowledge of Radio at home in your spare time. Yes, the few hundred $30, $40, $50 a week jobs of 20 years ago have grown to thousands.

Many Make $5 to $10 a Week Extra in Spare Time While Learning

The day you enroll, in addition to my regular Course, I start sending you Extra Money Job Sheets—start showing you how to do actual Radio repair jobs. Throughout your course I send plans and directions which have helped many make $5 to $10 a week in spare time while learning. I send special Radio equipment; show you how to conduct experiments, build circuits. My Course includes Television, too.

I Give You This Professional Servicing Instrument

This instrument makes practically any test you will be called upon to make in Radio service work on both spare time and full time jobs. It can be used on the test bench, or carried along when out on calls. It measures A.C. and D.C. voltages and currents; tests resistances; has a multiband oscillator for aligning any set, old or new. You get this instrument to keep as part of your N. R. I. Course.

Find Out How N. R. I. Teaches Radio and Television

Act today. Mail coupon now for Sample Lesson and 64-page Book. They're FREE. They point out Radio's spare time and full time opportunities and those coming in Television; tell about my course in Radio and Television; show more than 100 letters from men I trained, telling what they are doing and earning. Read my money back agreement. Find out what Radio offers you. Mail coupon in envelope or paste on penny postcard—**NOW.**

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

I Trained These Men

$10 to $20 a Week in Spare Time

I repaired many Radio sets when I was in my fourth lesson. I really don't see how you can give so much for such a small amount of money. I made $600 in a year and a half and I have made an average of $10 to $20 a week just spare time. JOHN JERRY, 1529 Arapahoe St., Denver, Colo.

Makes $50 to $60 a Week

"I am making between $50 and $60 a week after all expenses are paid, and I am getting all the Radio work I can take care of, thanks to N. R. I." H. W. SI'ANGLER, 126½ S. Gay St., Knoxville, Tenn.

Operates Public Address System

"I have a position with the Los Angeles Civil Service, operating the Public Address System in the City Hall Council. My salary is $170 a month." R. H. ROOD, R. 136, City Hall, Los Angeles, Calif.

Sample Lesson Free

I want to prove our Course gives practical, money-making information, that it is easy to understand—what you need to master Radio. My sample lesson text, "Radio Receiver Troubles—Their Cause and Remedy," covers a long list of Radio receiver troubles in A.C., D.C., battery, universal, auto, T.R.F., super-heterodyne, all-wave, and other types of sets. And a cross reference system gives you the probable cause and a quick way to locate and remedy these set troubles. A special section is devoted to receiver check-up, alignment, balancing, neutralizing, testing. Get this lesson Free by mailing the coupon.

Good for Both 64 PAGE BOOK SAMPLE LESSON *Free*

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

Without obligating me, mail your Sample Lesson and 64 page Book FREE.
I am particularly interested in the branch of Radio checked below. (No salesman will call. Write plainly.)

- ☐ Radio Service Business of My Own
- ☐ Service Technician for Retail Stores
- ☐ Spare Time Radio Repair Work
- ☐ Broadcasting Station Operator
- ☐ Loudspeaker Systems, Installations and Service
- ☐ Auto Radio Installations and Service
- ☐ Television Station Operator
- ☐ All-around Servicing Technician

(If you have not decided which branch you prefer—mail coupon now, for information to help you decide.)

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

Address .....

City ..... State **14X1**

RADIO-CRAFT

HUGO GERNSBACK, *Editor-in-Chief*

N. H. LESSEM, *Associate Editor* — THOS. D. PENTZ, *Art Director* — ROBERT EICHBERG, *Trade Digest Editor*

R. D. WASHBURNE, *Managing Editor*

In the **NEXT ISSUE!**

- Modern Microphone Technique
- Interference and the Ground
- Documentary Radio
- A Model Service Shop
- Analyzing the Electronic Violin

Contents AUGUST, 1940 Issue

VOLUME XII -- NUMBER 2

★

Published by Radcraft Publications, Inc. Publication office: 29 Worthington Street, Springfield, Mass. Editorial and Advertising Offices: 20 Vesey Street, New York City. Chicago Advertising Office: RADIO-CRAFT, 520 North Michigan Avenue, Chicago, Ill.

RADIO-CRAFT is published monthly, on the first of the month preceding that of date; subscription price is $2.00 per year in U. S. and Canada. (In foreign countries, $2.50 a year to cover additional postage.) Entered at the post office at Springfield as second-class matter under the act of March 3, 1879.

★

Foreign Agents:
London—Gorringe's American News Agency, 9A Green St., Leicester Square, W. C. 2, England.
Paris—Messageries Dawson, 4 Rue Faubourg, Poissonniere, France.
Melbourne—McGill's Agency, 179 Elizabeth St., Australia.
Dunedin—James Johnston, Ltd., New Zealand.

★

"DIRECT-COUPLED 10-W. AMPLIFIER"—REVISED

Dear Editor:

● IN reference to the article, "How to Design an Inexpensive All-Push-Pull Direct-Coupled 10-Watt Amplifier" in the July, 1939, issue of the *Radio-Craft* magazine, I would like to know from Mr. A. Shaney if it were possible to build the same amplifier with 2—2A3 tubes in the output stage, and a 53 in the driver stage according to the diagram as published. Of course, some changes must be made in the values of the resistors, and I would like to know what values would be used in place of those listed for the tubes as designed. I do not quite understand how you have calculated the values as they are prescribed in the article, as my RCA tube manual does not give similar plate and screen-grid currents for the 6SJ7 tubes as you specify in the article, i.e., 1.5 ma. and 0.5-ma., respectively, etc. The ratings I read are higher. Nevertheless, I would like to use the 2.5 volts I have at hand, and would like to know if it is possible, or feasible, and how it may be done.

PAUL E. HOLLS.
Baltimore, Md.

This letter was forwarded to Mr. A. C. Shaney, whose reply follows:

Dear Mr. Holls:

Your inquiry addressed to *Radio-Craft*, has been referred to me for reply.

It is quite possible to design a 2—2A3 Direct-Coupled Amplifier. The use of the 53 driver, however, is not recommended.

An amplifier of this type is scheduled to appear in the August, 1940, issue (on newsstands July 1).

The values used for the basis of calculating the resistances in the Direct-Coupled Amplifier, utilizing 6SJ7 tubes, were obtained by connecting up a tube with the applied potentials and then measuring the currents in plate, screen-grid, and cathode circuits.

A. C. SHANEY.

NEW ZEALAND SERVICEMAN ANALYZES US

Dear Editor:

● While looking through your November, 1939 issue of *Radio-Craft* I noticed in the "Mailbag" some opinions. One agrees, another differs with Mr. Moody; well, I am not going to say which is correct. They both have their faults and a magazine like yours serves not only one class of Serviceman but hundreds. I like Mr. Sprayberry's articles and read them diligently. I have to if I want to know all the trick circuits that come out, and although I may never come across one in a year, it improves my mentality for puzzling out those that I do come across and which I cannot find in my publications.

The Service Questions & Answers no doubt had good intentions when it started out but such a section always has the tendency to lead to the asking of a lot of stupid questions; by this I do not mean that all the questions are stupid. Also I do not agree with Bob Stetler who thinks they are mostly screwdriver mechanics. If the position in America is the same as it is here you find that certain areas have a predominance of one make of set and the Serviceman may run into trouble if he runs up against an orphan.

Against this, any man who can wait probably a whole month for the answer to come in your publication, cannot be so hot. He could tear the set to pieces and test each part a dozen times and probably find it long before he got the answer. (That

isn't quite the story, Mr. Carlisle. Answers go directly to inquirers by mail, at once, but certain of these questions and answers later are published in *Radio-Craft.*—*Editor*)

The Radio Kinks are quite interesting, but only for experimenters in most cases unless one wants to rig up something to use for a special job and tear it down again when finished as some of them do not meet the standard requirements for a permanent job or would be unwieldy with a lot of unnecessary controls or gadgets.

The data and articles on the construction of service equipment I think are extremely good and I would like to see a lot more of them. In this part of the world we do not have the variety of instruments to choose from and they are a great help to us in determining which type of instrument is best for the job and in some cases where constructional details are available I have made quite a number of useful instruments which I should otherwise have had to do without, owing to the cost not being warranted by the amount of business or the amount of work for such instruments, and these have saved me quite a lot of guess-work and headaches.

The section dealing with the latest equipment, etc., is a fine section and I think it gives us Servicemen who are in the remote corners of the earth an idea of what is going on and what is available.

I have had your magazine since 1933 and I was very sorry to see you change the cover style with the month and date on the back. However, I still think it is the best available. (Thank you!—*Ed.*)

L. F. CARLISLE,
Putaruru, New Zealand.

SIGNAL SERVICING

Dear Editor:

● ON Page 477 of the February issue of *Radio-Craft*, under "Useful Kinks & Circuits," J. C. Ravelle has a Signal Servicing hookup. I have hooked this up but it won't deliver any signal in my phones.

Could you enlighten me as to whether you believe such a device is practical?

When I connect the device to ground, and probe to grid or plate of tube, all it does is ground the signal to the speaker (?) of the set and no signal can be heard in phones.

A. SINGLETON,
Chicopee, Mass.

This letter was forwarded to author J. C. Ravelle whose reply appears below.

Dear Mr. Singleton:

By this time, no doubt, you have this "device" working and are getting as much satisfaction out of it as I am. However, I object to the second paragraph of your letter—after all, this device is merely a triode detector and as such has given results in radio for over 20 years. After this bit of gentle razzing, let me see if I can help you.

The wire from the grid-condenser must not run through the probe but *must* be attached at one end, leaving 5 or 6 inches of the probe free, so that there won't be any hand-capacity to short your grid action. The probe, of course, must be of insulating material. The gridleak must not be across the grid-condenser, but from grid to ground.

When testing grid circuits in the radio-frequency end of the set, it is best to detach the grid lead from the control-grid cap of the tube. Do not expect stations to come exactly on frequency on dial because of the large capacity introduced by the long grid wire of the probe. Remember you are merely trying to see if there is life there.

What makes this device work, of course, is voltage variations. These can be high frequency or audio frequency. Thus, if you have a local station tuned-in you can test the R.F. section as well as the audio or output section of the receiver. When a set is working properly, you should hear the music on any grid or plate of any tube (excluding the rectifier) in the set. That is how you can tell that R.F. coils, tuning condensers, I.F. coils and trimmers, plate resistors, both ends of push-pull transformers, etc., are intact. Naturally you should hear nothing at the cathodes, screen-grids and the filaments. You should hear the raw 60-cycle A.C. at the rectifier. I should say, rather, that it is 60-cycle pulsating D.C. But the "B+" line should be quiet in all sets, except the small A.C.-D.C. jobs which produce "music" even on the "B+" line because practically all the current is taken by the output tube and the "B+" varies according to the music.

J. C. RAVELLE,
Newark, N. J.

SERVICE Q. & A. HELPED HIM

Dear Editor:

● AFTER reading your monthly magazine *Radio-Craft* for more years than I care to remember it gives me a great deal of pleasure to write you.

In your March issue under Servicing Questions & Answers, please refer to question No. 151 concerning a Bush & Lane T.R.F. set.

I have encountered the same difficulty in a G.E. set model No. 77, and while the ground condition was a good mechanical job it was a failure electrically; and further, in addition to the hum mentioned a considerable amount of static prevented the correct operation of this set. A considerable amount of fine, white sand prevented a good ground condition. The writer has been servicing G.E. sets for a few years.

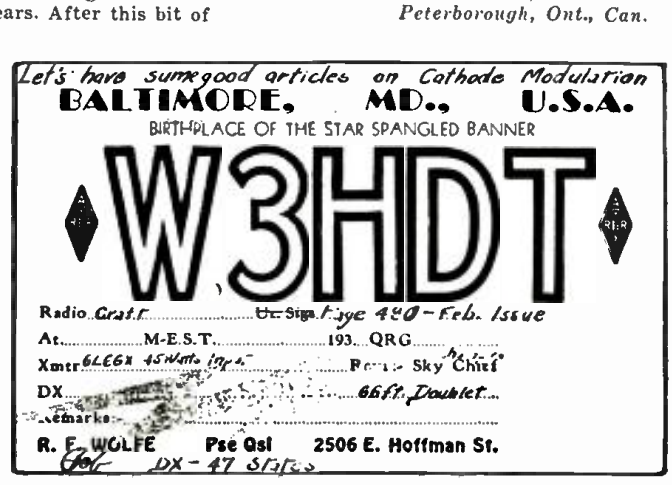
J. HOUGHTON,
Peterborough, Ont., Can.

●

YES . . .

Let's have some amateur-radio articles, says "Bob" Wolfe, in reply to *Radio-Craft's* QST in the Feb. issue. Cathode modulation is his especial "pet" interest, but this subject has received extensive treatment, insofar as the ham angle is concerned, in a book of the same title, and in the pages of magazines which feature operation on wavelengths below 200 meters. However, Mr. Shaney's recent articles on its application in public-address amplifiers may be worth studying.

●



DEPLORES OMISSION OF "OPERATING NOTES"

Dear Editor:

● I NOTICED in the March issue of *Radio-Craft* that you left out the Operating Notes section. I would like to see a bigger Operating Notes and Servicing Questions & Answers section, and less of the Radio Trade Digest. I have almost all of the *Radio-Craft* issues published.

S. PINDROH,
Pittsburgh, Pa.

Dear Mr. Pindroh:

We wonder whether *you* ever sent us any operating notes. We can't keep a department of this nature going without reader support. Send us your operating notes and tell your Servicemen pals to do likewise—we're always glad to publish them if they're considered helpful to others.—*Editor*

RADIO-CRAFT FOR THE SERVICEMEN

Dear Editor:

● I HAVE been reading *Radio-Craft* for some time and for the last year or so have been a regular subscriber. Your catering to the Serviceman's angle of the industry is our idea of making a better mag. If you have articles which aid the Serviceman they help him make more money and he will, therefore, wish to continue with you. Something which, in the end, makes the cash register ring—and that is what counts. Articles for the Amateur make it ring but for money he's taking out for new parts or a new rig you've told him about.

CECIL G. HARTNESS,
Hartness Radio Service,
Mineral Bluffs, Ga.

WANTS V.-T. VOLTMETER CIRCUIT

Dear Editor:

● IN your January issue of *Radio-Craft* I was very interested in Roy Powell's letter regarding the home-made instruments, and especially, the V.-T. voltmeter. Would you please publish a circuit on a vacuum-tube voltmeter operating from the line voltage of 110 volts A.C.-D.C. using a 25Z5 and a 6J5 having an input of 15 megs., and having ranges up to 1,000 volts.

I started reading *Radio-Craft* about 6 months ago so I have missed many of your construction articles. From now on I will be a constant reader of your magazine.

DENIS DAVIES,
Nanaimo, B. C.

DISLIKES RADIO-CRAFT'S NEW BINDING

Dear Editor:

● I HAVE been a regular reader of your magazine ever since it was known as the *Electrical Experimenter* and can truthfully say that I get more good out of *Radio-Craft*, than out of the other 3 radio magazines, combined, that I read.

And whenever I have a radio service problem or need a diagram I can be sure to find what I need in my *Radio-Craft* files.

My preference of the articles in the magazines is the Operating Notes, Useful Kinks & Circuits, and constructional articles on radio and test equipment.

One thing I don't like about the magazine is the new binder. It is not as easy to file the magazines as with the old binder.

Incidentally, the fewer ham articles you have in the magazine the better I will like it.

THOS. R. DISSINGER,
Chicago, Ill.

LIKES "R.-C." AS IS

Dear Editor:

● AS a steady reader of *Radio-Craft* I wish to inform you that I find the articles written by Charles R. Leutz very instructive and interesting, and look forward to reading many more articles written by him.

Also wish to add that the article written by H. S. Manney in the April issue was fine, and would like to read many more.

I find *Radio-Craft* magazine a good all-around periodical, and recommend it to my friends.

Hoping you keep *Radio-Craft* in its present form, I remain

I. L. FRIEDMAN,
Brooklyn, N. Y.

Your comments are appreciated, Mr. Friedman—especially that part about recommending "R.-C." to your friends!—*Editor*

V.-T. VOLTMETER ARTICLE GOES OVER BIG

Dear Editor:

● MAY we take this opportunity to compliment you on the most excellent article appearing in June "*R.-C.*", pg. 726, by Mr. Rufus Turner on the Universal Direct-Reading Vacuum-Tube Voltmeter.

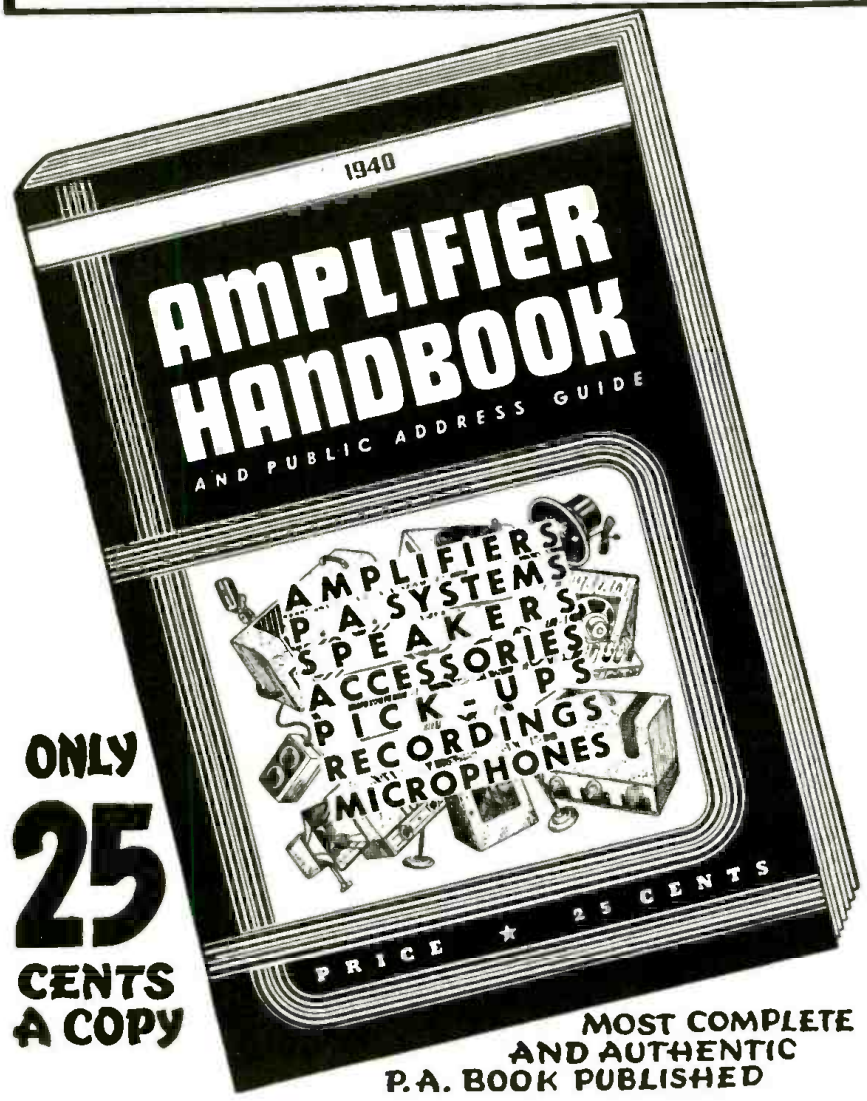
This instrument meets exactly, and fills, a long-felt want among constructors and Servicemen.

The circuit is so well engineered and the constructional data so exceptionally well written that this most useful unit will undoubtedly become an immediate addition to the equipment of many grateful subscribers to your splendid publication.

S. I. WELLS,
Wells Bros. Amusement Co.,
Toronto, Ont., Can.

Order your copy NOW—the only

P. A. HANDBOOK



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As complete as you would expect to find any engineering handbook—this is how the radio or P. A. man finds the **AMPLIFIER HANDBOOK AND PUBLIC ADDRESS GUIDE.** With essential technical data compiled from an exceptionally large number of sources, the volume covers nearly a hundred different subjects coordinating every conceivable branch or sub-division of Public Address.

THE CONTENTS

To actually show the scope and magnitude of the AMPLIFIER HANDBOOK AND PUBLIC ADDRESS GUIDE, an analysis of the contents is found at the right, showing the breakdown of the material featured within each particular section. A thorough reading of the contents shows the completeness of this book.

RADCRAFT PUBLICATIONS ■ 20 VESEY STREET ■ NEW YORK, N. Y.

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Gentlemen: Enclosed find my remittance of 25c for which send me POSTPAID, one copy of your NEW—1940 AMPLIFIER HANDBOOK AND PUBLIC ADDRESS GUIDE.

Send me ..... others, for friends, also POSTPAID @ 25c each.

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

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

Remit by check or money order; register letter if you send cash or unused U.S. Postage Stamps.

We Apologize for the Delay in Delivery:—

Due to editorial circumstances beyond our control, the Amplifier Handbook will be ready about July 15th.

A Resume of the Contents of the

AMPLIFIER HANDBOOK AND PUBLIC ADDRESS GUIDE

FOREWORD

INTRODUCTION
- Definitions—decibels, frequency, input, output, impedance, etc.

SECTION I—SOURCE
- Carbon microphones (single-button and double-button)
- Condenser microphones
- Velocity (ribbon) microphones
- Dynamic microphones
- Crystal microphones (sound-cell types, crystal diaphragm types)
- Cardioid microphones
- Contact microphones
- Phonograph pickups (magnetic types, crystal types)

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  - Class AB amplifiers
  - Class AB_1 amplifiers
  - Class AB_2 amplifiers
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  - When to apply class A, AB, and B amplification
- **Power Supplies**
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  - Full-wave rectification
  - Voltage doublers
- **Filter Circuits**
  - Power supply regulation, etc.
- **Practical Hints on Amplifier Construction**
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  - Tone compensation
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  - Remote control methods

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  - Power cone speakers
  - Radial (360° distribution) speaker baffles

SECTION IV—COORDINATION
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- Matching speakers to P.A. installations
- Phasing speakers
- Effect of mismatching speakers to amplifier output
- A typical P.A. installation (in a skating rink)

SECTION V—USEFUL PUBLIC ADDRESS DATA AND INFORMATION
- Speaker matching technique
- The ABC of Db., VU, Mu, Gm and Sm
- Charts and formulas useful to the practical P.A. sound man
- Handy index to important articles on public address and sound

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"RADIO'S GREATEST MAGAZINE"

....."dub" Servicemen can never understand why the successful ones succeed.

"THE SERVICEMAN'S FOLLIES"

By the Editor — HUGO GERNSBACK

YOU are lying on your sick bed, racked with pain; your eyesight doesn't function; you cannot move your legs and your digestion is just about completely gone. In short, as far as everyone is concerned, you have ceased to function normally.

In order to get back into circulation once more, you remember a certain doctor and you ask the wife to call him up. You are a cautious man, however, so you instruct your wife to find out how much he will charge for the call. She informs you that the "Doc" will charge 50c for the call. This information surprises you and you immediately jump to the conclusion that he must be a cheap quack and you certainly will not put yourself into the hands of such a man. Your wife then suggests that you call up a specialist of whom she has heard. You agree with this quickly and the telephone call is made. This time the doctor, who is too busy to answer calls himself, does not come to the phone but the nurse answers instead. "Yes, the doctor can come over in the afternoon and his fee for such a call is $20." This strikes you as more in line with your own importance and you ask the doctor to come as fast as he can.

Nothing unusual about all this and it happens hundreds of times all over the land every day, and whether the patient is a human being or a radio set makes little difference in the psychology of human beings. It is usually a matter of confidence. Believe it or not—the majority of the Servicemen will not get this simple fact into their heads; and that is the reason why we have 50c-a-call Servicemen—the quacks in the radio service field.

I have made it a point to tell the above parable, simply because the truth of it is not always apparent, which is the reason that thousands of Servicemen bemoan their fate when they cannot make a living.

I know that this will bring an outburst from many Servicemen who will write me indignant letters that I know nothing about servicing and that I only generalize. What these Servicemen seem to forget, however, is that we are in constant contact with hundreds of Servicemen right along. We see and speak to them, not only locally, but in our wanderings around the country, and therefore know their problems. Then, quite frequently, we have visiting Servicemen from out of town and—believe it or not—many of them do come here. Particularly last year and this year, they came, and are coming, in droves to see the New York World's Fair. Yes, and—the doubting Thomases notwithstanding—they stay here for a week at a time and spend quite a bit of money, too. On the other hand, that type of Serviceman is the successful species—the type who actually makes money—real money.

All this brings me to the instance of a visiting Ohio radio Serviceman who called on us last month. Usually we cannot afford to spend too much time with them, but when—let us call him Mr. G.O.Getter—came in, we spent over one hour and a half with him and, as usual, when we talk to a first-class Serviceman of his type, we absorb much knowledge.

Mr. G.O.Getter appears to be a man of acumen and, to boot, a mighty successful radio Serviceman. He has been so successful in his community that he is now erecting a good-size brick and steel building, *made from the profits of his business*, which comprises public address systems, stage lighting and talking picture equipment. Mr. G.O.Getter feels sorry for and pities the "dub" type of Servicemen and has naught but contempt for them. He maintains that the greatest trouble with them is that—first, they are not salesmen; second, they invariably employ the wrong psychology when talking to their prospects; and third, they are extremely poor businessmen. Usually, as Mr. G.O.Getter puts it, "They don't know what it's all about. They are lucky if they make $20 to $30 a week and a large percentage of them do not even average this much."

My visitor then gave me an example which I really believe is a classic and one which every Serviceman should read carefully.

It appears that in the city in which G.O.Getter lives there is a large hall in which a public address system is installed. Not so long ago, the system became out of order and the proprietors of the hall asked for bids to put it into good repair. A number of bids were received. Mr. G.O.Getter, as usual, got the order. A few days thereafter a local Serviceman—let us call him Mr. P.E.Ewee—called upon Mr. G.O.Getter complaining bitterly that G.O.Getter must have underbid him, otherwise how could he have gotten the order?

Mr. G.O.Getter drew a sort of pitying sigh, walked over to the filing case and took out a receipted bill. He then asked Mr. P.E.Ewee what his bid had been, "$5," was the answer. Without a word, G.O.Getter handed him the receipted bill which was for exactly $100. At the sight of this, the little fellow almost passed out and for some time he was too stunned to speak.

By rights, this should be the end of the story but the best part is yet to come. We will, however, let Mr. G.O.Getter tell it to you in his own language.

"The little 'dub' just sat there and looked at me dazed and uncomprehending. Finally, he reached for his hat and as he turned to go, he barked back at me, 'Well, it must be politics.'"

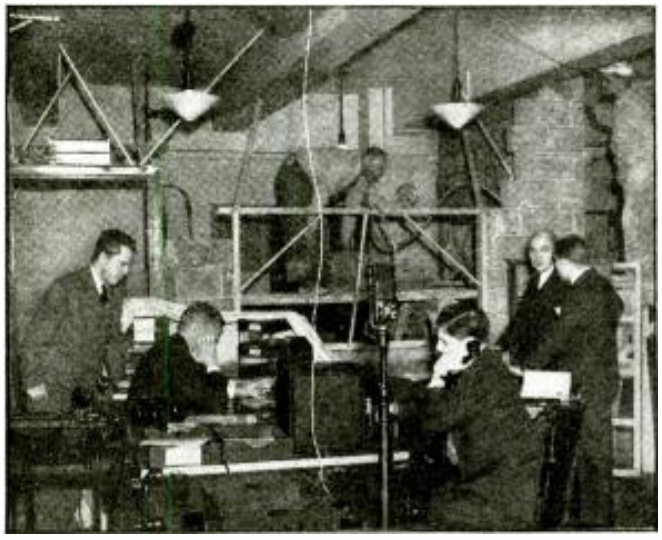
This demonstrates clearly what is wrong with "dub" Servicemen who do not know psychology and who can never understand why the successful man succeeds. Incidentally, Mr. G.O.Getter still hadn't finished the story, because he confided in me that when he got the check for $100, it was given to him most reluctantly because the person for whom the repairs were made has no use for the Union to which Mr. G.O.Getter belongs, so rather than having obtained the business through easy politics, he had to actually fight a hostile customer to get the business!

Incidentally, Mr. G.O.Getter did not always make money nor did he make it too easily. During the depression a few years ago, things became so bad in the servicing business that he even had to rig up electric bells to eke out a meagre living. One day he had an inspiration. He printed up a few calling cards with the legend, "Expert X-Ray Servicing." Now, Mr. G.O.Getter did not have a great deal of experience with X-ray machines but, being a radio man, he knew that they probably would be simpler than complex radio sets or public address systems. He soon had a telephone call from one of the local hospitals. He found upon arriving that what was wrong was a defective cord. The "dub" Serviceman probably would have charged 50c for the job. Mr. G.O.Getter charged $3 and got it without a murmur of protest because he had looked into the X-ray servicing business and found that the big manufacturers of these machines charged exactly that price for cord replacements. He had read through all the literature of the manufacturers and knew what the price scale was. In no time he was doing the repair work for practically every hospital within the county. He still does it today—not personally, of course—but he has a man broken into the work who now does it for him.

Opportunities? Yes, there are plenty of them in this country and good money is to be made even today by Servicemen. If they don't, it usually is their own fault.

•THE RADIO MONTH IN REVIEW•

The "radio news" paper for busy radio men. An illustrated digest of the important happenings of the month in every branch of the radio field.



"GOLDFISH BOWL" NEWS STUDIOS

War and near-war conditions throughout the world, last month, speeded completion of N.B.C.'s new Special Events and News Studios here shown under construction. Glass-enclosed, the new speaker-type studios—built in the News Room, 4th floor, RCA Building, N. Y. C.—offer commentators no more privacy than is ordinarily accorded a goldfish. Feeding news bulletins through a slot, from the adjacent teletype and shortwave monitoring rooms, makes it unnecessary to open a door.

Photo—Hartford Courant

HAM-TELEVISION CAMERA-TUBE

Amateur radio has won the distinction of being mainly responsible for the introduction, last month, of a comparatively low-cost Iconoscope or television image pick-up tube. This makes it possible for the first time for experimenters and shortwave enthusiasts to set-up their own experimental television transmitting stations! Photo shows Mr. Lamb holding the new type 1847 camera tube (right), and looking at the associated lens system; below is smallest previously-available image tube.

ABROAD

RADIO plays an indispensable part in modern warfare as evidenced by the bits of news that censors are passing these days. Items noted last month indicate in various degrees that this is so.

Paris.—A *U.P.* report credits the *Official Journal* with publishing a decree authorizing employees of radio stations to arm for protection in the exercise of their duties.

Berlin.—Radio stations of Luxemburg and Brussels have become part of the German Broadcasting System, *A.P.* announced.

London.—British Broadcasting Corp. engineers with the Advanced Air Striking Force have set up a broadcast studio and station on the French battlefront. Discs made with an A.A.S.F. recording van permit dubbing into programs, from the front to London, recordings made at airdromes and billets. Programs are written, censored and broadcast all in the same building. This technique enabled a French-German encounter on the Maginot Line to be broadcast blow-by-blow. (In similar fashion Berlin subsequently broadcast the account of a German-Belgian fight for an Albert Canal bridgehead, newspapers stated.—*Editor)*

India.—From Simla comes a *U.P.* report that all public and commercial radio licenses have been canceled; and that listening to broadcasts from (a) enemy countries, (b) countries occupied by Germany, or (c) countries allied with Germany, is forbidden.

This calls to mind a recent incident. It seems that the reprint, in the Radio Month in Review department of the Nov. 1939, issue of *Radio-Craft*, of an actual newspaper clipping entitled "Nazis Are Warned to Shun Foreign Radio," aroused the ire of Mr. Josip Sliskovic, of Vienna. Mr. Sliskovic wrote to say that "As a neutral foreigner, living since 18 years in Germany and being the chief engineer of one of the biggest Vienna radio firms"*, he felt it his duty to write us the truth. As he puts it, the German Government never published the item we quoted; and he and his German friends everywhere were enjoying unrestricted listening privileges on multi-band receivers.

A short time after Mr. Sliskovic's letter was received, the *New York Daily News* printed a special cable from wholly neutral Basle, Switzerland, from which we quote:

"Despite the severe penalties risked, more and more Germans are listening to foreign news broadcasts to find out what really is going on." One German said a favorite method to avoid detection was for listeners to lie flat on the floor with the radio set and himself covered with several quilts to deaden the sound; another German said that in his village of about 1,000 persons, near Basle, one member of a household would be assigned to keep a sharp lookout. The latter idea, of having lookout posted, seems to be much the likelier of the two.

*Chief Engineer, Kapsch-Radio, Vienna VII/62, Stiftgasse 21.

• • •

A young lady member—*Zoe*, by name—of the Sidney, New South Wales, police, has been the No. 1 goodwill publicity attraction at various police functions for more than a year. Photographs received by *Radio-Craft* last month from Constable 1st Class Adam Denholm, trainer of this German shepherd dog, now 3½ years old, show 2 of the more than 180 tricks this dog has been taught to perform in response to orders received on the portable radio set she carries! These include drawing water from a well and pouring it over an unconscious man (photo on facing page), arresting an armed criminal, putting on and removing her collar, discharging explosives or a revolver, and unfurling the Union Jack and then sitting up while the National Anthem is being played! How about training "seeing eye" blind-aid dogs to follow radio commands?

ULTRA-SHORTWAVE HORNS!

Here's one Ripley may spot! Instead of following schoolbook rules, which demands some wire-antenna arrangement for transmission and reception, Mr. A. P. King of Bell Telephone Laboratories has demonstrated that efficient, highly-directional radiation of 15-centimeter (3,000-megacycle) waves may be obtained by using metal horns. As the dash-line in photo shows, one merely points the horn-antenna of one station at the other, for distances within (ordinarily) the limits of the horizon. The fidelity is flat to 1 db. over a bandwidth of 250 megacycles, it is said.

SHORTWAVES

THE 1847, as the newest in Iconoscope (image viewing) tubes announced last month is designated, was developed by RCA Radiotron in cooperation with Mr. James J. Lamb, A.R.R.L. Research Engineer (see photo above). R. M. in R. suggests that radio Servicemen might try their hand at making up a sight-and-sound 2-Way Inter-Office Television Communication System, by combining, in duplicate, a standard television receiver or adapter with a simple transmitter incorporating the low-cost 1847. Use ordinary photographic floodlights for illuminating the subjects. The 1847 requires only 600 anode-volts, has better than 120-line definition, and has a mosaic under 2 ins. in dia. Electrostatic deflection is used.

TELEVISION HOPS 234 MILES TO SEA TO BE SEEN

Photos received last month show conditions aboard the *S. S. President Roosevelt*, en route from Bermuda, when the recent record of television signal reception aboard the ship, 234 miles at sea, was made. Above, ship passengers watch images received from the Empire State Building in New York; and, in second photo, as picked-up by a mobile unit on deck. Thus this trip between New York and Bermuda instituted the first "television voyage." Programs originating on the ship were piped by coaxial cables to receivers in the ship's various public rooms. It is estimated that when the DX television record was made the boat was about 7 miles below the horizon with respect to the top of the Empire State Building. First explanation suggested by RCA for this unorthodox long-distance range was refraction of the ultra-shortwaves from a point where a cold layer of air formed a junction with a high warm layer of air. A second was that the ultra-S.W. signals were reflected from an ionized layer of the atmosphere.

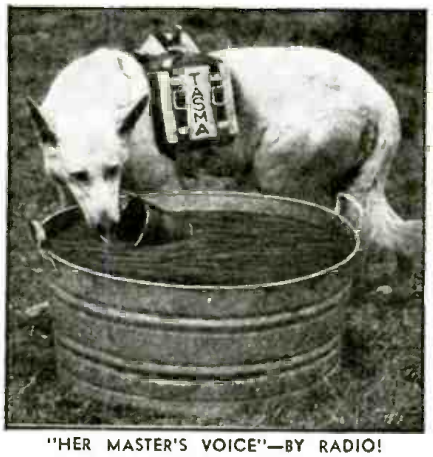
Memorial Day traffic in New York City was unsnarled by Police dept. monoplanes, 2-way-radio equipped. Instructions from the air to headquarters immediately were relayed to radio-equipped traffic cars. . . .

Professor Gordon Ferrie Hull, former chief of the ballistic division of the U. S. Army Ordnance Dept. and now a professor of physics at Dartmouth College, last month pointed out that ultra-short wavelengths such as may be generated by the W.F. "doorknob" tube (illustrated and described in the May, 1939, issue of Radio-Craft, *pg. 658), have extremely important applications in war time. For example, ultra-S.W. beam radio communication between ships, or ships and shore, would be almost 100% free from interception (or perhaps even from jamming —especially with frequency-modulated transmissions?*—Editor). *The advantages of transmitting in a searchlight-like beam are also applicable to war fronts on land, Prof. Hull points out. . . .*

Signals from N.B.C.'s shortwave station W3XAM last month played cops-and-robbers with the police radio system of the Oranges (N. J.). Kiddie programs for a half-hour tangled with police headquarters reports to roving radio police cars.

F.C. Commissioner Fly last month handed a bouquet to the Susquehanna Emergency Network for its fine work in past emergencies. The tribute was paid to the S.E.N., a group of Susquehanna Valley and eastern seaboard radio amateurs affiliated with the A.R.R.L., by Mr. Fly during a C.B.S. program dramatizing the amateur network's successes, in cooperation with the American Red Cross, when rivers inundated large areas, snowstorms isolated communities, epidemics threatened large rural areas, and rare medial cures were needed to save dying persons. . . .

Hobbiests at a Bell Telephone System hobby show in Denver included many radio "hamateurs" (to quote The New Jersey Bell*) who set up 2 complete 2-way shortwave systems, one for phone and one for code.*



"HER MASTER'S VOICE"—BY RADIO!

(Cover Feature)

Miss *Zoe*, German shepherd dog on the staff of the Sidney, New South Wales police, has been taught to do many tricks via remote control. The photo shows this wonder dog receiving instructions—from the loudspeaker of the portable radio set strapped to her back—to fill a pail with water and to pour the water over an unconscious person! This is just one of the more than 180 tricks in her amazing repertoire. (Story on facing page.)

F. M.

FREQUENCY Modulation seems to have earned for itself an almost permanent niche in this department of *Radio-Craft*. All news of the month of course pales into insignificance alongside the fact that the Federal Communications Commission took a deep breath and then announced the allocation of the full 42 to 50 mc. range to F.M. This necessitated kicking-out a television channel but the decision provides 40 F.M. channels, each 200 kc. wide; 35 are for commercial stations and 5 for "non-commercial educational" stations.

Newest score for frequency modulation reads 130 applications for transmitters pending at Washington. Immediate action is expected.

The new F.M. range clipped-out the No. 1 television band (44 to 50 mc.) which, after Jan. 1, 1941, will cover the former No. 2 band assignment (50 to 56 mc.); the old No. 2 band will be given a new yard in which to play (60 to 66 mc.); 16 other channels on still higher frequencies continue to be assigned to television. Now Mr. Serviceman can soon go to town on re-aligning the approx. 3,000 television sets in the New York area.

SOUND

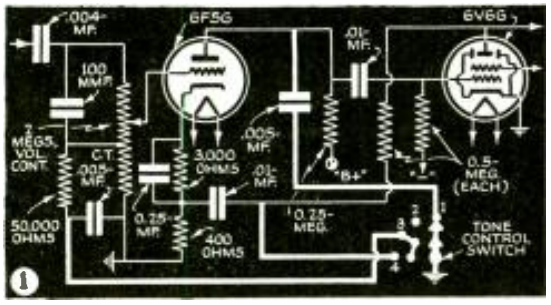
COMMITMENTS keep "The Voice of Hollywood" from coming East for the broadcast series but recordings made in Hollywood, and mailed to WOR, solve the problem 3 times a week. . . . Mobile sound recording equipment sent to the San Simeon, Cal., home of veteran American publisher William Randolph Hearst; later, an air program, over station WMCA in New York, incorporated an extensive "interview" with Mr. Hearst. The "interview" was a transcription made from the pick-ups by the mobile unit and airmailed to WMCA.

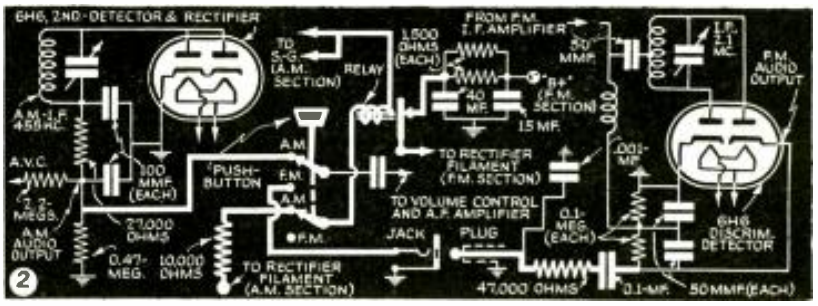
Chime tones generated by 5 radio tubes now clarion the quarter-hours from a location, in a clock, at 7th Ave. and 47th St., New York City. A master clock in the N.B.C. studios regulates the timing.

Most unique recording of 1940, to date, is the "Flight of the Flagship," reports the *N. Y. Mirror*. The discing, by General Records, includes sounds heard on a transcontinental air flight: greetings of the stewardess, motor warm-up sounds, the dash-dot, dot-dash buzzes of the radio beams, etc.

COUNT GEORG VON ARCO—1869-1940

The man mainly responsible for the formation of the German Telefunken Radio Co., Count Georg von Arco, died last month in Berlin at the age of 71. Often referred-to as a born scientist and said to be a pacifist at heart, he resigned from military service in the Prussian army to devote all of his energies to the development of his ideas for radio equipment. New tuning systems, for instance, were invented by Count von Arco when crystal detectors were yet being developed.





NEW CIRCUITS IN MODERN RADIO RECEIVERS

In this series, a well-known technician analyzes each new improvement in radio receiver circuits. A veritable compendium of modern radio engineering developments.

F. L. SPRAYBERRY

No. 35

(FIG. 1) 4-POSITION TONE CONTROL HAS UNUSUAL CIRCUIT

FADA MODELS 64APC, A66PC, 74APC AND A76PC.—*A single switch grounds (a) a regular tone control condenser, (b) an inverse feedback circuit, and (c) a bass compensator circuit, in proper combination to achieve the tonal quality desired.*

We may see, as in Fig. 1, that when contact 1 is grounded by the switch, the high frequencies in the audio circuit are progressively attenuated. The bass compensator and inverse feedback circuits function normally in this position. In position 2, all tone control circuits are open. In position 3, the bass compensator circuit is made inoperative by shorting out the 0.005-mf. condenser in the bass compensator circuit. In position 4, both the bass compensator and the inverse feedback circuits are shorted out.

The effect on the tone of progressing from points 1 to 4 is to obtain deep, mellow, normal and brilliant tones in succession.

(FIG. 2) PUSHBUTTON AMPLITUDE-FREQUENCY MODULATION CHANGEOVER

STROMBERG-CARLSON NO. 435.—*With a double pole-double throw switch operated by a pushbutton and a relay, reception may be switched from amplitude modulation to frequency modulation in this receiver in 2 units; each with a separate power supply.*

In the amplitude modulation (A.M.) position, as shown in Fig. 2, the regular audio output is derived from the usual diode rectifier, while the 1st-detector and I.F. screen-grid voltages for the A.M. receiver section are supplied through a relay solenoid. In carrying this screen-grid current, the relay opens the entire high-voltage supply for the frequency-modulation sections of the receiver.

(FIG. 3) FILTER INPUT CONDENSER PROTECTION

STEWART-WARNER MODELS 03-5R, 07-5R AND 03-5S.—*While it has now become general practice to make use of a resistance in the plate circuit of a half-wave rectifier for A.C.-D.C. supply, this has not been found adequate to protect the input filter condenser from voltage surges.*

The plate resistance has taken the form of a pilot and a section of the rectifier filament as in Fig. 3, but did not have all the anticipated advantages with respect to the input filter condenser. Now, a small resistance, 33 ohms in this case, has been placed between the cathode of the rectifier and the filter input to limit the peak voltage on the filter input condenser. As a result, less failure of input condensers has been achieved.

(FIG. 4) CIRCUIT MUTING ACHIEVED BY OPENING CATHODE CIRCUIT

CROSLEY MODEL 719.—*By means of pushbutton control, a grounded switch lever is released from the output cathode circuit, and connected to the solenoid of the magnetic tuning coil.*

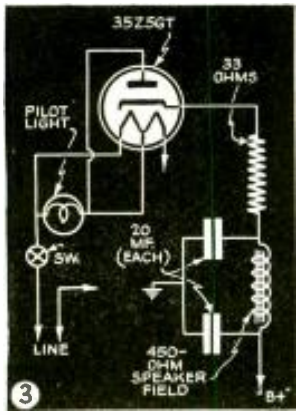
"Magnatune" for operation of the tuning mechanism. When the tuning operation is completed, the grounded switch arm is again returned to the output cathode circuit and reception is resumed. The circuit is shown in Fig. 4.

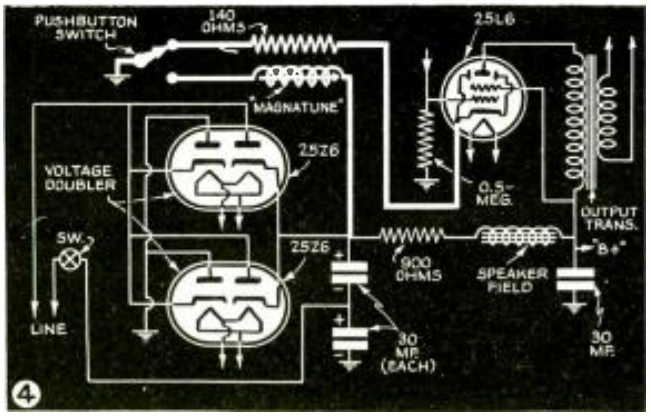
(FIG. 5) CRYSTAL MICROPHONE AND PREAMPLIFIER USED IN RECORDING

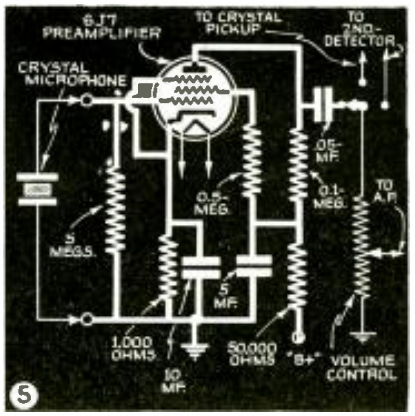
WILCOX-GAY MODEL A-70.—*Being provided with complete recording equipment, this receiver makes use of a crystal microphone and pentode preamplifier.*

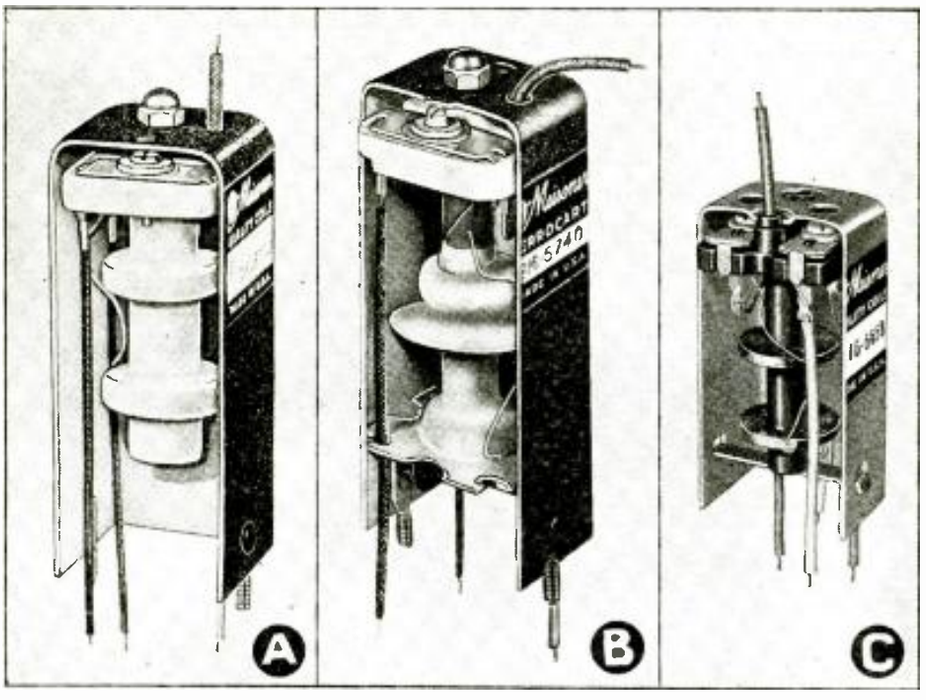
The preamplifier is a 6J7. The signal level entering the 1st audio grid (6Q7) may be comparable with that from the radio tuner and crystal pickup also entering at this point.

The circuit of the microphone and its preamplifier is shown in Fig. 5. It is one of the 3 inputs selected for the audio channel.









The June issue of Radio-Craft *contained the first article in this valuable series on coils; the title: "Servicing R.F. Coils." The July issue contained the article "Replacing I.F. Coil Windings." In this 3rd, next to concluding article, the author gives Servicemen and experimenters information they have long been wanting on the considerations involved in properly replacing manufactured I.F. coils.*

Fig. 1. A—Standard Meissner air-core I.F. transformer; B—iron-core I.F. (increased selectivity); C—new "plastic" I.F. transformer.

REPLACING I. F. TRANSFORMERS

L. V. SORENSEN

IN the article entitled "Replacing I.F. Coil Windings," published in last month's issue of *Radio-Craft*, it was pointed out that when an I.F. transformer fails there are 2 possible courses to pursue in making the repair: (1) either replace only the defective winding; or, (2) replace the entire I.F. transformer. The conditions that dictate replacement of the coil only were discussed in that article and detailed directions were given for making the repair. This next article concerns repair by replacing the *entire* transformer.

ECONOMICS OF REPLACEMENT

The Serviceman, like the doctor, has essentially only one commodity to sell—his knowledge of the operation of a given kind of device, in this case radio sets, and his ability to correct their malfunctioning. In order to sell the greatest quantity of this commodity, the Serviceman should confine his efforts to diagnosing trouble and to checking repaired sets, leaving to an assistant the actual work of repairing.

The installation of a completely engineered and factory-made replacement I.F. *transformer* is a task easily done by the least experienced assistant, requiring only checking and aligning by the Serviceman; and, in rare cases, the elimination of oscillation when the factory-made product results in enough greater gain over the original transformer to cause oscillation. On the other hand, the installation and adjustment of replacement I.F. *windings* require the knowledge, experience and judgment of a qualified Serviceman, and is a task not properly delegated to an assistant.

Replacement Transformers vs. Replacement Transformer Windings.—As long as factory-made replacement I.F. transformers of good quality are available at attractive prices the sound-thinking Serviceman will realize that he can not afford *not* to use them, falling back on Replacement I.F. Windings only on those occasions where no satisfactory complete Replacement Transformer is available. There is only one condition when this is not true—when there are a number of sets of the same model to be repaired, in which case the spacing of replacement windings may be worked out on one set and then applied to all of the remaining sets. Practically the only occasion for such a condition to occur is when a Serviceman is connected with a large dealer or jobber handling a single line of receivers.

SELECTION OF REPLACEMENT I.F. TRANSFORMERS

By far the greater number of radio receivers employ only 1 I.F. amplifier tube which means that both the input and output I.F. transformers must have high gain if the set is to be adequately sensitive, unless there is a high-gain stage of R.F. amplification ahead of the converter (which is comparatively rare). Even in the case of such a set the gain produced by a pair of high-gain I.F. transformers is seldom objectionable. In the few cases where a set may be too sensitive because of the use of a high-gain replacement transformer the sensitivity can always be reduced by a shift in either cathode bias or screen voltage. It can therefore always be assumed that *the correct replacement I.F. transformer for a set with 1 I.F. stage should be of the high-gain type.* Replacement I.F. transformers of various types are shown in Fig. 1; these have 1 side of the shield can cut away to clearly show the interior construction.

The air-coil (Fig. 1A) and iron-core (Fig. 1B) I.F. transformers have coils protected by a heavy coating of white wax. Shields are 1⅜ ins. square and 3½ ins. long.

The "plastic" I.F. transformer (Fig. 1C), is featured by a 1-piece molded low-loss trimmer-base and coil form, held in place in the shield can by a novel flat-spring mounting arrangement. Coils are protected by "Q-Max"; shield is only 1¼ ins. square and 2½ ins. long.

When radio sets have 2 I.F. amplifier tubes and 3 I.F. transformers, in a circuit similar to Fig. 2A, the transformer windings employed produce comparatively low gain-per-stage, at least in the 1st and 2nd transformers. The last transformer driving the diode usually enables amplification approaching that of a conventional "Output" I.F. transformer for a set with only 1 I.F. tube.

Sets that employ 2 I.F. tubes but only 2 I.F. transformers instead of 3, as in Fig. 2B, usually employ a resistance-capacity coupling network between the 2 tubes in much the same fashion as a resistance-capacity coupled audio-frequency amplifier.

The only essential difference lies in the values of the resistors and the condenser, in the frequency of the signal (I.F.) and in the amplification produced, which is much lower than that produced by the conventional resistance-coupled audio stage. Such sets employ high-gain input and output I.F. transformers and should be considered in this discussion as belonging to the type of sets having only 1 I.F. stage. Returning again to the set with 3 I.F. transformers, it must be realized that at least 1, probably 2 and possibly all 3 transformers employed have low gain so that the overall amplification will not be too high. If one of these transformers is replaced with a high-gain transformer it is probable that the circuit will oscillate.

It is also probable that such a set has a super-abundance of I.F. gain and that consequently, if the replacement transformer happened to have somewhat lower gain than the original transformer, the set would still be amply sensitive for normal reception. Following this idea and considering that the 1st and 2nd I.F. transformers usually have low gain in sets with 3 I.F. transformers, the logical replacement for either the 1st or 2nd of these transformers is a Meissner "Interstage" transformer which was purposely designed to have low gain. The Serviceman, with his signal-generator and output meter, can quickly tell

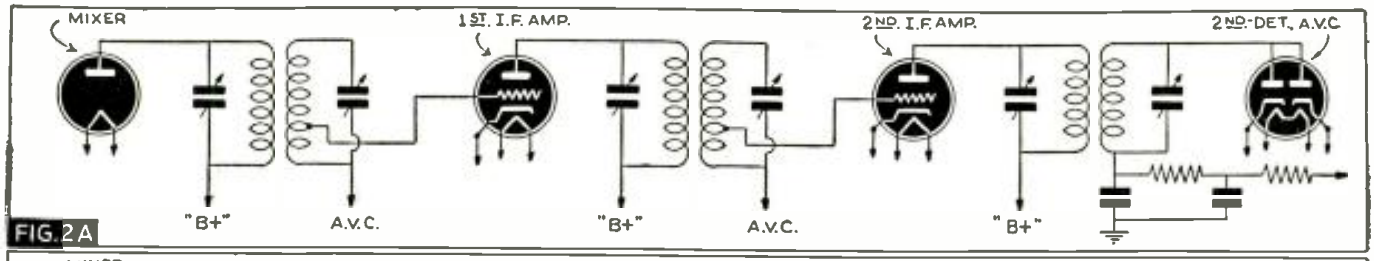


FIG. 2A

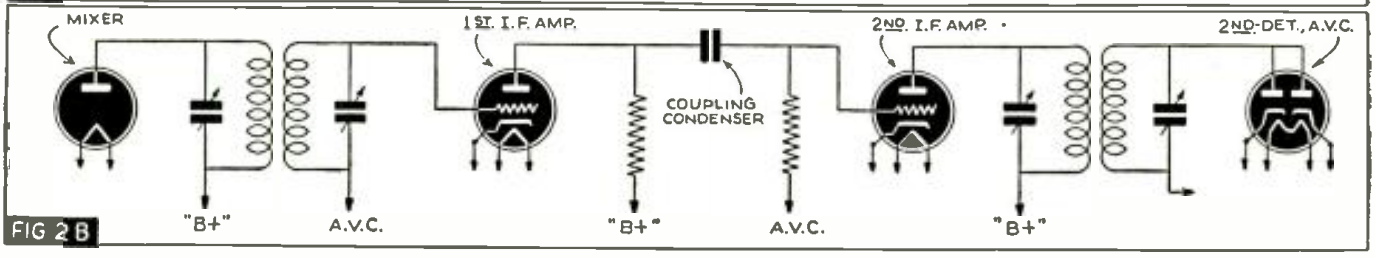


FIG 2B

whether the use of such an "Interstage" replacement transformer (low-gain) has made the set too insensitive for satisfactory service. In those rare cases in which the sensitivity is too poor, it will be necessary to change the "Interstage" transformer for an "Input" transformer which has higher gain. If the practice of replacing either the 1st or 2nd I.F. transformer (of a set with 3 I.F. transformers) by an "Interstage" transformer is followed, the number of cases in which it may be necessary to change the "Interstage" for a higher-gain unit will be far fewer than the number of cases of oscillation or excessive regeneration that it would be necessary to correct if high-gain transformers were always installed first.

In the case of the 3rd I.F. transformer, feeding a diode detector in most instances, the gain may approach that of the conventional "Output" I.F. transformer. It is, accordingly, recommended that an (Meissner) "Output" I.F. transformer be the first choice as a replacement for this transformer.

INSTALLATION OF REPLACEMENT I.F.T.

The replacement transformer should be installed in the defective receiver in as neat a manner as possible because customers frequently judge the technical quality of repair work by the mechanical appearance of the finished repair.

In some instances it may be necessary to drill new holes in the chassis for mounting the replacement transformer. A few minutes spent to properly lay out the holes so that the transformer, when mounted, will be appropriately spaced with reference to adjacent parts and will have its sides parallel to or at right-angles to prominent sides or edges of adjacent objects is a good investment. When replacement transformers are put on a chassis at odd angles with respect to adjacent parts the customer is quite likely to undervalue the technical ability of the Serviceman in direct proportion to his apparent lack of care in making the installation of the new parts.

In case that the hole under the original transformer is too large to permit the replacement transformer to be mounted over it, a flat metal plate should first be installed and the replacement transformer mounted on it. In any case, the work should be done as neatly as possible.

The leads on the replacement transformer may have a different color code than the original transformer leads; consequently the original color code should not necessarily be followed. The popular I.F. replacement transformers have the following color code unless otherwise specified:

INPUT & INTERSTAGE I.F. TRANSFORMER COLOR CODE

Red = "B+"
Blue = Plate
Green = Control-Grid
Black = A.V.C.

OUTPUT I.F. TRANSFORMER COLOR CODE

Red = "B+"
Green = Diode
Blue = Plate
Black = Diode Load
Yellow = Center-Tap (when used)

This code of connections must be followed if proper results are to be obtained.

The POSITION of the blue (plate) lead and the green (diode or control-grid) lead should be carefully chosen so as to be as far away from other grid or plate leads as possible. Usually the position of the original control-grid and plate leads is a reasonable guide to the best position for the leads of the replacement transformer, but in cases of oscillation trouble that occasionally develop when the replacement I.F. transformer has higher gain than the original transformer, the original lead positions may not necessarily be best, and a new position with greater separation between certain "hot" leads may have to be selected.

As a rule, the blue and green leads should be as short and direct as possible. The length and path of the red lead is seldom of any consequence on any (Meissner) I.F. transformer. The length and path of the black lead is seldom of any consequence on input or interstage transformers *but on output transformers should be short and direct to the diode load resistance and should be kept close to the chassis.*

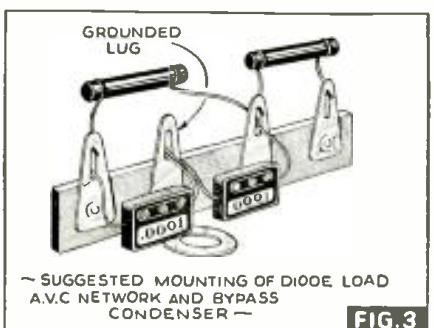


FIG. 3

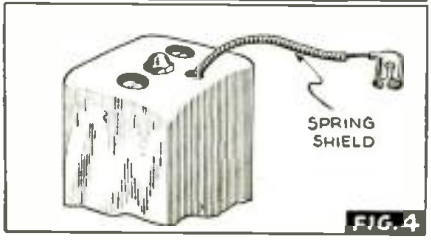


FIG. 4

When the defective transformer is an output transformer with the diode filter and perhaps part or all of the diode load resistors and condensers assembled in the same can there arises the problem of what to do with these extra parts. If the set is large it is recommended that these extra resistors and condensers be assembled neatly on an insulated terminal strip as in Fig. 3 and that the strip then be installed under the chassis close to the replacement I.F. transformer. This is, of course, not the best practice technically which would be to put the parts back into the new transformer, but is a reasonable procedure in making a satisfactory repair with a minimum expenditure of time.

The arrangement of parts shown in the figure, is merely a suggestion, as the actual values and connections depend upon the original circuit. If the set is congested it is recommended that these extra parts be installed in the base of the replacement transformer either on parts removed from the old transformer or on any reasonable substitute that can be improvised by the Serviceman.

SHIELDED LEADS

The use of shielded leads should be avoided because close-fitting shielding disturbs the I.F. transformer characteristics in several ways. The 1st and most apparent effect of close-fitting shielding on the grid, diode, or plate leads is to add to the circuit capacity. This requires that the trimmer condenser in the transformer be operated at a correspondingly lower capacity.

If the shielded lead is long and the shielding is close fitting it is entirely possible that the amount of capacity added in the shielding may be more than the amount required to tune the transformer, in which case the trimmer will never "peak" but the output will only approach a maximum as the capacity is reduced. In a less exaggerated case, where the capacity added in the shielded lead is not enough to prevent the trimmer from "peaking," the "peak" may occur at a setting of the trimmer condenser that is too loose for stability when the transformer is subjected to vibration.

A convenient check for this fault is to hammer on the side of the transformer with the handle of a screwdriver after the transformer has been aligned. If the output changes materially due to hammering, the

Quick, now, what are the answers to the following questions?

(1) Under what conditions is it preferable to install a Replacement Transformer instead of a Replacement Transformer Winding?

(2) How does a "plastic"-type I.F. transformer differ from air-core and iron-core types?

(3) What instruments would you use to check for excessive gain caused by an interstage-type replacement I.F.T.?

(4) What are the causes of, and remedies for, Single-Stage Oscillation?

(5) What are the causes of, and remedies for, I.F. circuit oscillation *off-resonance?*

Give up? Then, read this article, which answers these questions — and many more—in detail.

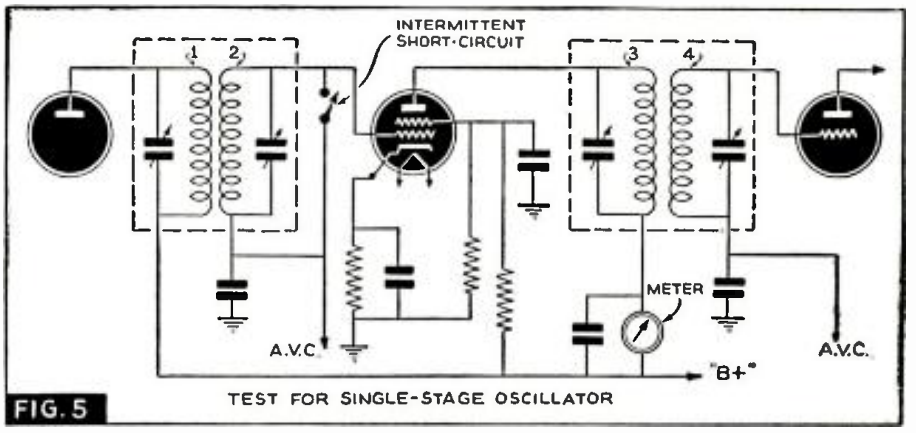


FIG. 5 TEST FOR SINGLE-STAGE OSCILLATOR

trimmer is probably too loose, and the shielding should be reduced to permit the trimmers to be worked at a more stable part of their capacity curves.

The 2nd objection to shielding on grid, diode or plate leads is that the insulation on the hook-up leads CHANGES CAPACITY and POWER-FACTOR (losses) with changes in atmospheric humidity. These changes cause the sensitivity of the set to shift with the weather. These shifts in sensitivity can become very bad if excessive amounts of shielding are used.

The 3rd objection to close-fitting shielding is that the insulation on ordinary hook-up wire has relatively high R.F. losses. lowering the "Q" of any coil to which the shielded wire is connected.

In A.C.-D.C. sets of the Underwriters-approved types there is another objection to shielding on either the diode or diode-return leads when the shielding is connected to the chassis. In such sets the "B–" point in the set is isolated from the chassis and is bypassed to it by a condenser whose capacity does not exceed 0.25-mf. Because of the capacity of various parts of the set to chassis, and because the isolating condenser is of limited capacity the chassis is not at "B–" A.C. potential nor, for that matter, is it at the potential of any other point in the set.

Across the isolating condenser appear audio frequencies from the filament supply as well as components from the half-wave rectified current. When a shield on a diode or a diode-return lead is connected to chassis the hum voltages appearing across the isolating condenser are impressed by the shield onto the high-impedance diode circuit, causing an audio hum voltage to appear across the volume control which, of course, is converted by the speaker into an audible hum. If the shielding is connected to the "B–" point in the chassis, this hum will not be present, but it will then be necessary to insulate the outside of the shielding so that it cannot ever come in contact with the coil shield, the chassis, or any other metallic object attached thereto. Unless this is done some one may accidentally receive an unpleasant or even dangerous shock upon touching the chassis and any grounded object simultaneously. Where flexible-spring shielding such as shown in Fig. 4, has been used on one of the leads on the original transformer, it is usually good practice to use the same shielding on the corresponding lead of the replacement transformer. This is permissible because the shielding is not tight on the wire and because the length of shielding is seldom more than 2 or 3 inches. It is, in other words, a low-capacity shield.

On experimental or custom-built sets that have not enjoyed competent engineering, long grid or plate leads have sometimes been employed without the builder being aware of the troubles that may result. When shielding is added to such leads, to eliminate troublesome coupling, it should be of large diameter such as is used on the "lead-ins" of auto-radio sets.

ALIGNMENT

After the replacement transformer is installed it should be aligned. It is true that all Meissner replacement I.F. transformers have been aligned in the factory and tested for gain and selectivity before shipment, but installing the transformers in receivers in which the circuit wiring has a different capacity than that which existed in the test set, coupled with the fact that the intermediate frequency of the receivers may be some kilocycles different from the frequency to which the transformers were adjusted in the factory, requires that the transformers be re-aligned after installation. The methods of aligning are so well known that the details of that simple process are omitted.

OSCILLATION AND FEEDBACK

There will be a few sets in which the replacement transformers will result in enough more amplification than the original transformer that oscillation will result. The following discussion of the subject of oscillation gives an account of the most important methods by which feedback occurs and shows how oscillation caused by the feedback can be cured.

Feedback can be divided roughly into 2 classes: (1) Single-stage, and (2) Overall. Single-stage feedback is literally what the name signifies, whereas under the heading of "Overall Feedback" are considered all types of feedback involving more than 1 tube.

SINGLE-STAGE OSCILLATION

Single-stage oscillation in amplifiers is usually the least understood type of regeneration trouble. It has frequently baffled Servicemen and experimenters. It is peculiar in that *no amount of filtering applied to plate supply, screen, cathode or A.V.C. circuit, nor any amount of shielding seems to make any improvement.* This form of trouble is seldom encountered in a set made by a reputable manufacturer if the set is in its original condition and has the original sets of tubes in the original sockets. Experimental sets, custom-built sets and sets that have had new I.F. transformers installed on them are far more likely to exhibit single-stage oscillation.

The enthusiastic amateurs or experimenters may select I.F. transformers of the highest-possible gain characteristics for their sets and then wonder why they have so much difficulty making a single I.F. stage behave; and why they have to use such abnormally high biases on their I.F. amplifier tubes before stability is attained. The fact of the matter is that the grid-to-plate capacity of the I.F. amplifier, although it is only 0.01-mmf. or less, is the limiting factor in the amount of gain that can be obtained from a tube before oscillation results.

In order to obtain high gain from an amplifier it is necessary that the coupling impedances be very high. To this end, I.F. transformers have been built with higher and higher inductance and with better and better (higher-"Q") coils until, when used in an amplifier, the amplifier oscillates. If this oscillation persists even after completely shielding the stage and isolating the screen-grid, "B+", cathode and A.V.C., the limit of amplification possible with that tube and circuit has been reached. Only by neutralizing the grid-to-plate capacity of the tube can circuits of higher gain be used. What actually occurs is that a part of the I.F. voltage appearing in the plate circuit of the tube gets back through the grid-plate capacity of the tube and impresses itself on the grid circuit. If the amount of this *feedback* voltage is large enough and the impedance of the grid circuit is high enough, sustained oscillation will result in much the same fashion as the well-known "Tuned-Grid—Tuned-Plate" transmitting circuit performs. Technically speaking, it is also necessary that the phase relations be correct, but these can so easily be changed by slight adjustments of the trimmer that it is a foregone conclusion that the proper adjustment for oscillation will be obtained when the impedances are high. The remedies for single-stage oscillation are:

(1) Use a close-fitting tube shield on the offending tube.

(2) Use a tube with lower grid-plate capacity.

(3) Use a tube with lower mutual conductance.

(4) Raise the bias on the present tube until oscillation stops.

(5) Use circuits of lower impedance.

(6) Neutralize the grid-plate capacity.

If the positions of the grid and plate leads of the I.F. transformer are already located one above the chassis and the other below and if the tube has around it a close-fitting shield that is grounded to the chassis, there is nothing further that can be done from this standpoint to improve the situation. If these conditions are not all fulfilled some improvement may be made by adding the tube shield or placing leads for lower coupling.

Concerning lower grid-plate capacity, it can be said that normally this parameter of tubes is quite constant although occasionally there are a few tubes with capac-

ities up to or even exceeding 10 times their normal value. *It is always recommended that several tubes be tried in an oscillating I.F. amplifier* (realigning each time) *before doing much work to determine the cause of oscillation or attempting to correct it.*

It can also be said that some G (glass) or GT (bantam glass) equivalents of metal tubes have appreciably more grid-plate capacity than the corresponding metal tubes. *Therefore, if the tube giving trouble is a G or GT tube and the metal equivalent is handy it is wise to try the metal tube, being sure however to realign the circuits.*

Concerning the use of a tube with lower mutual conductance, one might say that such a remedy is academic and is included only for sake of completeness. It is far more practical and logical to raise the bias on the offending tube until its mutual conductance is reduced far enough to establish stability.

The use of lower-impedance circuits is a very wise procedure for eliminating single-stage oscillation and is the method employed by qualified radio engineers when designing receivers. When high-impedance circuits are used and the I.F. amplifier tube is biased-up to attain stability, the A.V.C. characteristic of the receiver suffers, the degree of control becoming less as the minimum fixed bias is increased. In (Meissner) replacement I.F. transformers the circuit impedances were carefully chosen to prevent single-stage oscillation in practically all cases. There will still be found, however, a few sets in which the remaining good transformer has a high enough impedance to cause the stage to oscillate when a (Meissner) replacement transformer is installed. Such sets call for increased cathode bias to restore stability. The use of neutralized circuits in combination with screen-grid tubes is academically interesting and has been of practical interest in a few special cases but normally such circuits are no longer used to any extent.

Since a complete understanding of single-stage oscillation involves a knowledge of circuit impedances, at least qualitatively, the following explanation of the changes in circuit impedances is given as a background for explaining a peculiar phenomenon that some Servicemen may have noticed which is that some I.F. amplifiers oscillate when some of the trimmers are out of adjustment and that as alignment proceeds the oscillation stops.

Anti-Resonance Oscillation. — When an inductance is shunted by a condenser a "resonant circuit" is formed whose impedance is very high at the frequency to which the circuit is tuned but the impedance drops off very rapidly above or below this frequency, soon reaching a low value. The impedance at resonance is approximately equal to the product of frequency times 2π, of inductance, and of the "Q" of the circuit.

When 2 similar circuits are separated far enough so that they have no effect upon each other (are not coupled) and they are both tuned to the same frequency, they each have a definite high impedance, but if these circuits are brought progressively closer together (coupled) until "critical coupling" is reached, the magnitude of the impedance of each circuit will drop to approximately ½ of the original impedance when isolated from each other.

When the position of the coils of 2 tuned circuits is fixed, as in the conventional I.F. transformer, and the trimmers are adjusted so that the circuits are tuned to vastly different frequencies (are electrically far apart), the impedance of each circuit is high *at the frequency to which it is tuned.* Now if one of these circuits is tuned to the intermediate frequency it will have its highest impedance at that frequency when the other circuit is tuned to a frequency far removed from it, but as the frequency of the 2nd circuit is brought progressively closer to the intermediate frequency the high impedance of the original tuned circuit begins to drop until when *both circuits are resonant to the same frequency, the impedance of the original tuned circuit reaches its lowest value,* approaching ½ of the original value if the coils are "critically coupled." When an I.F. amplifier such as is shown in Fig. 5, is stable with all circuits in resonance and oscillates when the 1st and 4th circuits are detuned in opposite directions, the oscillation is caused by the impedance of the 2nd and 3rd circuits reaching or exceeding the critical value as the 1st and 4th circuits are detuned.

All competent engineers designing radio sets test their designs for this type of trouble so that they will be sure that even though the I.F. trimmers or coils may drift a little from exact alignment, the circuit impedances will not rise high enough to cause single-stage oscillation. Occasionally, however, when sets have been pushed to obtain the maximum sensitivity from average tubes, exceptionally high-gain tubes may cause oscillation with surprisingly little detuning. The usual remedy is to use a tube not quite so good or to raise the bias slightly.

The most certain check for single-stage oscillation is to connect to the grid of the suspected tube the I.F. probe of a Meissner Analyst or similar "Signal Tracing" service equipment and to watch for indications of the presence of a strong I.F. signal when the 1st and 4th circuits are detuned in opposite directions while the 2nd and 3rd circuits are left in alignment. If no Analyst or equivalent is available, a milliammeter connected as shown in Fig. 5, bypassed by a 0.1-mf. condenser, can be used to check for single-stage oscillation in the following manner:

Detune the 1st and 4th circuits in opposite directions, then watch the milliammeter while an intermittent short-circuit is applied to the control-grid of the tube, meanwhile slowly shifting the grid trimmer

slightly above and below resonance. If the plate current changes when the short-circuit is applied and removed, the circuit is changing from the oscillating to the stable condition, or vice versa.

OVER-ALL REGENERATION

Over-all oscillation is a familiar complaint on multi-stage T.R.F. receivers, even of good design, and on I.F. amplifiers of high gain. On experimental receivers in the process of development it may be produced by any one of a number of causes. Only by experiment can the offending source of coupling be discovered and removed. It may be of 2 general types, high-impedance or low-impedance; or might be considered *voltage* feedback and *current* feedback although all feedback phenomena in radio receivers are, strictly speaking, voltage feedback phenomena.

Coupling between antenna and control-grid or plate leads, and couplings between control-grid leads or plate leads, etc., all of which impress relatively high voltages on the very small capacities existing between the points just mentioned, are classed as *high-impedance feedbacks*. Appropriate partition-type shielding quickly stops this type of feedback. Under the heading of *low-impedance feedbacks* are placed all oscillation troubles resulting from the use of common cathode, screen-grid or plate bypass condensers, common leads in high-frequency circuits, couplings resulting from the common shaft of a gang condenser, etc. Eliminating oscillation from these sources requires a study of the receiver and many experiments, isolating the various circuits that are suspected of causing the feedback, until finally the real offender is discovered.

Sometimes feedbacks are *degenerative* instead of *regenerative* and the disconcerting fact may be discovered in some cases that isolation of certain circuits increases rather than decreases oscillation troubles.

On manufactured receivers made by a reputable company which attempts to keep uniform quality, over-all oscillation after some time in service can usually be traced to some circuit element that changes characteristics with age. For example, if no paper condenser is used across the electrolytic filter condenser to insure a permanent low-impedance R.F. path to ground, over-all I.F. oscillation can occur when the R.F. resistance of the electrolytic filter condenser increases with age.

In T.R.F. receivers, frequently high-resistance contacts between the gang-condenser shaft and the wipers causes over-all oscillation which can be eliminated by a thorough cleaning of the contacting surfaces. Common bypass condensers also should be suspected as the cause of feedback. When they are, they are usually found very easily by connecting a known good condenser across each bypass condenser successively until the defective unit is found.

REGENERATION OF A.C.-D.C. SETS

In A.C.-D.C. sets of the Underwriters-approved types, regeneration is usually a serious design problem because the chassis is not solidly connected to the "B–" point in the receiver but is merely bypassed to that point by a capacity not exceeding 0.25-mf. This isolation of the chassis from the "B–" point, which is usually one side of the power line, is done to eliminate the hazard attached to a set that has its chassis connected solidly to the power line. For the same reason the capacity allowed between the chassis and the minus "B" is limited to 0.25-mf.

Since every alternating or pulsating voltage in the set causes some small current to

(Continued on following page)

BROADCAST NEWS ITEMS

Says Dr. Raymond B. Fosdick (pres., Rockefeller Foundation), those who listen most to radio programs find the least interest in their reading. Hence, "radio listening" predominates among those who never reached high school, and decreases as the level of literacy rises toward college graduates. . . . Yesterday it was little more than a pile of rocks sticking out of the water at high tide, but soon it probably will be filled-in and made the site of WABC's broadcast transmitter (now located in Wayne Twp., N. J.), for Little Pea Island in Long Island Sound recently was purchased by Columbia Broadcasting System.

(Continued from preceding page)

flow through the capacity of the parts to the chassis, thence through the isolating condenser and back to "B–", there is in the input circuit of the receiver (which includes the isolating condenser) a mixture of frequencies, amplitudes and phases that is impossible to predict. Some of the voltages are regenerative, some degenerative, some cause trouble at any setting of the gang condenser, while others cause trouble only over a limited range of positions of the dial (usually at the low-frequency end). When oscillation troubles result after replacing an I.F. transformer there are 2 logical remedies possible:

(1) Reduce the common impedance across which the feedback occurs.

(2) Reduce the gain of the I.F. system.

As mentioned above, the Underwriters limit the value of the isolating condenser to 0.25-mf. to reduce the shock hazard. If the chassis is well protected from contact, the capacity can be increased to some extent. However, due care should be exercised to see that the condenser is of good quality and rated at not less than 400 volts (working).

A more satisfactory method of eliminating I.F. oscillation is to increase the bias on the I.F. amplifier until the gain of the tube is reduced enough to restore stability. When it is considered that most A.C.-D.C. sets are of the very inexpensive type, and that the customers are usually not willing to pay any considerable sum for repair work (approaching 1/3 to ½ of the original cost) it is usually best practice to correct oscillation troubles by the fastest method—raising the bias—even though perhaps somewhat better results might possibly be obtained if more time were to be spent on the repair.

Look next month for the final article: "Servicing Oscillator Coils."

OPERATING NOTES

. . . . CANADIAN ROGERS SETS

741A.—A rather troublesome intermittent turned up in a Rogers model 741A receiver. This set played for days without any apparent defect, then suddenly would drop in volume accompanied by hum and distortion. The type 45 output tubes tested OK as did all other tubes and condensers. To make things worse, the set would often start to play normally just as I started to make some tests. The plate voltage on the 45's would drop about 50 volts whenever the trouble started. I then disconnected the 1,200-ohm bias resistor for the 45's. The set continued to play. The trouble was caused by an intermittent short at the place where the wire from the center-tap of the type 45 filaments was soldered to the resistor.

832.—An annoying trouble in the Rogers model 832 is intermittent reception due to poor contacts on the tuning condenser assembly. All movable parts should be cleaned and Russian oil applied, as well as some vaseline.

645.—In the Rogers model 645 the input transformer usually gives trouble. I find it advisable to replace the bypass condenser from the 10,000-ohm resistor to chassis. This resistor is in series with the high voltage and the primary of the output transformer. This condenser usually burns out along with the resistor so it pays to replace it and save trouble later.

951.—A common trouble in the Rogers 951 chassis is the opening-up of one of the windings of the band-pass I.F. assembly. The can should be removed and the various coils checked.

Another trouble in this set is caused by dirt on the contacts to the rotor of the tuning condenser. As the input transformer primary is bypassed with a 20,000-ohm resistor, voltage will be present on the plate of the type 27 A.F. tube, even though the primary winding may be burned-out.

ALLAN FORD,
Portneuf Station, P.Q., Canada.

. . . . FERGUSON MIDGET

In Ferguson midget receivers utilizing a 25A6 output tube, distortion after a few minutes of operation frequently may be traced to the grid leak in the 25A6 stage. Sometimes measures as much as 2 megs. Replace this with a ½-megohm resistor.

WILLARD MOODY,
New York, N. Y.

. . . . RCA U-30

This model utilizes automatic motor tuning. In several models I have discovered that erratic or complete inoperation of the automatic mechanism is caused by a leaky or open motor-starting condenser connected across the tuning motor. It is rated for intermittent use only and is frequently a cause for repair.

This unit, a 60-mf. 40-V. A.C. electrolytic is mounted directly on the tuning motor. Replacement with a manufacturer's part restores complete operation and smooth, even travel of pointer over the face of the dial.

A. W. FREYER,
Holyoke, Mass.

. . . . CANADIAN GENERAL ELECTRIC CO. RECEIVERS

S22X, S22, 42, 62, S25, S42B.—Receiver oscillation and lack of sensitivity, in these models, can be corrected on the whole by replacing R4 with a 15,000-ohm, 5-W. unit; also R1, 8,000, 1-W. It is good practice to replace these although they may be in apparently good condition. Clean and adjust the rotor springs. Rebalance the entire unit.

R44, 46.—Due to wear the gang condenser shaft frequently shifts so that the fixed and movable plates are not centrally located. Loosen the holding screws for the 3 sets of fixed plates and if necessary ream the holes to obtain greater movement. Then center the 2 sets of plates and tighten holding screws. Clean the shield and tighten the holding springs. A realignment of the set and it performs like new, if not better.

H31, 32, 51, 71.—These are large cabinet-type receivers and excellent performers. Poor tone, lack of volume, and sometimes no control of volume can in most cases be cured by replacing the 4 resistors, 18,000, 10,000. 110,000 and 14,300 ohms, located on the connection board at back of set; in case you are in doubt, these are located next to the R.F. choke, and are replaced in the order given.

In this set, to check audio-frequency transformer for continuity it is necessary to disconnect the primary to secure results, otherwise an incorrect reading will be obtained.

Set the "Local-Distance" control in the QUIET position and realign. It is advisable in most cases to remove the speaker cone and clean the housing as this unit has a powerful magnet which is liable to scale. This scale will be found obstructing the correct operation of the speaker.

K52, 53, 59, 75, K60, K57.—On these 6 types, motorboating and oscillation are the most common breakdowns. The oscillating condition is quite easily checked by touching the cap of the 2A7 and in most cases reception will be obtained. It is advised that the dual condenser be replaced entirely; it will prevent a further call in a month or so.

K72, 76, 105, 107, 85, 125, 83, 87.—Hum and oscillation obtained on these sets can be cured by a careful survey of the wiring diagram. For a shorted condition the defective condenser should of course be disconnected but the average are open-circuits which can be easily bridged by a condenser of the same size. Cleaning the rotor springs is also a necessity on these models.

K106, 126.—The 2 models noted here, very often break down entirely. The plates of the 80 and 5Z3 tubes getting red are an indication of the failure of C36 in the case of K106; and the condenser pack and C32 for the K126.

Oscillation can be traced to a failure of screen-grid condenser C41. Several cases of poor and intermittent reception were cured by replacing the antenna coil; however it was later found that the application of a hot iron to the terminals of this coil would have cured this complaint!

Of the later models bearing the C.G.E. monogram it would be only fair to state that tube troubles caused 85% of set failure and where possible output tubes of the metal type were replaced by glass tubes.

E Series.—In conclusion, the "E" series have been serviced for oscillation and in a number of cases the 6K7 metal tube, while OK under test will prove to be the offender. These should be checked by changing their position or by substitution.

J. HOUGHTON,
Peterborough, Ont., Canada.

. . . . CANADIAN WESTINGHOUSE 410

Several times recently, in my service work I have encountered a number of Canadian Westinghouse model 410 receivers which had a rather annoying hum only when tuned to a carrier. This trouble has always been eliminated by connecting two 0.05-mf. condensers in series across the power transformer primary and grounding the center connection to the receiver chassis. This receiver uses a type 6X5 rectifier connected half-wave.

STANLEY DAVIS,
Vancouver, B. C., Canada.

. . . . PHILCO 800 AUTO-RADIO

A "receiver dead" complaint, in connection with one of these sets, can usually be attributed to defective vibrator points which are sticking. Replace with a new unit; do not attempt to file the vibrator points. In replacing, check the buffer condensers for shorts or opens. To test them in the primary circuit of the power transformer open the transformer case cover. Sometimes handling of this receiver will throw it out of alignment, and therefore, realign it as a safety measure. Align first the I.F., then adjust both the high- and the low-frequency padders at 1,500 kc. and 600 kc., respectively.

(Author unknown.)

REBUILDING FOR PROFIT

Servicemen and Servicemen-dealers may find it worthwhile to suggest alterations in an existing receiver in preference to restoring it to obsolete standards. Just what steps to take and how to go about taking them—thereby turning "nuisance" jobs into profit-makers—is the subject of this article.

CHARLES R. LEUTZ

EVERY technical trade has to contend with "nuisance" jobs and amateur competition. The carpenter is called upon to replace a broken picket, the electrician to replace a blown fuse, the plumber to fix a leaky faucet, etc. In each case the overhead expense and time involved costs much more than can be properly charged. The radio technician has the same problems, wherein the receiver defect is due to some simple trouble, easily located, such as a defective tube, dried out electrolytic condenser or partially defective paper condenser. However, in the last mentioned examples, invariably the customer is uninformed technically and accordingly a reasonable repair charge is in direct proportion to the technician's degree of fairness and conscience.

During recent years, radio set owners have begun to realize this state of affairs and are therefore becoming inclined to give repair jobs to some acquaintance, usually some young chap with limited technical knowledge but who can be counted upon for fair treatment. If the "beginner" is unsuccessful in making the required repairs, the customer turns to an established Serviceman. In the latter case, if the estimate of repairs is low, the job is placed.

Otherwise, the customer purchases a new set, invariably some small receiver available at a low cost. Therefore everyone loses. The repair job is lost. Neither the dealer or manufacturer can make a profit on a low cost receiver. Furthermore the customer also loses as the low-cost set can only give mediocre service and for a limited time.

The "beginners" giving amateur competition cannot be eliminated. *As a matter of fact they need encouragement* so they can adjust themselves into established and qualified technicians. In the interval, the established technician needs more business to survive, and it can only be obtained by being in a position to offer more value than can be offered by less skilled and informed "beginners."

A large majority of all radio Servicemen are trained to repair sets by restoring them to their original circuit conditions. *This means, in many cases, restoration to conditions of obsolete engineering practice!* Some radio repairmen, in fear of making mistakes, go so far as to insist on "original replacement" parts although these may be inferior to modern "universal replacement" equivalents.

In view of this unusual condition, it is apparent that a well-informed and skilled radio technician, instead of conducting a simple repair business, can offer a complete overhaul; and the new improvements made possible by available new component parts and tubes released from time to time.

THE REBUILDING MARKET

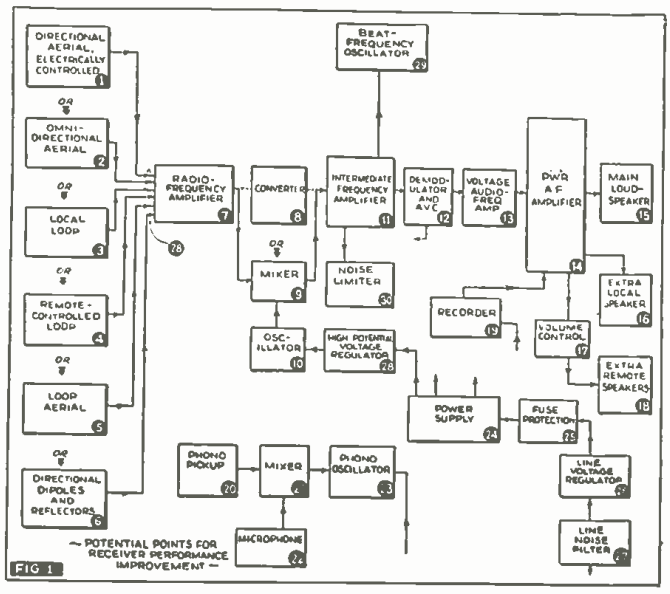
Naturally these jobs are not applicable to low-cost sets. Fortunately, however, there are hundreds of thousands of high-quality multiple-tube receivers, a year or more old, that can be substantially improved. This is not due to lack of designing skill but on account of the fact that production set designers are limited by cost considerations. Technicians who familiarize themselves with technical advances in the art can definitely offer real service which can be readily marketed and executed at a profit.

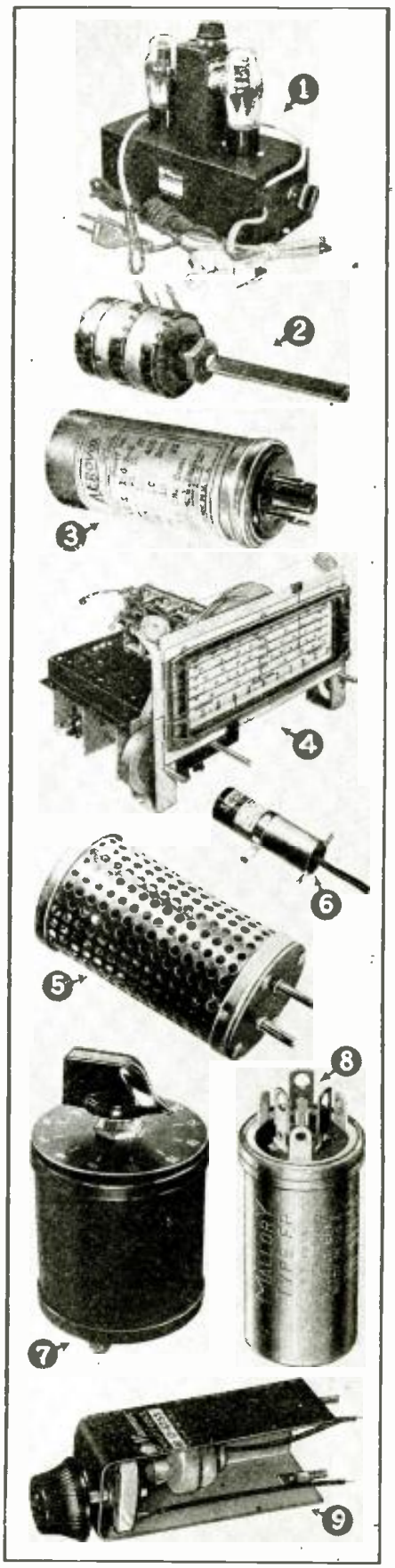
Figure 1 is an elementary diagram of a typical, modern superheterodyne receiver, showing the circuit divisions and points subject to possible improvement. It is not the intention of the article to give detailed instructions covering every possible improvement. Past articles in this publication have treated the proper design of different sections of a modern receiver including aerial systems, radio-frequency amplifiers, different systems of automatic volume controls, audio-frequency amplifiers, etc. These articles can be referred-to in this connection. (See appended list of a few such articles suggested by the author.—*Editor*)

The most important improvements can be summarized as follows:

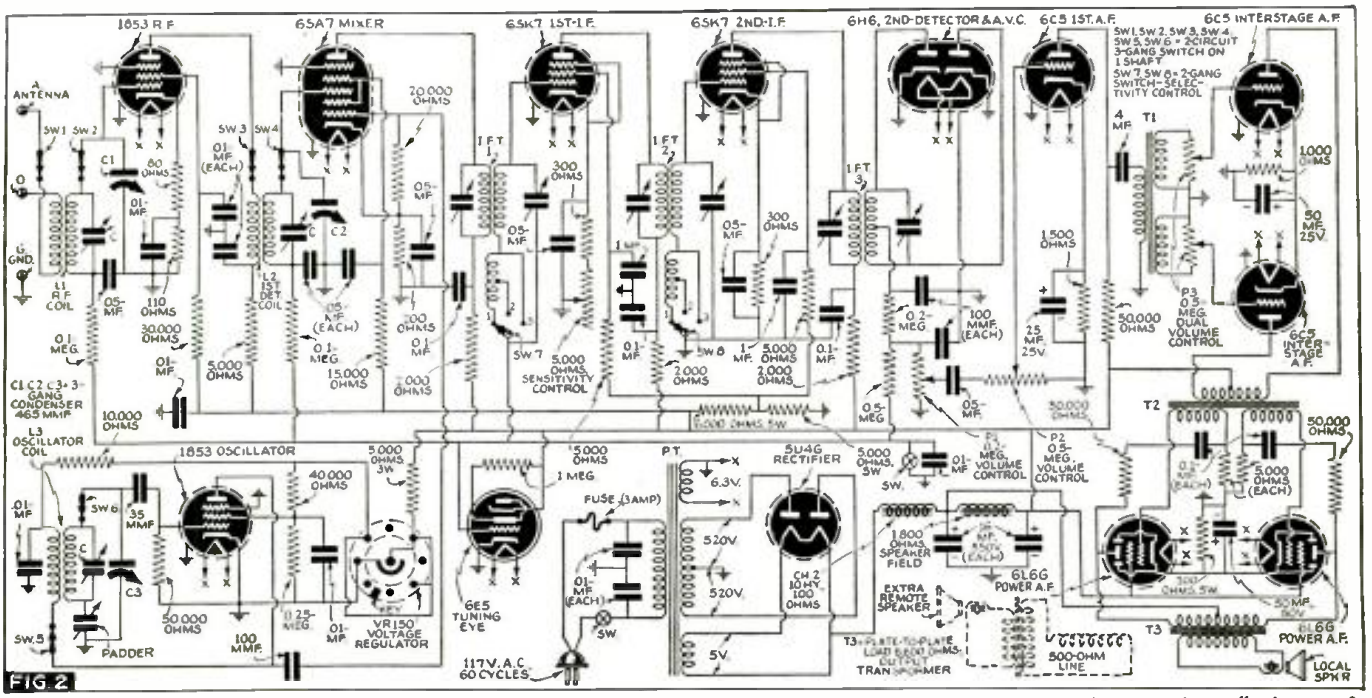
A. AERIAL OR SIGNAL COLLECTOR

The prime idea is to provide an aerial system to secure maximum signal energy from the desired stations and minimum





Profitable rebuilding may utilize the following components (shown above): (1) standard A.C.-D.C. phono oscillator; (2) dual volume control for push-pull audio input circuits; (3) plug-in type electrolytic; (4) factory-assembled and pre-aligned all-wave tuner; (5) line-voltage regulator; (6) tubular electrolytic; (7) output attenuator for extra loudspeakers; (8) heavy-duty dry electrolytic; and, (9) beat-oscillator transformer and trimmer.



Where would *you* start to check up on an existing receiver? And having decided where you wanted to make changes how would you go about effecting them? The first of these questions is answered in Fig. 1 on the facing page; answers to the second question are shown in Fig. 2, above.

signal energy from possible interfering stations—together with a minimum of local noise pick-up. The different systems available are as follows:

(1) **Directional Aerial, Electrically controlled**
The use is primarily for long-range "DX" reception but the application requires considerable space for erection.

(2) **Omni-directional Aerial**
The useful application is limited to receiving locations providing a high signal energy strength from desired stations.

(3) **Local Loop**
This is useful in eliminating adjacent-channel interference but the application is limited to locations where the local noise level is low, for example in the country.

(4) **Remote-Controlled Loop (See Fig. 3)**
This application is not only useful in eliminating adjacent-channel interference but also enables removing the loop from the field of local noise interferences.

(5) **Loop Aerial**
Same as No. 4 but due to the larger-size loop provides increased signal-to-noise ratio.

(6) **Directional Dipoles and Reflectors**
The advantages are the same as under No. 4 but the application is suggested for reception of shortwaves of 30 meters or less including television and frequency modulation signals (on between 5 and 10 meters).

B. LEAD-IN

The method of connecting the signal collector to the receiver is very important. In Fig. 1, this is designated as item No. 28 and involves the following methods, given in the order of relative efficiency, No. 1 being the least desirable and No. 6 being the most efficient:

(1) **Ordinary Single-Wire Lead-In**
Provides no discrimination between signal and noise collection.

(2) **Shielded Single-Wire Lead-In**
Eliminates lead-in signal and noise pick up but due to inherent capacity drastically reduces signal energy.

(3) **Twisted or Transposed Lead-In**
Satisfactory for low-frequency applications.

(4) **Best Rubber-Insulated Coaxial Cable**
Satisfactory for service down to 15 megacycles.

(5) **Flexible Copper Braid Coaxial Cable**
Satisfactory for service down to 30 megacycles.

(6) **Copper Tube Coaxial Cable, Polystyrene Insulated**
Essential for high-frequency and ultra-high frequency applications.

Types Nos. 1 and 2 should be eliminated in connection with any high-grade radio receiver installation. The choice of Nos. 3, 4, 5 or 6 depends entirely on the possible expenditure for this item, No. 6 being suggested for de luxe installations.

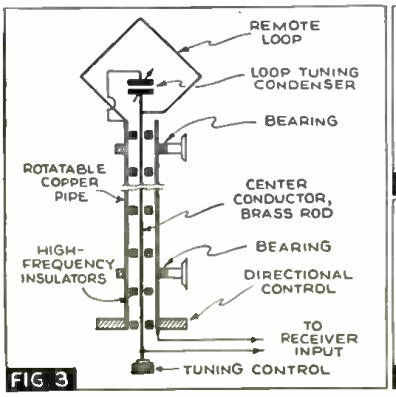
R.F. AMPLIFICATION

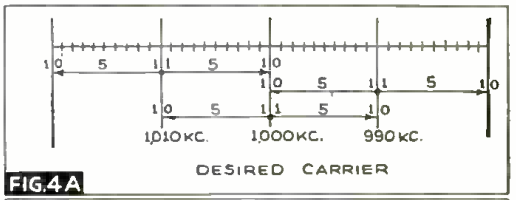
After covering the problem of signal collection, the next point to consider is *radio-frequency amplification.* Accordingly the antenna coupling transformer, R.F. tube and R.F. transformer must be given full consideration. By using properly-designed "iron-core" antenna input and R.F. transformers it is not only possible to secure high gain, but to secure nearly uniform gain over the entire frequency spread involved. Furthermore such transformers will have a "broad top," conducive to high-fidelity reception.

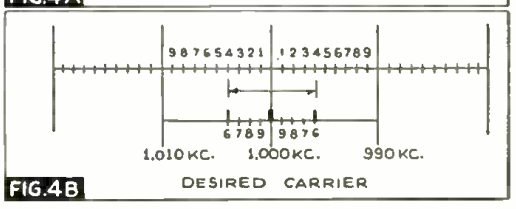
The R.F. tube suggested is the single-ended 6SK7 for broadcast-band receivers or the 6AB7/1853 for all-wave receivers. These tubes automatically provide stable operation, high uniform gain, and have the inherent ability to handle unusually strong signals without cross-modulation or modulation distortion, due to their remote cut-off characteristics.

For a receiver designed to cover the broadcast band exclusively, there is little choice between the use of a converter tube or a mixer-oscillator. In the case of an all-wave receiver including the higher frequencies, the use of an efficient mixer and separate oscillator becomes essential to obtain uniform results over a wide range of frequencies.

Figure 2 illustrates a typical modern all-wave superheterodyne receiver circuit wherein the 1853 is used for the radio-frequency amplification, a 6SA7 as a mixer and another 1853 as the separate oscillator. These tubes are selected due to their favorable noise characteristics, high uniform gain, and stability in operation. Used as either a converter or mixer, the 6SA7 is







practically free from frequency shift even at high frequencies. Furthermore, due to special structural design, there is a minimum of oscillator detuning by the action of A.V.C. The oscillator can be stabilized to a still higher degree by feeding the oscillator plate and screen-grid voltages from a voltage regulator tube (VR-150) as shown in the schematic diagram.

For simplification, the schematic diagram shows only 1 band position of a typical all-wave arrangement. Multiple-contact gang switches are available enabling installation of 5 or more band positions. Standard antenna input, R.F. transformer and oscillator coils are available to cover most any specified frequency range. For example one combination might consist of Longwave, Broadcast and 3 Shortwave bands. An alternative could consist of Broadcast and 4 Shortwave bands; or any other desired special arrangement.

I.F. AMPLIFICATION

The *intermediate-frequency amplifier* (11) is one point that can be substantially improved in a very large percentage of all receivers manufactured. This important receiver section must be altered before it becomes possible to use a wide-range high-fidelity audio amplifier.

Assuming the audio amplifier provided will cover from about 30 cycles to 10,000 cycles with reasonably uniform gain, then of course, the associated I.F. amplifier must have a flat-top band-pass of at least 10 kc. each side of the carrier. Under these conditions, unless the desired signal is many times stronger than adjacent-channel signals, it is impossible to eliminate interference. Accordingly unless adjacent-channel interference is eliminated external to the receiver, it becomes necessary to sharpen the I.F. amplifier selectivity down to a point where the band-pass acceptance is about 4 kc. above and below the desired carrier. This automatically limits the audio reproduction to a maximum of 4,000 cycles. However, an A.F. amplifier that faithfully reproduces a range of from about 30 cycles to 4,000 cycles is by far preferable to a wide-range A.F. amplifier subject to distortion.

Figure 4A clearly illustrates the above problem and if the 1,010, 1,000 and 990 kc. signals are of equal strength and all modulating up to 10,000 cycles, it is impossible to properly separate one from another. If the adjacent-channel interference can be eliminated by a loop or directional aerial, the desired signal can be received and directed to R.F. and A.F. amplifiers that will reproduce the full audio range up to 10,000 cycles.

Due to the fact that such adjacent-channel interference cannot always be eliminated external to the receiver, some adjustable I.F. amplifier selectivity control becomes necessary. A very satisfactory method calls for the use of *adjustable-coupling I.F. transformers* having 3 different degrees of selectivity.

In the sharpest position of such transformers, the band-pass is narrowed to approx. 4 kc.; the result is shown in Fig. 4B. The desired, received signal (1,000 kc.) is modulated up to 4,000 cycles. The frequency acceptance from both adjacent channels is limited in each case to the frequencies of 6,000 cycles or higher (shown by the shaded area). These higher frequencies form a small part of all musical renditions and accordingly interference is drastically reduced. Type 6SK7 tubes are suggested for the I.F. amplifiers.

It will be noted from the schematic wiring diagram that no A.V.C. is applied to the last I.F. stage. This is very important as a diode detector must be worked at high levels. As a matter of fact if the receiver is to be used exclusively for reception from a number of different local stations, it is advisable to eliminate the use of A.V.C. altogether.

The R.F. and I.F. amplifier circuits include decoupling filters in the plate-return and screen-grid leads.

Possible useful additions to existing I.F. circuits include a Lamb *noise silencer* (30) and a *beat-frequency oscillator* (29). The noise limiter is particularly useful in reducing automobile ignition interference encountered during shortwave reception. The beat-frequency oscillator is useful to locate

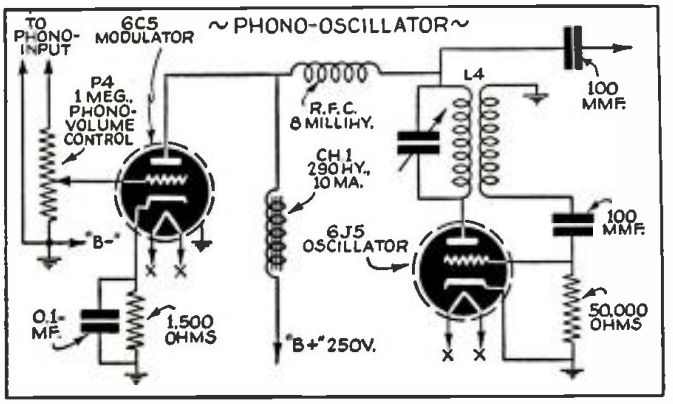


Fig. 6. "Wireless" Mike or Phono Oscillator. Here's the diagram and all circuit details for that "wireless" microphone and phono oscillator you have been asking for. Nothing to it, is there? Use it with any radio set; power it from the set or from a separate A.C.-D.C. supply, as you prefer.

weak carriers during "DX-ing" tuning operations.

A cathode-ray visual tuning indicator is an essential for any receiver having positions of "broad" tuning. For the circuit shown, the 6E5 eye is suggested.

The 6H6 is suggested as the demodulator or 2nd-detector and A.V.C. (12). The schematic wiring diagram shows the method of using the load resistor as a 1st volume control potentiometer P.1, and associated with the 1st A.F. input volume control, P.2. Adjustment of P.1 results in a loss of gain but together with the setting of P.2 enables maintaining the most favorable conditions for "distortionless" diode detection.

In the A.F. amplifier (13) a dual volume control, P.3, regulates the input voltage to the 2nd or interstage A.F. amplifiers. The power audio-frequency amplifier (14) consists of two 6L6G's, self-biased, in push-pull class AB1, with inverse feedback applied, using a split-secondary input transformer.

The above arrangement, at first glance, may appear to have excessive A.F. amplification. However, this is not the case. First, extra A.F. gain must be available to compensate for the loss of gain at P.1 Secondly, considerable driving power is required to properly excite the power amplifier tubes, after ample inverse feedback has been applied.

Low-gain triodes (6C5) are suggested for the 1st A.F. stage and interstage A.F. amplifiers. Low-ratio, wide-range high-quality audio-frequency coupling transformers are essential for maximum results. An ideal arrangement also calls for triode power output tubes, however the proper application of such tubes calls for more space and power than available ordinarily in the average set chassis. Push-pull 6LG6's in class AB1, operated at 360 volts plate and 270 volts screen-grid, even with cathode bias, will provide an audio-frequency output of up to 24 watts.

By providing high-grade input and output transformers, the output as reproduced by a high-quality 12-in. or 18-in. electrodynamic speaker, operated under favorable acoustical environments, is free from any noticeable distortion. Where the installation involves a relatively large room, it is better practice to use two 12-in. speakers in opposite corners of the room, rather than 1 large 18-in. speaker. Where speaker cabinets are necessary, use of the bass reflex principle is suggested. Otherwise, speakers mounted right in the wall (infinite baffle) and covered with a thin tapestry will give excellent results. Extra, *remote loudspeakers* (preferably permanent-magnet dynamics) can be installed using a 500-ohm line and providing each speaker with a local remote volume control (17).

POWER SUPPLY

An essential adjunct for outstanding audio amplifier performance is a well-regulated *power supply* (24) of ample capacity. Figure 5 shows the tremendous, irregular rush of current involved, using a condenser input rectifier filter circuit, as compared with a choke input system. The schematic wiring diagram (Fig. 2) shows a choke input power supply.

Fuse protection (25) is recommended as a means to prevent serious damage by shorted filter condensers or shorted rectifier tubes. In some rural districts, sudden line voltage variations often reach abnormally high voltages, strong enough to cause considerable damage to transformers and tubes. In such locations, line supply fuses are most essential.

Less violent voltage variations affect reception and can be counteracted by installing a *line voltage regulator* (26).

Where an all-wave receiver is used largely for shortwave reception, interference from the power line supply is a possibility although unusual. Installation of a *line noise filter* (27) is a solution for this problem.

The discussion so far has been confined to the receiver and antenna systems. The sale of useful receiver accessories is in many ways more interesting and profitable than service work.

ACCESSORIES

Phonograph records and players are becoming more popular each day and apparently the demand will be sustained for some time. Many service customers are good prospects for a *record player* and *phono-oscillator* (23). Customers that already have a small player are prospects for a higher-grade installation including an improved oscillator. Figure 6 shows a constant-current modulated phono-oscillator which is a little more complicated than ordinary oscillators, but which will give excellent results. One 6C5 and one 6J5 are required.

This brings us to the subject of recording (19), first regarded as a novelty and used principally for entertainment. It is now realized that *home recorders* are exceedingly valuable adjuncts in connection with studies, viz., foreign languages, diction, word pronunciation, public speech, voice culture, elocution, etc. There are many other applications including the recording of favorite programs, important speeches, etc.

The sale of a recorder automatically brings the sale for one or more microphones and one or more mixers aside from blank records, cutting needles and other accessories.

In suggesting certain types of tubes for the different circuit functions, reference has been made to basic types. Equivalents having different type numbers can of course be used.

At the conclusion of this article, reference is made to a list of articles which have appeared in the past giving detailed data on some of the subjects covered herein. In

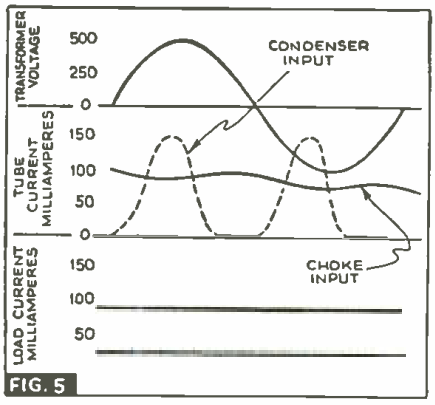


FIG. 5

addition to reviewing these articles, it is suggested that the service technician secure a complete set of different manufacturer's catalogs and technical data sheets covering the following:

Antenna Systems, Loops and Transmission Lines or Cables.

Iron-Core Antenna, R.F. Oscillator and I.F. Transformers.

All-Wave Factory-Assembled Tuning Units.

Standard Tube Manual.
Audio Transformers.
Power Transformers.
Loudspeakers.
Line Voltage Regulators.
Line and Other Noise Filters.
Phonograph Players.
Pickups, Microphones and Mixers.
Recorders.
Resistors, Condensers and Volume Controls.

REFERENCES

Past issues of *Radio-Craft* contain detailed information on the following subjects.

"The 1853 Tube," Nov., 1938.
"Anti-noise Counterpoise Antenna System," Oct., 1938.
"Ballast Resistor Tubes," Jan., 1939.
"The 6SK7 Tube," Dec., 1938.
"Principles of Noise-Reducing Antenna Systems," Sept., 1938.
"Phonograph Pickups," May and June, 1938.
"All-Direct-Coupled 30-Watt Push-Pull A.F. Amplifier," Oct. and Nov., 1939.
"A Combination DX Directional Receiving Aerial," Nov., 1939.
"Marine-izing Radio Sets," June, 1940.
"Amplifier Load-Matching Technique," March, 1940.
"Iron-Core 6," Oct., 1939.
"Combating Radio Interference," May, 1940.
"Profits in Recording," May, 1940.
"A.C.-D.C. Power Supply for Battery Portables," Oct., 1939.
"The ABC of Electronic Automatic A.C. Voltage Regulators," July, 1940.
"Specialized A.F. Tubes," July, 1940.
"A '3-in-2' A.C.-D.C. Midget Amplifier," Jan., 1940.
"Frequency-Modulated Programs on Your Present Receiver!," Jan., 1940.

Following is a list of a few components specified by make and model number which may be used in the positions shown in the schematic circuit, Fig. 2. Makes having equivalent characteristics may be employed.

SUGGESTED COMPONENTS

Two Meissner I.F. transformers, type 17-7414, I.F.T. 1, I.F.T. 2;
One Meissner I.F. transformer, type 16-6139, I.F.T. 3;
One oscillator coil (any make), L3;
One Meissner phono oscillator coil, type 17-9373, L4;
One R.F. choke, 8 millihy., R.F.C.;
One Kenyon choke, type T-155, 290 hy., 10 ma., Ch. 1;
One Kenyon choke, type T-152, 10 hy., 100 ohms, Ch. 2;
One Kenyon push-pull input transformer, type T-58, ratio 1-to-2, T1;
One Kenyon interstage transformer, type T-54, ratio 1-to-8, T2;
One Kenyon output transformer, type T-317, plate-to-plate load 6,600 ohms (and provided with a 500-ohm-line secondary), T3.

MORE DATA SHEETS!

Starting with the September issue, *Radio-Craft* will carry 4 Data Sheets on new receivers, instead of the usual 2 Sheets!

AUTO-RADIO INSTALLATIONS

On All 1940 Passenger Cars

Knowing just how to go about a job is the hall-mark of the proficient technician. It is these Servicemen who will benefit most from the following article, by the Service Editor of an automotive magazine, on the way to correctly install radio receivers in this season's crop of cars.

EDWARD H. BARRY

WHEN INSTALLING a car radio receiver, be sure to select an aerial which will give best results with the set being used. Automobile radio sets, being very sensitive, often are designed to operate with a certain type of aerial. Some sets have separate connections for different types of aerials, while on others an adjustment must be made to compensate the set for the aerial being used. It is also easier to install some types of aerials on certain cars. Following the manufacturer's recommendations will save time in making an installation.

The recommended locations for installing noise-suppressors, condensers, ground straps and static collectors on each car are shown in the table below. After they have been installed as described, the set should be tested to see if they eliminate sufficient interference. Conditions may vary on 2 cars of the same model, and in some cases additional interference eliminators may have to be installed. The heads of the table suggest additional places where the installation of a condenser or ground strap may do some good. To make a test, connect the lead of a bypass condenser with a capacity of 0.5-mf. to the "hot" side of the suspected unit. Ground the condenser case or the 2nd lead on a metal part of the car. When the position is found where the condenser clears up the interference, make the installation of the condenser permanent.

When installing a condenser or ground strap, all dirt or paint must be cleaned from the contacting surfaces and the connections must be tight. When a condenser is installed on a generator, be sure to connect its lead to the generator armature terminal. Should it be connected to the field terminal it will cause pitting of the voltage regulator points, which will prevent the unit from operating properly. When installing static collectors in the front wheels, the inside of the dust caps and the center of the front-wheel spindles, to give good results, must be clean and free from grease.

INTERFERENCE ELIMINATION CHART	Battery terminal grounded	Distributor suppressor	CONDENSERS												GROUNDS						
			Water temperature gauge	Oil pressure gauge	Ignition coil	Generator	Ignition switch	Voltage regulator	Ammeter	Gasoline gauge	Distributor	Clock	Circuit breaker	Front wheels	Cylinder head	Hood	Dash controls	Muffler	Steering column	Heater hose
Buick	N	39			12	6								36						
Cadillac	P	39			12	4								36			33			
Chevrolet	N	37				6	14		21					36	29			30		
Chrysler	P	39				5				16						31	32			
DeSoto	P	39				5				16						31	32			
Dodge	P	39				5				16						31	32			
Ford	P			25				7			11									
Graham	P	40				3	*													
Hudson	P	*	17			2	13			15					*					
LaSalle	P	39			12	4								36			33			
Lincoln-Zephyr	P		18	23				8		15	10		28							
Mercury	P			25				7			11									
Nash	P	38				5										31				
Oldsmobile	N	37				6			19					35						
Packard	P	38				5	*		*											
Plymouth	P	39				5				16						31	32			
Pontiac 6	N	37				6			20					36	27					34
Pontiac 8	N	37				6			20					36	28					34
Studebaker Champ.	P	38								16							32		*	
Studebaker Comm.	P	40				1														
Studebaker Pres.	P	40				1					9									
Willys	N	30		24		6														

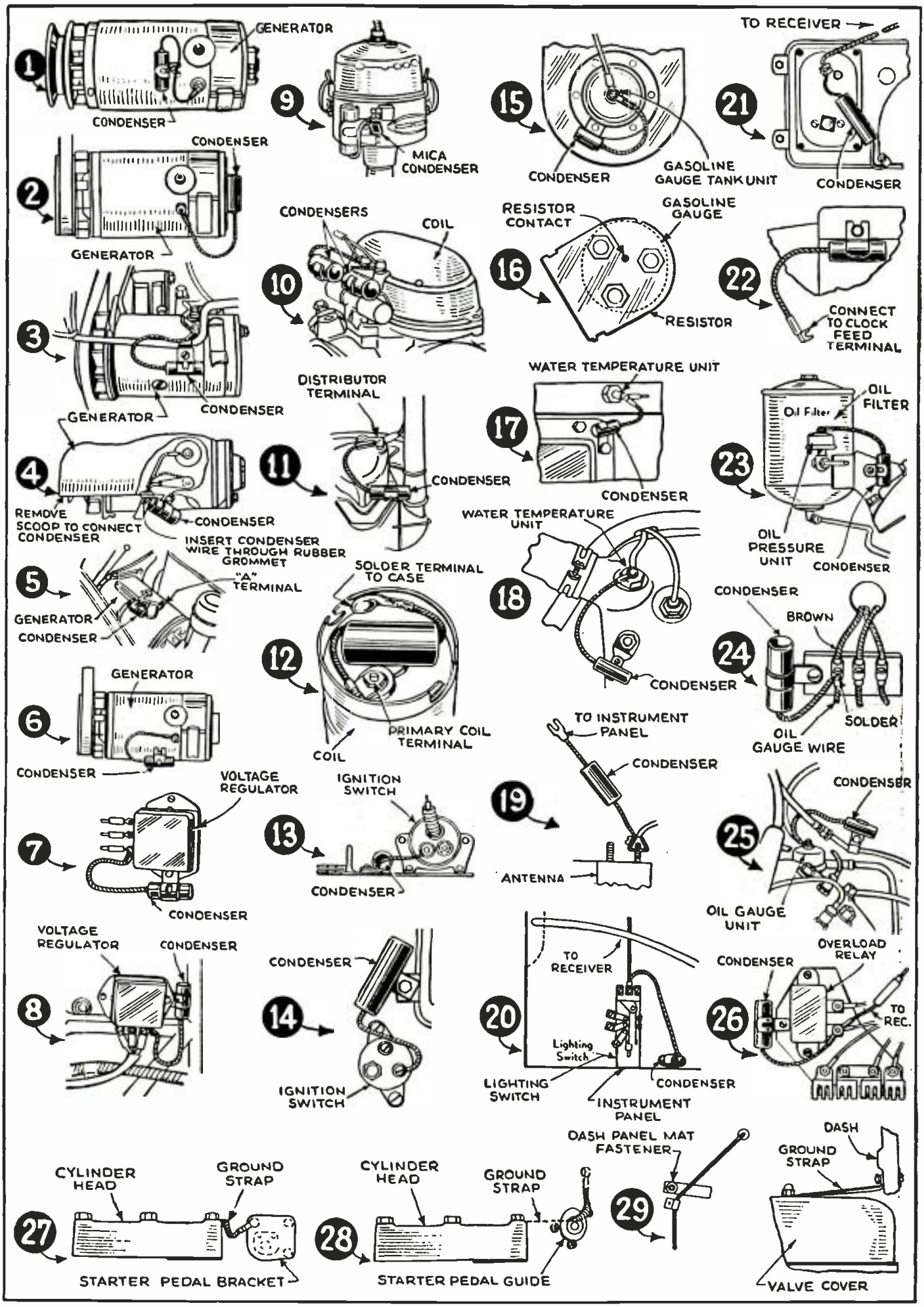
Numbers refer to illustrations on following pages.
Star * indicates unit is used but not illustrated.

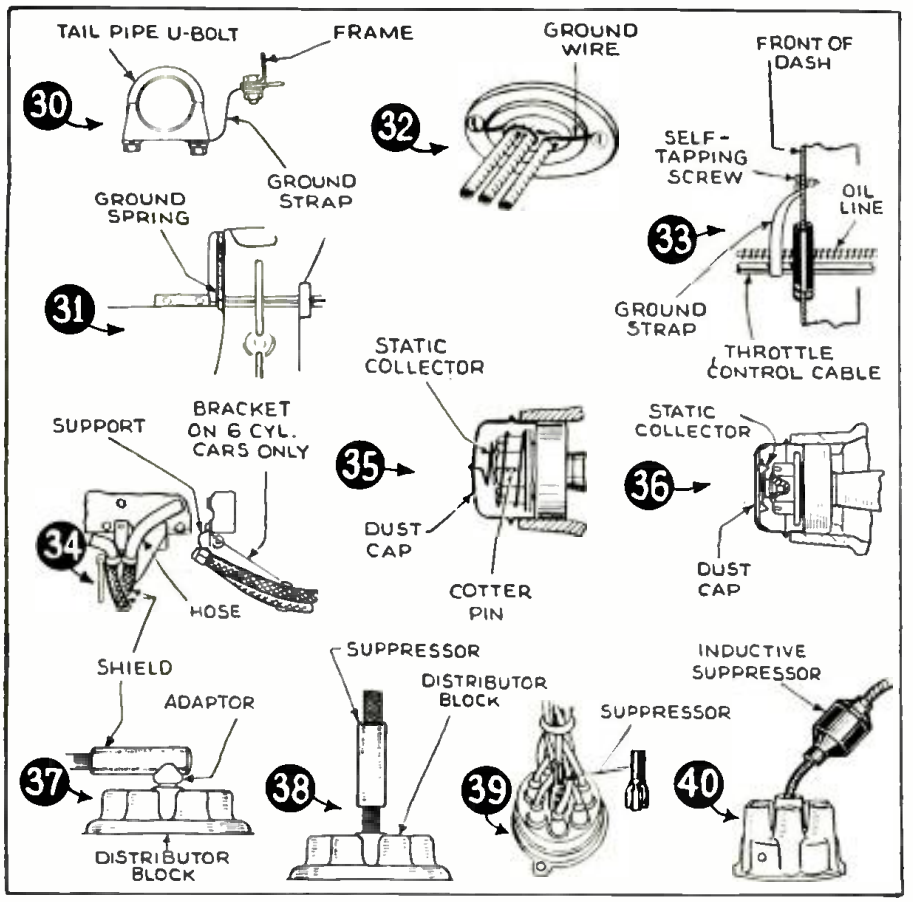
The installation of the receiver and speaker depends upon the make and type of set being used. The radio manufacturer's recommendations should be followed, bearing in mind, of course, that on almost every car there is some accommodation already in the car for the receiver.

Buick—Insert a suppressor in the high-tension lead to the center of the distributor block. Connect the lead from a condenser to the outside terminal, not the field terminal, on the generator and mount it on the generator cable clamp screw. Remove the cover from the ignition coil by inserting a thin-blade tool under the edge of the cover about 1-in. to the left of the container seam. Push the tool between the lock and the recess, twist the end of the cover and lift off the cover. Solder one lead of the condenser to the case and connect the other lead to the terminal inside the cover. Do not attempt to connect this condenser to the terminal on the outside of the coil as it will result in damaging the distributor points and will cause erratic engine performance. Install static collectors in the front-wheel dust caps. The center of the collector supplied with Buick sets is made of self-lubricating material. To fit the collector in the larger dust caps used on Buick 80 cars it will be necessary to straighten out perfectly flat the sharp, pointed prongs on the collector.

Cadillac, LaSalle—Install a suppressor in the high-tension lead to the center of the distributor block. Remove the air scoop from the generator and insert the lead from a condenser through the rubber grommet for the generator wires on the generator and connect the lead to the armature terminal. Mount the condenser on the generator ground screw. Install a condenser on the ignition coil as described for Buick. Peen the distributor rotor insert to lengthen it, or install a radio rotor bar. Install static collectors in the front wheels on models 50, 52, 60S, 62, and 72, making sure that the cotter pin is bent around the nut so that it will not interfere with the static collector. Bond the throttle control cable and the oil line to the dash with a ground strap and a self-tapping screw.

Chevrolet—An elbow suppressor and an adapter should be installed in the center terminal of the distributor block and attached to the high-tension wire leading to the terminal. Mount a condenser on the generator frame and connect its lead to the generator armature terminal. Mount a condenser on the flange of the instrument panel near the ignition switch and connect its lead to the ignition switch. Connect the lead from another condenser to the spring clip at the end of the fused lead from the dash unit with a self-tapping screw and attach this clip to the discharge terminal of the ammeter. Ground the free end of the ammeter condenser to a convenient mounting bolt on the under side of the instrument panel. Connect a ground strap from the frame to the muffler tail pipe U-bolt. Install


1
GENERATOR
CONDENSER
2
CONDENSER
GENERATOR
3
GENERATOR
CONDENSER
4
GENERATOR
REMOVE SCOOP TO CONNECT CONDENSER
CONDENSER
INSERT CONDENSER WIRE THROUGH RUBBER GROMMET
5
"A" TERMINAL
GENERATOR
CONDENSER
6
GENERATOR
CONDENSER
7
VOLTAGE REGULATOR
CONDENSER
8
VOLTAGE REGULATOR
CONDENSER
9
MICA CONDENSER
10
CONDENSERS
COIL
11
DISTRIBUTOR TERMINAL
CONDENSER
12
SOLDER TERMINAL TO CASE
PRIMARY COIL TERMINAL
COIL
13
IGNITION SWITCH
CONDENSER
14
CONDENSER
IGNITION SWITCH
15
CONDENSER
GASOLINE GAUGE TANK UNIT
16
RESISTOR CONTACT
GASOLINE GAUGE
RESISTOR
17
WATER TEMPERATURE UNIT
CONDENSER
18
WATER TEMPERATURE UNIT
CONDENSER
19
TO INSTRUMENT PANEL
CONDENSER
ANTENNA
20
TO RECEIVER
Lighting Switch
LIGHTING SWITCH
CONDENSER
INSTRUMENT PANEL
21
TO RECEIVER
CONDENSER
22
CONNECT TO CLOCK FEED TERMINAL
23
OIL FILTER
Oil Filter
OIL PRESSURE UNIT
CONDENSER
24
CONDENSER
BROWN
SOLDER
OIL GAUGE WIRE
25
CONDENSER
OIL GAUGE UNIT
26
CONDENSER
OVERLOAD RELAY
TO REC.
27
CYLINDER HEAD
GROUND STRAP
STARTER PEDAL BRACKET
28
CYLINDER HEAD
GROUND STRAP
STARTER PEDAL GUIDE
29
DASH PANEL MAT FASTENER
DASH
GROUND STRAP
VALVE COVER



another ground strap from the rear valve cover nut to the dash. Then install static collectors in each front wheel, making sure that the cotter pin is bent around the nut so that it will not interfere with the static collector.

Chrysler, DeSoto, Dodge, Plymouth—Screw a suppressor on the center high-tension lead to the distributor block and plug the suppressor into the distributor cap. Mount a condenser under the generator ground lead screw and connect its lead to the "A" terminal on the generator. Remove the 3 terminal nuts and wires on the back of the gasoline gauge dash unit and assemble a resistor in place. Then replace the wires and nuts. Bond the hand brake cable, heat indicator tube, oil line, throttle, choke, and speedometer cables where they pass through the dash. Loosen the grommet holder screws and fasten a braid around the tubes and screws. Loosen the hood side panel bolts on the left side and pry out the lower hood lacing screw. Attach a hood grounding clip spring with a self-threading screw using the hole from which the screw was just removed. Then drill another hole with a No. 29 drill and insert a screw. This grounds the top and side of the hood to the cowl.

Ford, Mercury—Mount a condenser on the voltage regulator fastening screw and connect its lead to the bottom terminal of the regulator. Mount another condenser with a special bracket on the distributor and connect its lead to the distributor terminal nut. Connect the lead from another condenser under the center terminal on the oil gauge engine unit and mount it on the line. In some cases it may be necessary to move this condenser to the instrument board and connect the lead to the bar between the oil gauge and the fuel gauge indicators.

Graham—Cut the high tension lead to the center of the distributor block about 1 in. from the distributor and insert an inductive type of suppressor. Mount a condenser on the generator under the screw holding the wiring harness and connect its lead to the armature terminal of the generator. Mount another condenser under the screw which secures the steering column bracket to the instrument panel and connect its lead to the ignition switch.

Hudson—Clamp a condenser under the rear left nut holding the ventilator handle guide assembly and connect its lead to the "AM" terminal of the ignition lock. Attach another condenser under one of the gasoline gauge tank unit mounting screws. Attach its lead to the gauge units terminal. Mount another condenser on the upper rear cap screw in the engine water manifold plate and connect its lead to the terminal of the water temperature gauge unit. Another condenser should be mounted on the rear of the generator with a machine screw. Connect its lead to the generator armature terminal. Install a suppressor in the high-tension lead to the center of the distributor block. Mount a ground strap between the left rear cylinder head bolt and the dash, fastening it to the dash with a metal screw and a lock washer.

Lincoln-Zephyr—Install 2 suppressors with special brackets on the distributor and connect the leads under the terminal nuts. Install a condenser on the overload relay, which is mounted on the dash inside the car and over the steering column. Connect its lead to the same terminal on the relay as the battery lead of the radio set is connected. Mount a condenser on the rear of the oil filter bracket and connect its lead to the terminal on the oil gauge. Mount another condenser under one of the gasoline gauge tank unit bolts and connect its lead to the gauge terminal. This is accessible under a metal cover beneath the spare tire in the rear compartment. Mount another condenser with a special bracket under one of the cylinder head bolts and connect its lead to the water gauge terminal. Another condenser should be fastened to the voltage regulator mounting bolt and its lead connected to the "BATT" terminal.

Nash—Insert a suppressor in the high-tension lead to the center of the distributor block. On Ambassador cars it will be necessary to insert a suppressor in both center leads. Mount a condenser under the generator ground lead screw and connect its lead to the generator armature terminal. Attach 2 hood grounding clip springs under one of the hood lining screws to ground the top and side of the hood to the cowl.

Oldsmobile—An elbow suppressor and an adapter should be installed in the center terminal of the distributor block and attached to the high-tension wire leading to the terminal. Mount a condenser on the ground lead screw on the generator frame and connect its lead to the "A" terminal on the generator. Attach the lead from another condenser to the ammeter terminal to which the radio set wire is connected and ground the condenser with another lead to the upper flange of the instrument panel. Install static collectors in the front wheels, making sure that the cotter pin is bent against the nut so that it will not interfere with the collector.

Packard—Cut the high tension lead to the center of the distributor and insert a suppressor in it. Mount a condenser under the ground lead screw on the generator and connect its lead to the generator "A" terminal. Mount a condenser on the instrument board flange and connect its lead to the feed line on either the ignition switch or the ammeter, depending upon where it does the most good. Interference from an electric clock can be eliminated by connecting an additional condenser to its ammeter terminal.

Pontiac—An elbow suppressor and an adapter should be installed in the center terminal of the distributor block and attached to the high-tension wire leading to the terminal. Mount a condenser under the head of the ground screw on the side of the generator case and connect its lead to the generator armature terminal. Mount another condenser under the left-hand instrument board mounting stud nut and connect its lead to one of the accessory terminal screws at the extreme front end of the lighting switch. Install static collectors in the front-wheel inner dust caps, making sure that there are no burrs around the center hole in the wheel spindle which would cause excessive wear of the contact button. Bolt a ground strap to the cylinder head with a special screw and lock washer. On the 6-cylinder cars connect the other end of the ground strap to the dash under the upper starter pedal bracket. On the 8-cylinder cars drill a 0.199-in. hole through the dash 2⅛-ins. above the upper starter pedal guide screw and connect the other end of the ground strap to the dash at this point with a self-tapping screw. Spot face around the hole to obtain a good ground connection. If the car is fitted with a "Fore-'n'-aft" underseat heater it will be necessary to install a heater hose shielding. To make an installation, slip 2 pieces of braided metal loom over the hose and stretch them lengthwise until they are tight on the hose. Remove the clamp bolt from the double clip which supports the hose at the cylinder head and scrape away all paint and dirt from between the support and the clip, and between the support and clamp bolt nut to form a good ground.

Studebaker Champion—Cut the high-tension lead to the center of the distributor block and install a resistor type of suppressor in it. Mount a condenser under the generator ground lead screw and connect its

lead to the generator armature terminal. Remove the 3 terminal nuts and wires on the back of the gasoline gauge dash unit and assemble a resistor in place. Then replace the wires and nuts. Ground the controls that pass through the 2 rubber grommets in the dash by using a braided shielding. Place one end of the shield under the screw on one side, make a turn around each cable and fasten the other end of the shielding under the other screw. Drill a ⅛-in. hole in the steering column jacket just outside the engine bulkhead. Also drill a ⅛-in. hole through the bulkhead just above the steering column and fasten a ground strap between the 2 points with self-tapping screws.

Studebaker Commander—Cut the high-tension lead to the center of the distributor and install a resistor type of suppressor in it. Mount a condenser under the generator ground lead screw and connect its lead to the generator armature terminal.

Studebaker President—Cut the high-tension lead to the center of the distributor and install a resistor type of suppressor in it. Mount a condenser under the generator ground lead screw and connect its lead to the generator armature terminal. Connect one side of a small mica condenser to the battery terminal on the distributor and ground the other terminal of the condenser under the distributor condenser mounting screw.

Willys—Install a suppressor in the center terminal of the distributor block and connect the high-tension lead to it. Mount a condenser on the generator ground lead screw and connect its lead to the generator armature terminal. Attach another condenser under a junction block mounting screw and solder its lead to the terminal of the brown wire leading to the oil gauge. Be sure that the floor board bolt heads are tight enough to make a good electrical contact.

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FIX THAT RADIO!

THE deadline is 2 hours from now . . . . the set is on the bench . . . . you turn it on, watch the ammeter indicate too much current consumption, flip the receiver switch "off" to prevent damage. You get out the ohmmeter, check the resistance from the screen-grid to chassis of the output tube, and the result indicates a short-circuit. Next, you take a look around and see that there is a filter condenser with some white stuff leaking out of the top of it. You put the ohmmeter here, with one side of the condenser disconnected from the receiver wiring. The condenser is shorted, you find, and another is put in its place.

You turn the set on again, and this time the power consumption is not too high, is in fact normal. But the tone is none too good, being lacking in bass response, which leads you to the conclusion that, since the reactance of a condenser varies inversely as the frequency, the opposition to audio voltages must be too high at the low frequencies, indicating high reactance and too-low capacity. So you disconnect the other filter condensers and test them by putting the ohmmeter on the 100,000 Ohms range, watching the meter needle flip up as the condenser takes the charge, watching it gradually recede to zero, if the condenser is a good one. The amount of kick the meter needle receives is proportional to the capacity and the quality of the condenser, which may be compared with a good one. A new set of condensers, you find, results in improved tone and much less hum.

There is now almost pure D.C. on the plates of the tubes. But the A.V.C. is "out," and a high-resistance voltmeter indicates an open A.V.C. circuit, which is repaired by replacing the resistor in the negative line.

A glance at the clock, and sigh relievedly—you made it on time!

WILLARD MOODY,
New York, N. Y.

Radio Service Data Sheet 282

SENTINEL MODEL 217-P PORTABLE RADIO SET

6-Tube Superhet.; A.C.-D.C. and Battery Operation; Automatic Volume Control; Built-In Loop Antenna; Sliderule-Type Dial; Underwriters Approved; Broadcast Band (Range 535 to 1,730 kc.); Inclined-Panel Leather Case Stage of R.F. Amplification; 5-In. P.M. Dynamic Loudspeaker.

ALIGNMENT PROCEDURE

Remove chassis from cabinet. Place loop antenna in the same position it would be when the chassis is in the cabinet.

I.F. STAGES

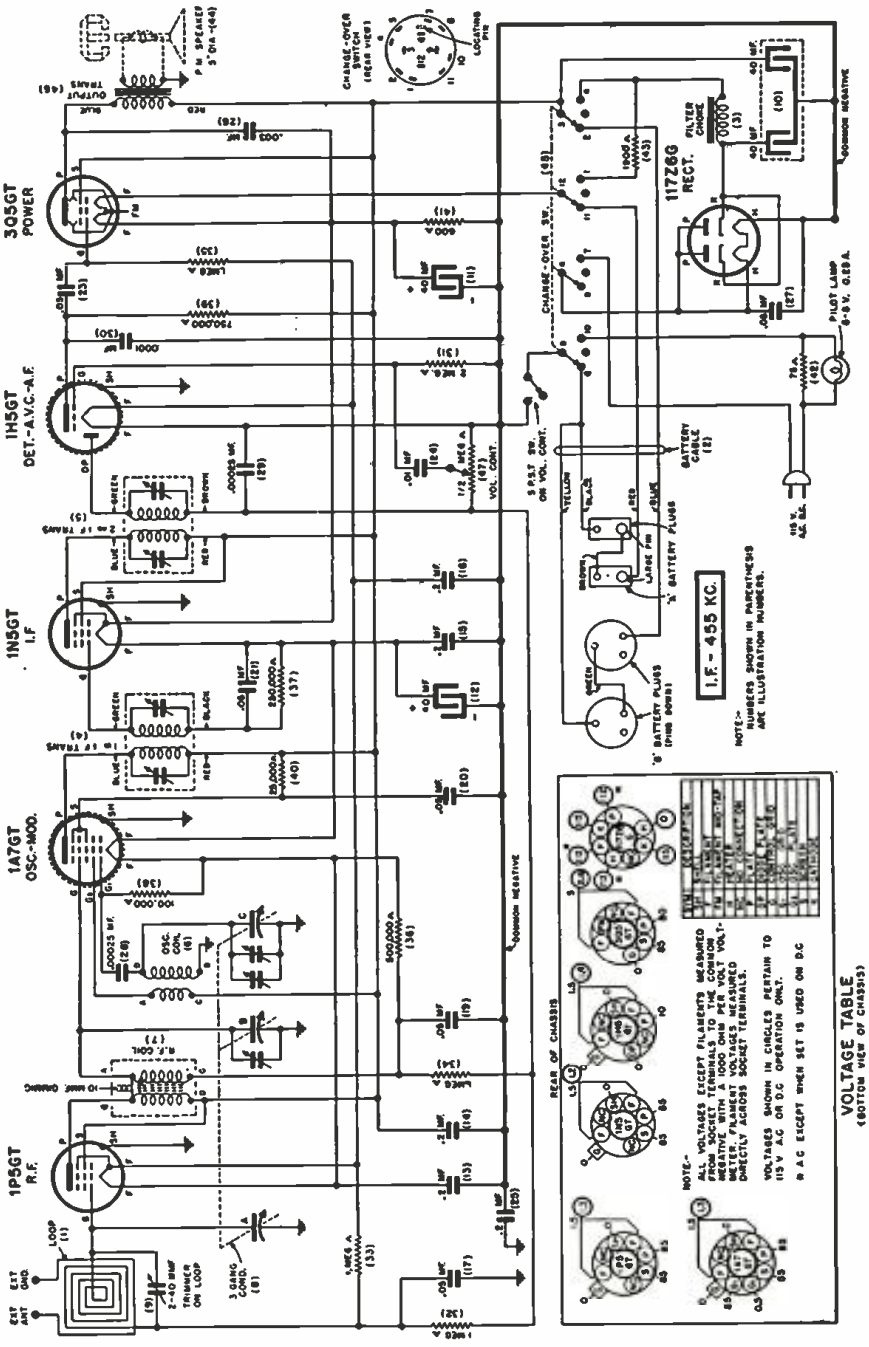
Set receiver dial to any point where no interference signal is received. Feed a 455-kc. signal from the test oscillator to the grid cap of the 1A7GT tube through a 0.2-mf. dummy antenna condenser. Do not remove the grid cap. Adjust each of the 2nd I.F. transformer trimmers for maximum output and each of the 1st I.F. transformer trimmers for maximum output. (See diagram showing locations of trimmers.)

1,730 TO 540 KC. BAND

When adjusting the 1,730 kc. oscillator trimmer and the 1,400 kc. antenna trimmer, do not connect the test oscillator directly to the loop. Instead, couple the test oscillator to receiver loop by making a loop consisting of 5 to 10 turns of No. 20 to 30 size wire wound on a 3-in. form and attached across the output of the test oscillator. Place this test oscillator loop near the set loop and be sure that neither moves while aligning.

Set the receiver dial to exactly 1,730 kc. and feed a 1,730 kc. signal to the loop antenna of the receiver. Adjust the 1,730 kc. oscillator trimmer for maximum output. Then set the receiver dial to approximately 1,400 kc. Feed a 1,400 kc. test signal into the receiver loop antenna and adjust the loop trimmer for maximum output, rocking the gang condenser throughout this operation.

Note that this portable, unlike most portables, incorporates a stage of R.F. amplification. When an external aerial is used a good ground connection must be made.



Complete schematic diagram and operating voltages of Sentinel 217-P receiver.

Sentinel model 217-P 3-way portable radio set.

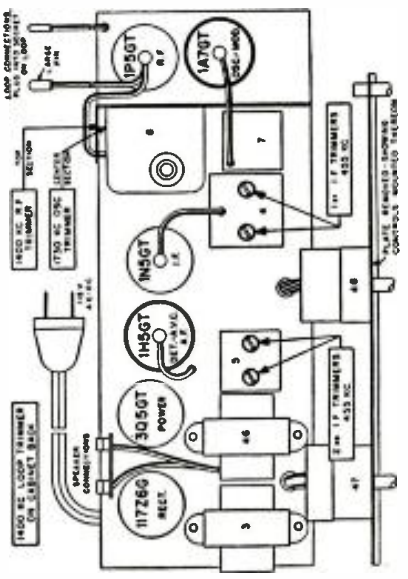


Diagram showing locations of trimmers and components.

283 Radio Service Data Sheet

BELMONT MODEL 678 AUTO-RADIO SET

6-Tube Superhet.; 6-Button Automatic Remote Tuner Unit; Automatic Volume Control; Range 535 kc. to 1,565 kc.; Synchronous-Type Vibrator; Single Stud Mounting.

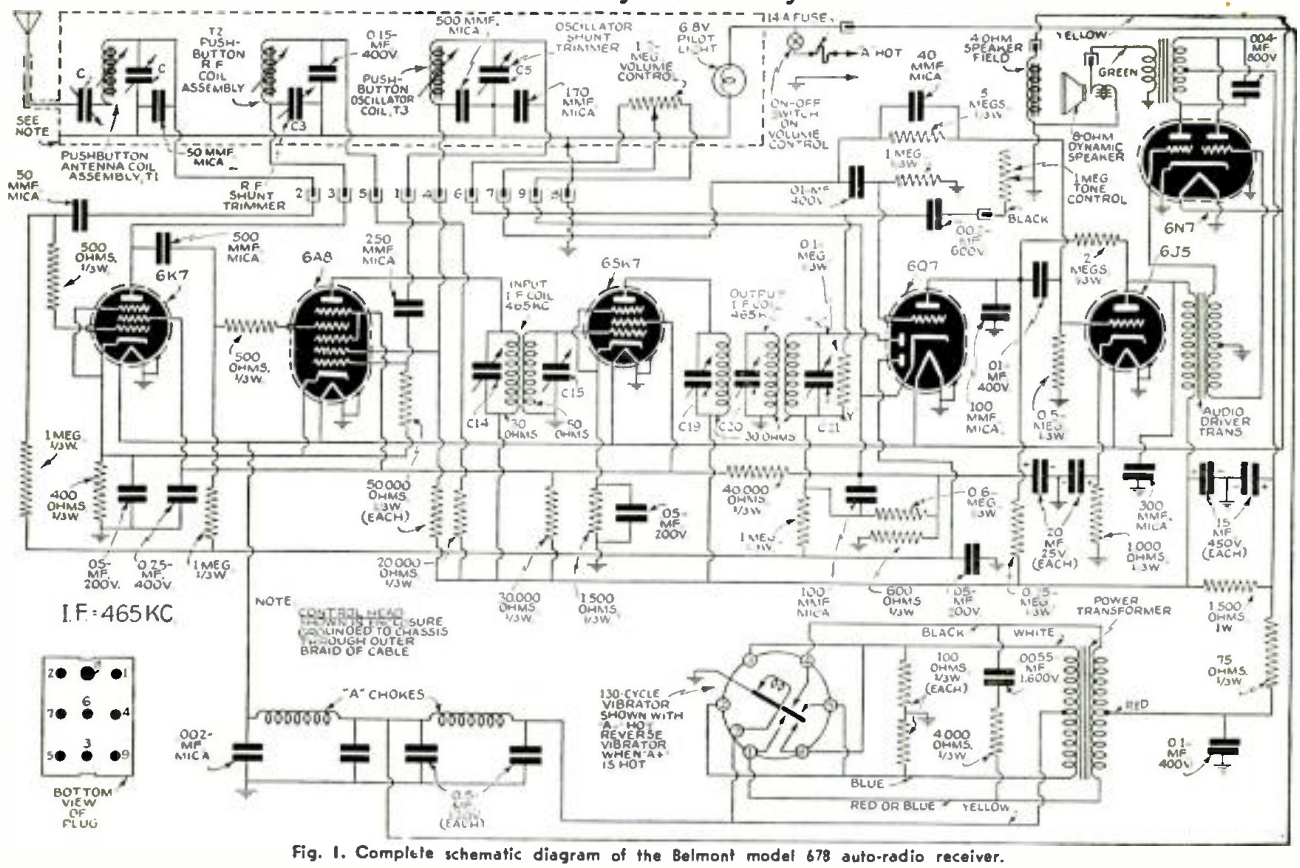


Fig. 1. Complete schematic diagram of the Belmont model 678 auto-radio receiver.

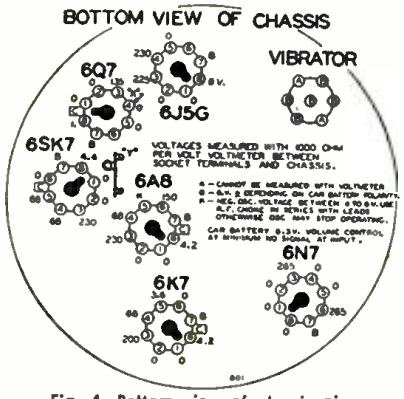


Fig. 4. Bottom view of chassis giving socket voltages.

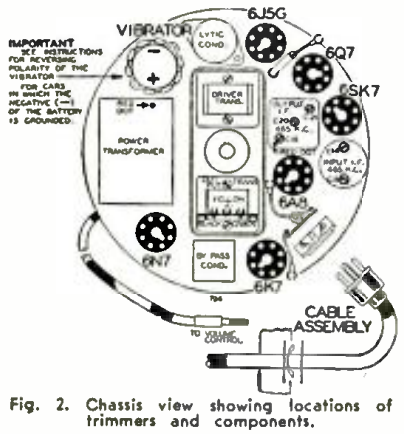


Fig. 2. Chassis view showing locations of trimmers and components.

ALIGNMENT PROCEDURE

Turn volume control to maximum for all adjustments. Connect radio chassis to ground post of signal generator with a short, heavy lead. Connect dummy antenna in series with generator output lead;—0.1-mf. for the I.F. band and a 125 mmf. for the broadcast band. Use an output meter across the primary of the output transformer. Allow chassis and signal generator to heat up for several minutes.

I.F. ALIGNMENT

Feed a 465-kc. signal to the grid of the 6SK7 I.F. tube. Set dial at 1,400 kc. Adjust trimmers C19 and C20 for maximum output. To align this output I.F. unit without using cathode-ray oscilloscope, a 10,000-ohm resistor must be shunted across the diode tuned circuit as indicated by points X and Y on the schematic (Fig. 1) and in Fig. 4. Trimmer C19 is identified by a red dot on top of the I.F. can.

After alignment of these 2 trimmers, remove the 10,000-ohm resistor and align trimmer C21 for maximum output. *Do not* readjust trimmer C19 or C20 after the resistor has been removed. Shift the signal generator lead to the control-grid of the 6A8 and adjust trimmers C14 and C15 for maximum output.

Fig. 5. Belmont auto-radio model 678. Note Remote Tuner at right.

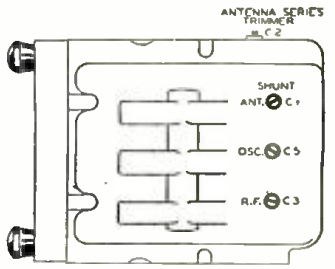


Fig. 3. Bottom view of remote tuner

BROADCAST BAND

Feed a 1,565-kc. signal to the antenna lead with the set dial adjusted to 1,565 kc. Adjust trimmer C5 for maximum output. Reset the dial to 1,400 kc. and adjust trimmers C1 and C3 for maximum output using a 1,400-kc. test signal. Finally, reset the dial to 600 kc. and adjust trimmer C2 using a 600-kc. test signal in the antenna lead. Maximum gain for this adjustment depends on the capacity of the antenna system of the car in which the radio receiver is installed.

Power consumption is 7.7A. at 6.3V. No suppressors required on the spark plugs; only a distributor suppressor is needed. The output I.F. coil has 3 tuned circuits giving superior band-pass qualities and selectivity as compared to the conventional 2-tuned-circuit coils. Antenna, R.F. and oscillator circuits are permeability tuned, offering automatic tuning applications that are both accurate and stable. The entire coil assembly is mounted in the Remote Tuner control head being connected to the oscillator and R.F. circuits by an R.F. transmission cable.

The R.F. oscillator, and I.F. and A.F. amplifiers, including the power supply, are contained in the speaker case.

This unit has been designed to facilitate servicing.

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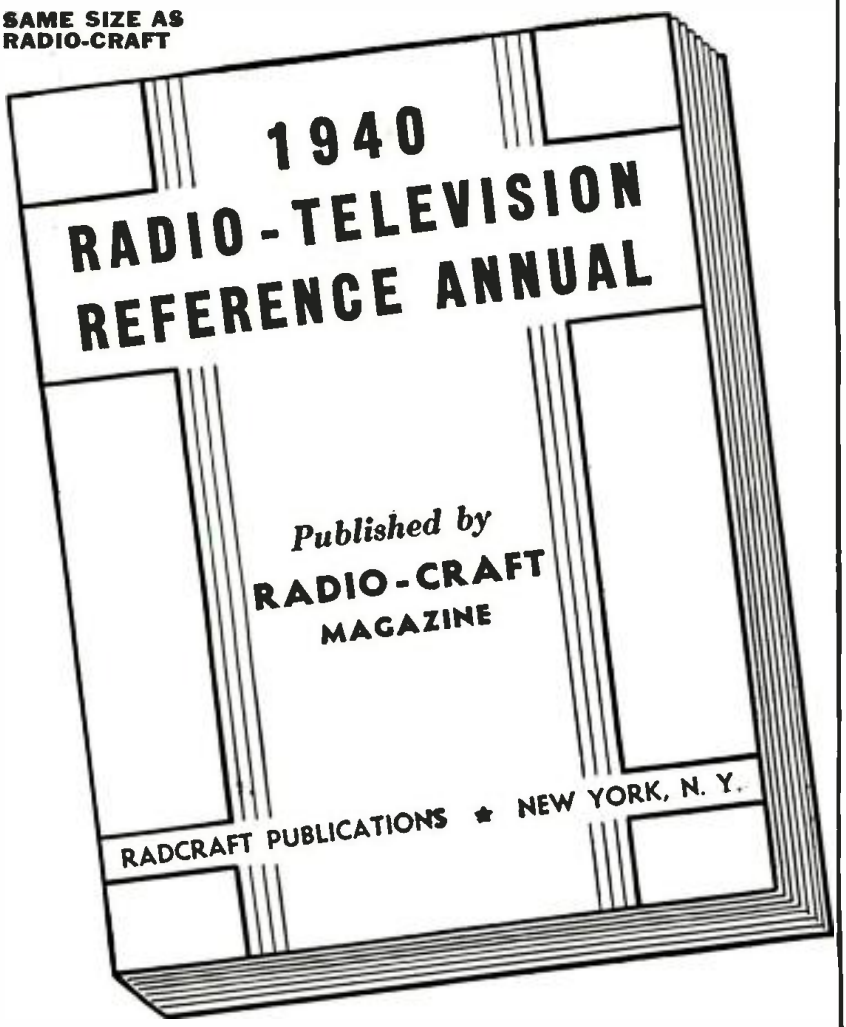

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The "High-Seas 4" Broadcast Lamp Radio—How to Build a 6-Tube 1.4-Volt Short-Wave Superhet for the "Ham" or Short-Wave Fan—Build the "Lunch Box 5" Super Set - a Broadcast Battery Portable—How to Build a Plug-Together 8 Tube Broadcast Set—The "5-in-4" All-Wave Radio for A.C. Operation—An Easily-Built 3-Tube Midget Broadcast Superheterodyne Receiver.

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A LOW-COST SIGNAL CHASER — *Plus*

"While the instrument was designed primarily for beginners, and Servicemen who operate on a small scale, the advanced technician will also find this tester capable of promptly locating the trouble in possibly 90% of all ordinary calls." The instrument here described is not only a signal chaser but also functions in other capacities.

C. RASK LATIMER

NEW Servicemen are often discouraged and handicapped by not being able to afford a complete set of modern test instruments. Accordingly there is a decided demand for substitute low-cost instruments really capable of useful functions.

The instrument to be described in this article can be built at a very reasonable cost. The functions include signal chasing at either radio or audio frequencies, voltage indication, voltage polarity, high-resistance continuity, low-resistance continuity, interference search, hum search and many other applications that will be apparent to resourceful technicians.

USES

Figure A is a view of the complete instrument which only occupies a space of 10 x 5 x 3 ins. deep, and which is entirely self-contained and -powered. Using the versatile 1D8GT tube, diode detection, triode voltage amplification and pentode power audio amplification are all available within the single tube envelope. The tube requires one 1½-volt "A" cell and two 51-volt "B" batteries, and there is room for these within the case. Accordingly the instrument is useful at points where ordinary 110 volt 60 cycle A.C. may not be available to operate standard test apparatus. An example would be the field servicing of auto, marine or farm receivers which operate from 6, 12 or 32 volts D.C. or 110 volts D.C.

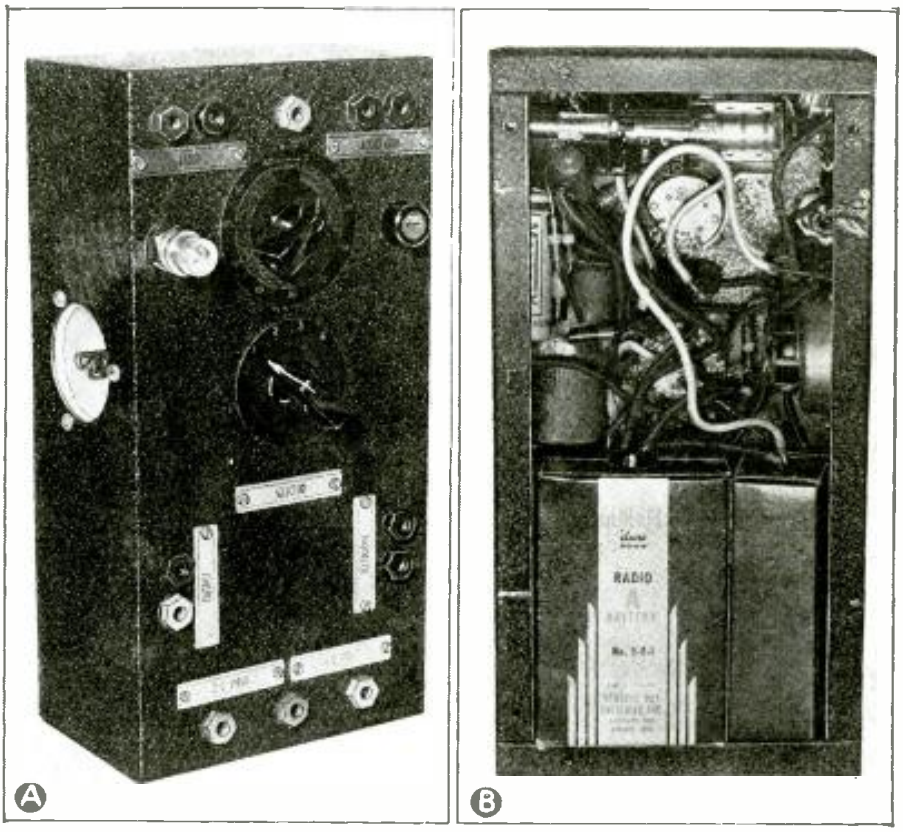
While the instrument was designed primarily for beginners, and Servicemen who operate on a small scale, the advanced technician will also find this tester capable of promptly locating the trouble in possibly 90% of all ordinary calls. This is especially true if the receiver tubes are first tested.

There are some limitations to the applications. The R.F. search cannot be expected to pick up very feeble signals as there is no R.F. amplification. However the output from any R.F. or I.F. stage can be detected and noted. Voltage indication below 65 to 90 volts cannot be secured as the neon lamp requires that initial voltage before it can strike the arc. For R.F. search ordinary prods and leads are suggested, same being connected in place, and the operator's hands removed to prevent disturbance of the circuit. If desired, a coaxial cable type R.F. prod can be substituted. If the matter of circuit unbalance is important, the "hot" R.F. prod can be connected through a 100 mmf. condenser or series 1-megohm resistor.

In spite of the 2 limitations admitted, the useful functions are numerous and offset the small disadvantages. The instrument is not intended to replace precision equipment.

CIRCUIT

Figure 1 gives the complete schematic wiring diagram showing the 1D8GT tube circuit used which consists of a diode detector, triode 1st A.F. stage (resistance coupled), and a pentode 2nd A.F. or power output stage. Bias for the pentode control-grid is obtained from a series resistor, R10, in the "B"-negative lead. Tip-jacks, 12 in all, are provided to make the necessary connections. In addition a 3-circuit 4-position selector switch is provided to secure the circuit changes required.



(A) Front view of the Low-Cost Signal Chaser—Plus. The recessed power-cord receptacle is seen on the left side. To put this "signal chaser—plus" into full operation you need only headphones. (B) The rear view suggests the ease of construction.

For the low-resistance continuity test, the headphones and "A" cell are in series with the prods. For high-resistance continuity, A.C. or D.C., they are in series with the neon lamp and prods. In the case of D.C. the "B" battery is used. In the case of A.C., it is connected to the tester by the receptacle plug provided. Using D.C. with the neon tube, only the negative element glows, so that gives an indication of polarity.

In making an R.F. search, the diode can be used with either 1 or 2 stages of audio amplification and the audio gain adjusted by the volume control.

In making an A.F. search, either 1 or 2 audio-frequency stages can be used and here again the gain is controlled by the input potentiometer. The radio input (diode) will of course also pick up audio signals (diode to ground).

HOW TO USE

The principal suggested useful tests are as follows:

No. 1—Audio Test:
Input prods at IV and III;
Switch at Position 2 for 1A.F., at Position 1 for 2A.F.;
Phones at output VI and VII;
Regulate volume at Gain Control.

No. 2—Hum Search:
Same as above, but connect prods to a suitable open-core iron inductance.

No. 3—Radio-Frequency Test (at any R.F. input or output circuit):
Input prods at I and II;
Switch at Position 2 for diode detector and 1A.F.;
Switch at Position 1 for diode detector and 2A.F.;
Phones at output VI and VII.

No. 4—Interference Locator:
Same as above, but connect a suitable loop antenna and tuning condenser to input terminals I and II.

No. 5—Voltage Indication:
Prods at VIII and IX;
Switch at 1 for up to 500 volts, max.;
Switch at 2 for up to 330 volts, max.;
Switch at 3 for up to 220 volts, max.;
Switch at 4 for up to 110 volts, max.;
(65 to 90 volts min.).
The neon tube draws 1 milliampere.

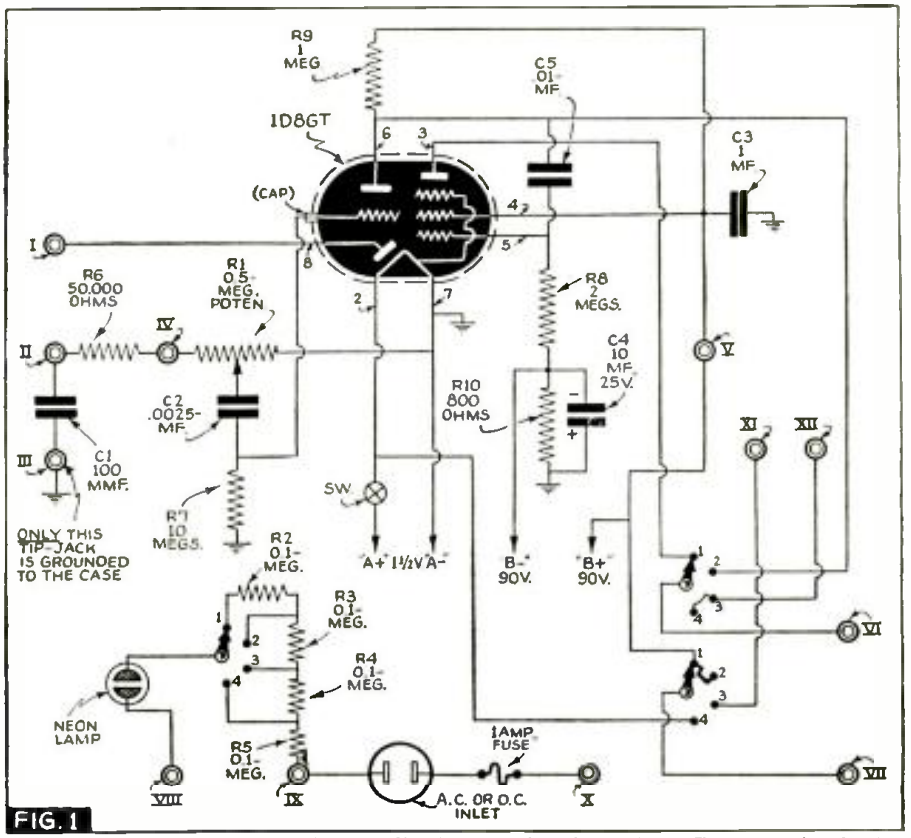


FIG. 1

Headphones and test prods complete the Signal Tester—Plus, shown above. The neon tube, in the actual instrument, is protected by a transparent cover.

No. 6—Line Polarity:
Same as above, negative neon electrode glows.

No. 7—A.C. Continuity Neon Test (for indication of condenser capacity, test or open condenser, etc.):
Prods at VIII and X;
Connect 110 volts A.C. to plug receptacle;
Switch on Position 4.

No. 8—D.C. Continuity Test (for condenser dielectric strength, condenser leakage, etc.):
Prods at III and VIII;
Connect jumper from V to IX;
Switch on Position 4.

No. 9—Direct Phone Prods (for audio test, phono pickup output, microphone transformer output, etc.):
Phones at VI and VII;
Switch at Position 3;
Prods at XI and XII.

No. 10—Low-Resistance Continuity:
Switch at Position 4;
Prods at III and XII;
Phones at VI and VII.

No. 11—Lead-in, Transmission Line or Aerial Test:
Connect aerial input to primary of R.F. transformer.
Connect secondary of the R.F. transform-

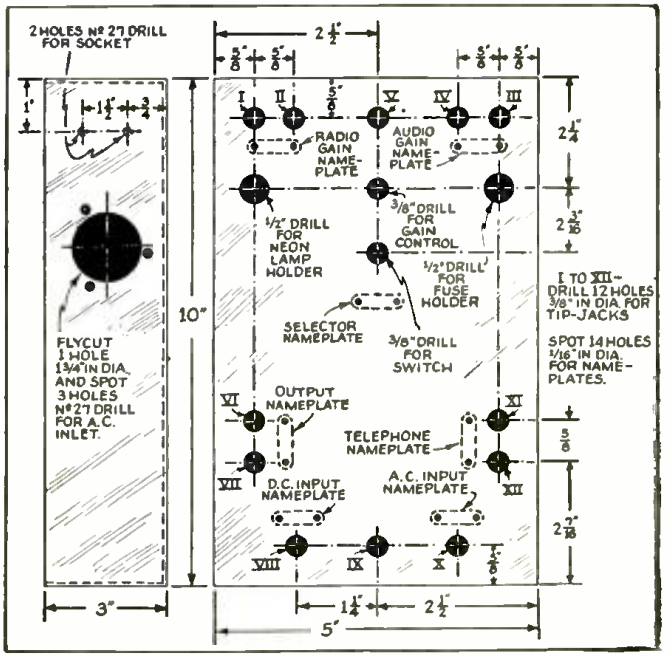


Fig. 2. Cabinet details. Tip-jack colors preferred by the author are: I, red; II, black; III, purple; IV, dark green; V, slate; VI, light green; VII brown; VIII, slate; IX, dark brown; X, brown; XI, XII, green.

er to R.F. input I and II, with a parallel tuning condenser if necessary.
Other connections same as No. 2.

No. 12—Test for Line Power Supply:
Prods at VIII and IX to power outlet;
Switch at Positions 1 to 4;
Note neon indication.

LIST OF PARTS

CASE

One Parmetal case No. B-4508, and bottom plate No. BP-4508, black wrinkle finish, size 10 x 5 x 3 ins. deep.

RESISTORS

One Mallory type N, ½-megohm potentiometer and switch;
Four IRC, 0.1-meg., ½-W., type BT½, R2, R3, R4, R5;
One I.R.C., 50,000 ohms, type BT½, R6;
One I.R.C., 10 megs., ½-W., type BT½, R7;
One I.R.C., 2 megs., ½-W., type BT½, R8;
One I.R.C., 1 meg., ½-W., type BT½, R9;
One I.R.C., 800 ohms, ½-W., type BT½, R10.

CONDENSERS

One Mallory, 100 mmf. mica, C1;
One Mallory, 250 mmf., mica, C2;
One Mallory, 1 mf., 400-V. paper, C3;
One Mallory, 10 mf., 25 V. electrolytic, C4;
One Mallory, 0.01-mf., 400 V. paper, C5.

MISCELLANEOUS

One National Union type 1D8GT.
One Mallory 3-circuit 4-position switch No. 3234J, with plate and knob;
Twelve Mallory 400 Series tip-jacks, colors as desired;
Four Mallory No. 15 tip-plugs;
Two ICA No. 355 test prods;
One General 1½-volt "A" cell No. 2F1;
Two General 51-volt "B" batteries No. V-34-AAA;
1 Pair Cannonball "Master" headphones;
One Littelfuse No. 1075 fuse extractor post and 1-ampere fuse;
One Littelfuse No. 5123 neon holder;
One Littelfuse No. 5122 neon tube, 1/20 watt;
One Amphenol 61M10 male receptacle, flush mounting;
Seven Crowe nameplates, one each No. 16, A9, I15, G15, J11, D9 and A2;
One triple insulating tie lug;
Two hollow spacers, 3/16-in. in dia. x 1½ ins. long (for socket);
Two No. 6-32 round-head brass screws 1¾ ins. long;
One Amphenol octal socket No. MIP8;
One grid clip;
Ten feet Push-back hook-up wire;
Six feet No. 18 flexible rubber-covered wire;
One double and 2 triple connector plugs for batteries;
Four No. 6-32 round-head brass screws, ½-in. long;
Six No. 6-32 hex. brass nuts, lock washers and soldering lugs;
One-quarter lb. rosin-core solder.

BOOK REVIEWS

TELEVISION, by V. K. Zworykin and G. A. Morton (1940). Published by John Wiley & Sons, Inc. Size, 6 x 9 ins., cloth cover, profusely illustrated, 646 pgs. Price, $6.00.

V. K. Zworykin, E.E., Ph.D., Electronics Research Laboratory, RCA Manufacturing Co., and G. A. Morton, Ph.D., same division, same company, have collaborated to produce the most up-to-date book on electronic television.

"Television—The Electronics of Image Transmission" considers in Part I the fundamental physical phenomena involved in electronic television. Part II deals broadly with the field of television. Part III is an analysis of the components of the electronic television system. Part IV describes the entire television system exemplified in RCA/N.B.C. television operations.

Chapter headings give only a suggestion of the wealth of detail and ample illustrations in the many subjects treated.

No person interested in television can afford to be without this timely book.

Part I—Fundamental Physical Principles—Emission of Electrons from Solids; Fluorescent Materials; Electron Optics; Vacuum Practice. Part II—Principles of Television—The Fundamentals of Picture Transmission; The Transmission and Reproduction of High-Definition Pictures; Video Pick-up Devices; Picture Reproducing Systems. Part III—Component Elements of an Electronic Television System—The Iconoscope; The Kinescope; The Electron Gun; Video Amplifiers; Scanning and Synchronization; The Television Transmitter; The Receiver. Part IV—RCA/N.B.C. Television Project—RCA Television Project—Studio and Monitoring Equipment; Empire State Transmitter; Conclusion.

RADIO ANNUAL 1940, Compiled by the Staff of *Radio Daily*. Published by *The Radio Daily*. Size. 6½ x 9½ ins., cloth cover, 988 pgs. Free with 1-yr. subscription to *Radio Daily*.

It is evident from a review of the third or 1940 Edition of the "Radio Annual" issued to *Radio Daily* subscribers, that lessons have been learned from the experiences of the preceding issues. The march of radio during 1939 is succinctly portrayed, and the prospects for 1940 are analyzed, by a group of specialists.

James Lawrence Fly, Chairman, Federal Communications Commission, discusses radio from the social standpoint; Neville Miller, Pres., National Assoc. of Broadcasters, describes the broadcasting kaleidoscope of events; David Sarnoff, Pres., RCA, presents facts and figures; Elmer Davis, C.B.S. news analyst, analyzes his field of operations; education is covered by William Dow Boutwell, U. S. Office of Education; Margaret Cuthbert, N.B.C., writes on "The Women"; foreign affairs is John H. Payne's (U. S. Department of Commerce) topic; Orson Welles' topic is "Radio Drama". Frequency modulation, short waves, facsimile, the New York World's Fairs of 1939 and 1940, television, and air schools are other subjects briefly analyzed.

Another chapter is "Radio History Makers of 1939" with thumbnail illustrations and writeups; operations and decisions of the Federal Communications Commission are reviewed.

Room does not permit further analysis of the innumerable topics touched upon in this nearly 1,000-pg. book. It may be pointed out however that, as with preceding issues of the Annual, there are included an up-to-date listing of the broadcast stations of the United States; publications covering the field of radio; advertising agencies and radio station representatives; and, a number of other groupings of lesser extent, but in proportion of perhaps equal importance.

Television and facsimile have a 26-pg. section all to themselves.

FLUORESCENCE AND PHOSPHORESCENCE, by E. Hirschlaff (1938). Published by Chemical Publishing Co., Inc. Size, 4 x 6¾ ins., cloth cover, 41 illustrations, 130 pgs. Price, $1.50.

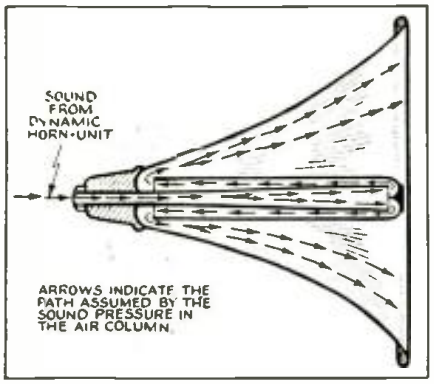
We do not know what particular significance, if any, may attach to the statement that this is a "First American Edition—1939" but you now have the quote for whatever it is worth.

Essentially this book is a "monograph" and is of little interest to any but tube specialists, more particularly those interested in photoelectric and television phenomena; to these, this book will be an invaluable reference to the most up-to-date information on how and why a vapor or a liquid irradiated by light may be able to emit light (fluorescence), and why this re-emission may continue after the existing radiation has been cut off (phosphorescence). Chemical formulas and mathematical equations are included to clarify such subjects as the fluorescence of atoms and molecules, the quenching of fluorescence, cathodeluminescence in gases, liquids and solids; etc.

THE METEOROLOGICAL GLOSSARY, (3rd Edition, 1940). Published by Chemical Publishing Co., Inc. Size, 6 x 9 ins., cloth cover, illustrated, 251 pgs. Price, $3.00.

The 3rd Edition of this book will be of interest to those technicians whose business it may be to acquire familiarity with the underlying causes of the changes in weather conditions. This group would include amateurs interested in learning the whys and wherefores of shortwave performance; and, broadcast technicians.

(See Pages 100 and 128 for other book reviews)



At top.—"Morning Glory" reflex projector makes available in an over-all length of 25 ins. an effective 6-ft. air column; frequency cut-off, 90 cycles. With a bell opening of 29 ins. the projection angle is 100°. Note the weatherproof housing for the P.M. dynamic motor unit.

Below.—This cross-section illustration of the reflex projector shows how the long air column is achieved in a short horn.

IMPROVED REFLEX SPEAKER

This article explains the advantages achieved by applying the principle of sound reflection to an exponential horn driven by a horn unit.

R. C. REINHARDT

A NEW line of sound projectors, characterized by a foreshortened horn driven by a horn unit, achieves increased transducing efficiency, good voice reproduction, and high-intensity projection, in addition to having the mechanical advantages of compactness, simplicity of mounting, and 100% storm-proof protection. How these desirable qualities have been obtained is information of interest to many sound men.

The "Morning Glory," as the new construction has been named, is an adaptation of the so-called "marine-type reflexed trumpet," driven by a horn-type unit, which has been used for warship and merchant marine service for the past 5 years. By combining this general construction (but with improvements which will be described) with certain desirable features of a second class of loudspeakers generally referred-to in the sound field as the *"WX-type marine horn," driven by a cone-type unit, the attributes mentioned in the first paragraph of this article are obtained.

Although the resultant loudspeaker construction is ideally suited to the rigorous demands of continuous outdoor service under any weather and atmospheric conditions, it is readily adaptable to the requirements of indoor use, as sound men will perceive.

IMPROVED REFLEX SPEAKER

All acoustic transducer systems having to do with the reproduction of sound fall into 2 broad classifications. The most popular of these is the *paper-cone dynamic speaker mounted in a baffle or housing.* (See Fig. A.)

It will be generally agreed that the popularity of this assembly is due to the low initial cost and small physical dimensions of the equipment together with proper mounting facilities. However, the attendant low acoustic transfer efficiency (that is, comparatively low audio output power for a given electrical input power), and poor articulation, preclude the use of paper-cone speakers on a system in which the transmission of intelligence (voice) is of paramount importance.

It is this problem of selecting loudspeakers, for application in a system where it is considered better engineering to install apparatus that will most efficiently transmit intelligence under the required operating conditions, that is being primarily considered in this article.

PROJECTORS FOR HIGH OUTPUT

To design a loudspeaker for high output it is almost imperative to use a horn (or "projector" as it is called). The inherent low efficiency of the flat-baffle type, if it were used, would impose at least 2 very serious objections.

First, the source of audio supply for the flat-baffle type would necessarily be greater than that required for the horn type for equivalent acoustic output. This would also indicate (a point which naturally follows) that higher-powered—and necessarily more costly—amplifiers are necessary.

Second, and of great consequence, the degree of heat produced in the voice coil for a pre-set output requirement would naturally be higher in the low-efficiency speaker. The degree of heat production in the voice coil is one of the most tenacious problems which confronts the designer of a high-power speaker. For a given size of voice coil, the temperature rise is directly proportional to the power input, and a precarious limit is reached at relatively low power (watts) for conventional speakers.

EXPONENTIAL HORNS

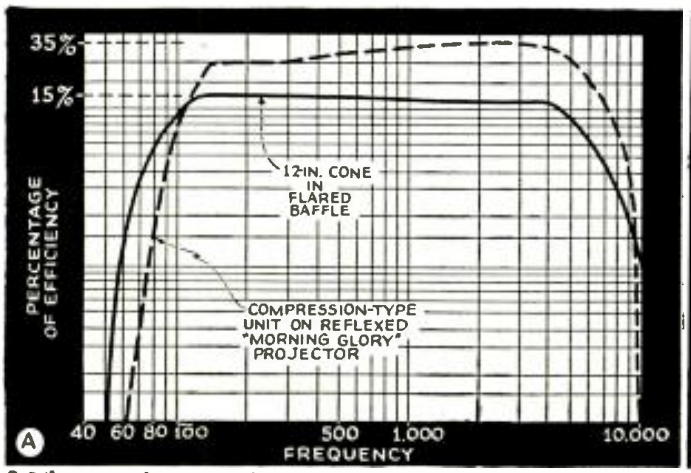
It was originally believed that a horn merely confined the sound pattern within a limited angle with a corresponding increase of intensity in this region. Conical-shaped horns were widely used in the past to increase radiation from loudspeakers.

Functionally, however, this was most unsatisfactory, inasmuch as a conical horn does not take into consideration the fact that air in motion assumes sharply-defined characteristics. More recently it was found that the true function of a horn is to increase the load on the vibratory system. For a given throat area, the impedance of the horn depends on its shape, and it has been found that the exponential rate of expansion creates a greater degree of linear loading than any other type. (See curve A.)

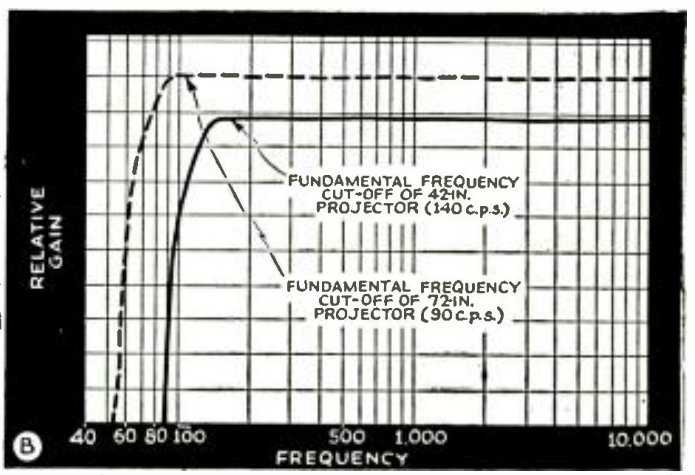
The formulas which show this to be a fact are quite involved, but if any *Radio-Craft* readers wish to delve deeper into the subject, an excellent reference is available.** However it is generally sufficient merely to keep in mind the importance of

*See Radio-Craft, June 1938.

**"Applied Acoustics," by Olson and Massa, P. Blakiston's Son & Co., Inc.



Relative conversion factor of cone speaker in flared baffle vs. compression unit on exponential cavity. A considerable increase in effective output is seen to result with an exponential increase of diaphragm loading.



Theoretical response curve. This curve illustrates the fact that the sound projection of an exponential horn may be considered uniform over the frequency range for uniform input from the driving unit, up to cut-off.

having a horn, the rate of expansion of which is an exponent, in contrast with horn types which frequently are loosely referred-to as being "exponential" but which in truth are merely patterned to some conical degree of flare.

Referring to curve B, note how the exponential horn maintains uniform loading right out to the cut-off point; and that the longer air-path of the larger horn exhibits somewhat greater efficiency. Do not confuse this theoretical curve of horn performance with the overall frequency response. The latter is almost entirely a function of the motor unit (an item which may be discussed in a later article).

REFLEX HORNS

In view of the advantages to be gained in the use of exponential horns coupled to compression-type (or, as they are more generally called, horn-type) speaker units, the concentrically-folded, or "re-entrant" horn herein illustrated, was developed, and because of its flower-like shape, was appropriately named the "Morning Glory" horn.

These have been made available to replace the straight (long) exponential horns which, by comparison with paper cone speakers, are proving too unwieldy and of too great size for efficient handling and mounting.

SOUND COVERAGE

Adverse, or cross-wind conditions, which normally disperse low-intensity sound projection, have little effect on the sound beam emitted by these high-velocity output projectors. The sound beam, upon being directed to the area requiring coverage, will produce a †"Splash Effect" and thereby cover large areas with uniform-intensity sound.

The directional characteristics and total absence of rear sound generation minimize feedback or acoustic "howl." The flatter frequency response is also of great importance in eliminating feedback at certain peaked frequencies.

PHYSICAL DETAILS

The "Morning Glory" projector here illustrated, in addition to its electrical and acoustical advantages mentioned above, presents certain mechanical features that are worth consideration. The entire construction is of metal, and all details are so proportioned that it can be subjected to severe strain and stress without any appreciable damage.

The mounting details are fabricated from malleable iron castings and have unlimited fatigue resistance. The horn proper is built up of a progressive series of non-resonant aluminum spinnings, of heavy gauge, adequately protected against the elements with a 2-tone battleship gray enamel. All other details, such as the malleable-iron mounting yoke and trunnions, and the hardware, are electroplated with a zinc-cadmium alloy to resist oxidation and ultimate deterioration.

Unlike its prototype, the marine-type reflexed trumpet, which used an electrodynamic motor unit, the Morning Glory utilizes the more modern, permanent-magnet dynamic motor, thus eliminating field pot wiring. This unit is shown, in the photo, encased in a weatherproof, streamline housing.

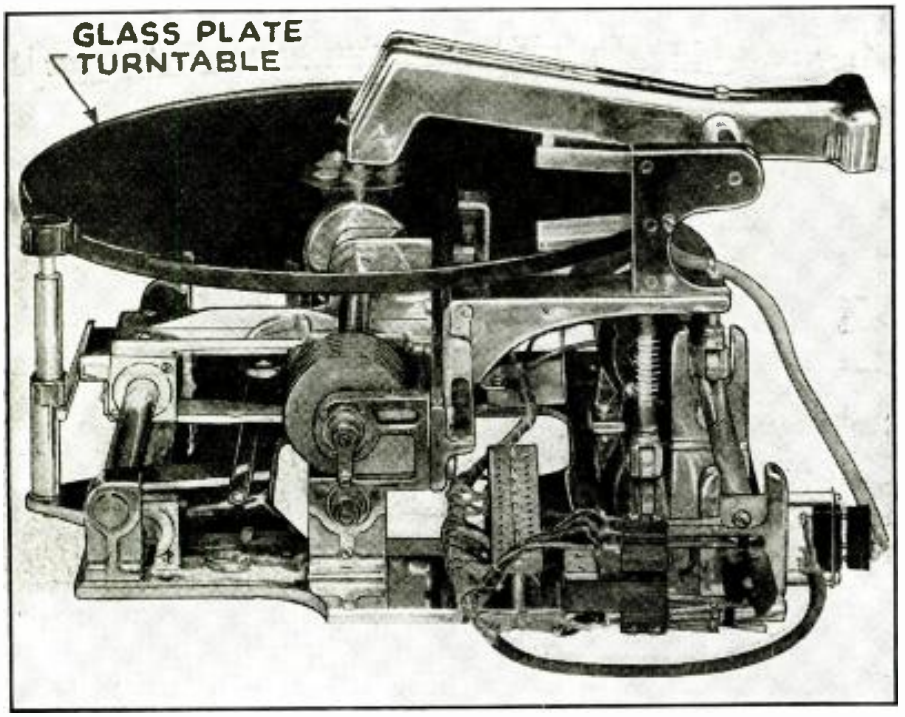
Contrary to popular belief, the concentrically-folded re-entrant horn will perform quite as well as a straight or full-length exponential trumpet; requires a fraction of mounting space; and the construction obviates the possibility of water or any other foreign matter reaching the throat.

The Morning Glory projectors have a universal application — indoors, outdoors, and sound truck. The reflexed construction results in a considerable reduction in overall length.

This article has been prepared from data supplied by courtesy of Atlas Sound Corp.

†This term, inasmuch as it is introduced here for the first time, requires a little explanation. Briefly, it may be likened to the effect which results when a stream of water is directed at high intensity against a solid surface. Just as in the water analogy, when a high-intensity sound beam strikes a given area, as for instance a crowd at a stadium, it has been found to "mushroom," or "splash," to a much greater extent than is the case when a low-intensity sound beam reaches its objective. In fact, in the latter instance, the sound may be entirely absorbed, allowing none of the sound energy to disperse even within a limited area.

See Page 120 for Important Announcement on Radio Service Manuals



A well-known sound specialist describes a method of recording and playback of sound-on-disc said to be new in principle and revolutionary in the industry. The result of 4 years' laboratory work, it permits recording a ½-hour of music (present recording time, 4½ mins.) and 45 mins. of speech (vs. 8 mins. by conventional methods), by embossing on thermo-plastics.

●

Fig. 1. The commercial recorder at left was developed by Recordall Mfg. Company for recording and playback of constant groove-speed discs. The same "cutting" head and needle are used for playback of the embossing.

●

CONSTANT GROOVE-SPEED RECORDING

On Thermo-Plastics — Using the Embossing Process

E. E. GRIFFIN

ENTIRELY new in principle and revolutionary in the industry, Constant Groove-Speed Recording is one of the most outstanding improvements in disc recording since 1926, when Maxfield and Harrison published the results of their work on the art of disc recording.

This new method in combination with the *embossing* process rather than the *cutting*, in addition to giving the highest fidelity possible, results in the most economical method yet developed since it makes possible the recording of a full ½-hour of music on one side of a standard-size record—as against 4½ minutes on the conventional phonograph disc—or 45 minutes of speech as compared to 8 minutes on the present conventional dictating machine.

FIXED LINEAR SPEED

Constant groove-speed, as the words imply, means that the linear speed of the recording track in inches per second is fixed, independently of the record diameter.

In the conventional phonograph a fixed *angular* velocity of 78 or 33 1/3 r.p.m. is used, and this results in an excessive groove-speed at the outside and a too-slow groove-speed at the inside of the record. Taking a 12-in. diameter disc, the groove-speed at 78 r.p.m. will change continuously from 48 to 12 ins. per second as the stylus moves from the largest to the smallest diameter. The same size disc will give a variation of groove-speeds approximately from 21 to 5 ins. per second at 33 1/3 r.p.m.

It is at once obvious that it is not possible to have the same quality of recording for all of these different speeds—without continuously-variable compensation and equalization, in addition to correction for varying amounts of distortion. The excessive linear velocity near the outside of the disc reaches a point where the heat created through friction puts excessive wear on the recording stylus and playback needle.

At constant groove-speed an optimum linear velocity can be selected for the required frequency response in each case, and this linear velocity being constant, all equalization can be predetermined and permanently built into the amplifier. No variable equalization or compensation is required. The quality, volume level and distortion percentage remain fixed in quantity, regardless of the momentary diameter of the record at any recording position.

This feature of the constant groove-speed makes the use of the embossing process practical, since excessive high-frequency attenuation—caused by the damping effect of the record material's resistance to burnishing—can be equalized by proper tilting of the amplifier's frequency response curve —for a uniform linear velocity.

The building-up of high-frequency response, on the other hand, is made possible by qualities inherent in the embossing process (outlined subsequently) without bringing surface noise to an objectionable level.

Also, since the embossing process causes practically no wear on the polished round point of the embossing stylus, its life is practically limitless, a decidedly economical advantage over sharp-edged styli as used in the cutting method.

EQUIPMENT

Figure 1 illustrates how constant groove-speed is accomplished in Recordall equipment. The relative position of cutting head, recording stylus and the patented drive wheel is visible through the plate-glass turntable.

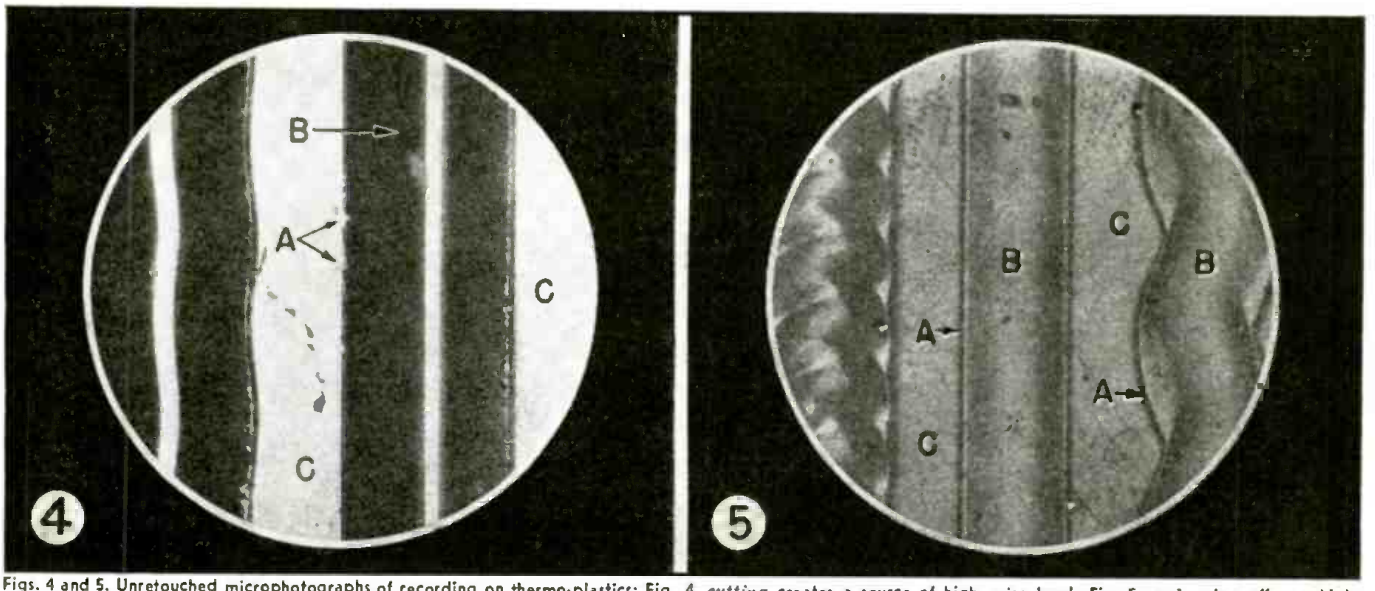
This drive-wheel and shaft are integrally mounted with the head carriage mechanism, so that the relative position of the recording stylus and drive wheel remains the same, regardless of the momentary position of the head on the record. The rotating of the drive wheel by a synchronous motor explains how constant groove-speed is obtained.

A drive shaft speed of 90 r.p.m. has been arbitrarily chosen for *high-fidelity* recording and is used on Recordall models where high-fidelity recording of the wide range of the audible spectrum of voice and music is desired. Slower drive shaft speeds are used on the *business* and *conference* models, where their use requires the intelligibility and recognizability of the speaker only, while still slower speeds are used on the *communication* models where intelligibility only is required. Figures 2 and 3 show the time available on different-size discs for recording on the various models.

EMBOSSING

Embossing or *burnishing* was used almost exclusively in recording on aluminum blanks —the first and comparatively recent, yet already outmoded, form of "instantaneous" recording. The crystalline structure of all aluminum alloys used made this imperative —since cutting exposed such granularity in the material that the increased surface noise created an entirely unsatisfactory signal-to-noise ratio. The *embossing process on aluminum*, on the other hand, required very much greater power, since the cutting head had to be weighted and the cutting armature damped, "stiffened," to overcome the resilience of the metal and its high resistance to burnishing.

All these requirements added up in creating all kinds of frequency distortion and the resultant distortion being a function of the momentary linear groove speed, equalization was extremely difficult. A well-trained, experienced recording engineer



Figs. 4 and 5. Unretouched microphotographs of recording on thermo-plastics; Fig. 4, *cutting* creates a source of high noise level; Fig. 5, *embossing* offers a high signal-to-noise ratio.

could produce satisfactory results on carefully-designed equipment—but even the best records were comparatively short-lived, deteriorated with age and had to be played with special equipment, and non-metallic needles to maintain their quality, even during this short life. Thus embossing on aluminum has gradually gone into the discard and with it, apparently, its outstanding one good feature, either overlooked or purposely disregarded by recording engineers, but retained by the present method of *embossing on thermo-plastics.*

THERMO-PLASTICS

The introduction of "acetate" coating on aluminum recording discs caused the return to cutting instead of embossing—since cutting was at the time a much better developed art and without any doubt had quite a few advantages. It didn't require excessive weight on the cutting head or too much equalization—at average speeds—and could well be played back with most any kind of pickup and most any kind of needle.

The fine-grained structure of most nitrates used to make these "acetate discs" reduced surface noise to a satisfactory minimum and with a little training even the uninitiated layman could learn to produce records comparable in many respects to commercial pressings. These facts account for the increasing popularity of instantaneous recorders.

The fact that acetate records are much more stable to temperature changes than wax, and so eliminate the necessity of temperature-controlled storage and recording, in combination with simplified mechanical construction and the instantaneous playback feature makes their use in professional recording advantageous.

Constant groove-speed — as mentioned above—made the return to embossing possible. Several features of this process in combination with acetates and other plastics make it desirable.

The atomic structure of these materials shows a combination of hydrocarbons and crystalline substances, and the "floating" process used in the manufacture of records, brings the finest grain to the surface. The coating and hardening of the substance creates a surface tension. The combined result is a shiny "skin," the thickness of which is a function of (a) the chemical structure, (b) the thickness of the entire coating, and (c) the speed employed in the drying process. Considering the fact that total thickness of coating seldom exceeds 0.0065-in. (for cutting), it is easy to see that the skin can be measured in microns only.

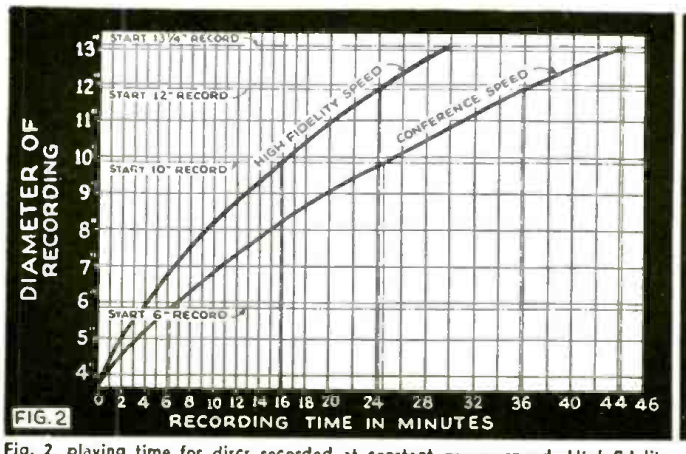
"SCRATCH"

Cutting disturbs the continuity of the skin, unbalancing the surface-tension. The microphotograph, Fig. 4*, clearly shows at "A" the resulting "tear," ragged edges on the unmodulated groove. At the same time comparatively larger grains are exposed, as is plainly visible if the dull structure of the sidewalls, "B," is compared with the shiny, undisturbed land, "C," between grooves. It should be apparent that faithful reproduction of this groove will result in some surface noise ("scratch").

Let us now examine the microphotograph of an embossed section of the same record, Fig. 5. (The photographs, by the way, were taken under identical conditions with the same magnification and are unretouched.) The cut was recorded on a standard professional recorder with a new sapphire stylus by a competent recording engineer and the embossing on a standard Recordall machine. Note that the "skin" was not disturbed on the embossed record. Edges, "A," of the unmodulated groove show absolutely no tear, no raggedness, and the structure of the sidewalls and the bottom of the grooves, "B," is just as smooth and shiny as the undisturbed land, "C," between grooves. Approximately 100 diam. enlargement does not show any *source* of surface noise here.

Analyzing the embossing process it was found that the triple action of burnishing results in the best groove obtainable—*if* used in combination with constant groove-speed. A blunt stylus under great pressure (between 75,000 and 125,000 lbs. per sq. in.) compresses the recording substance, the heat created by friction followed by rapid

*Courtesy: Dr. Gordon Laboratories, Hollywood, Calif.



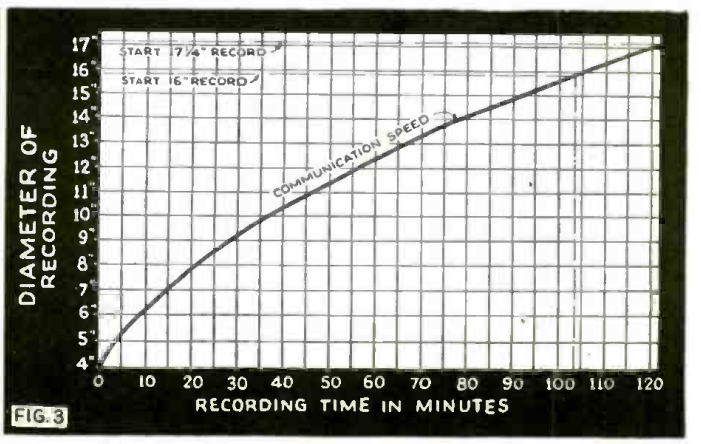


Fig. 2, playing time for discs recorded at constant groove-speed. High-fidelity speed at 10 ins. per second; conference speed, 7½ ins. per second. Fig. 3, playing time at rate of 5 ins. per second, as used on communication models.

cooling—uniform at constant groove-speed—hardens the groove by "heat-treatment"—while the blunt, smooth nose of the stylus polishes the recorded surface by burnishing. The result is a hardened, durable and smooth groove with an excellent signal-to-noise ratio.

FIDELITY

Examining the frequency-distortion characteristics of the same 2 kinds of recording, the cutting process has an undisputed superiority—in recording. A sharper stylus under less weight, with less damping can more faithfully follow high-frequency modulation. But the necessity of using a different-shaped playback needle point and equalization necessitated by the inherent surface noise features of the cut groove, practically eliminate these advantages.

The fundamental defect existing in all disc recording systems where a sharp-edged, chisel-shaped cutting tool is used to form the groove, and a round-nosed needle is used in playback, is the fact that these 2 shapes are entirely different. The groove so cut will couple to the round-point playback needle so long as the groove is unmodulated; as soon as modulation takes place, the cut groove becomes narrower as it deviates from a straight line, resulting in improper coupling to the playback needle in reproduction.

This condition is overcome in the embossing method since the recording stylus is used in playback exactly the same as it is in recording, thus resulting in the best possible coupling and resultant minimum distortion. What good does a "high-fidelity" recording do if the higher frequencies have to be eliminated to correct the signal-to-noise ratio in playback?

The damping effect of the plastic on the embossing stylus attenuates the high frequencies—as we pointed out above. The constant groove-speed on the other hand makes permanent predetermined equalization for this diminished high-frequency response possible and the absence of inherent noise in the embossed groove makes this equalization practical with very little effect on the signal-to-noise ratio. Boosting the high frequencies as much as 30 db. at 7,000 cycles was found to be quite permissible, the noise level of the resultant record, when played-back without equalization being still lower than that of any cut record.

RECORDING-PLAYBACK STYLUS

The fact that constant groove-speed embossed records can be played back with the same stylus they were recorded with, *at the same angle*, makes it possible to reproduce all there is on the record. Another glance at the microphotographs (Figs. 4 and 5) will show at "D" that the groove-width remains constant in the modulated track on the embossed record, but undergoes substantial variations in the cut record.

This is caused by the chisel-point shape of the cutting stylus in combination with the pivoting of the armature as usually employed, causing a vertical shift of the momentary periphery of the point doing the actual cutting. The blunt nose of the playback needle will have a noticeable up and down motion as it is squeezed out of the groove where it contracts—adding to the distortion as it increases the danger of jumping grooves. This necessitates a deeper groove in the cut than in embossing.

Thus more lines per inch can be used with the embossing system without endangering the tracking of the playback needle in the groove—while the reduced depth also reduces the required thickness of the recording substance on the metallic backing.

All these factors tremendously increase the economy of this system in addition to appreciably improving the quality of reproduction and simplify the process to enable the operation of such equipment by laymen—and we think it justifies the contention that it is the most outstanding improvement in disc recording since 1926.

This article has been prepared from data supplied by courtesy of Recordall Mfg. Co., Inc.

BOOK REVIEWS

DICTIONARY OF TECHNICAL TERMS, by Frederic S. Crispin (3rd Edition, 1940). Published by The Bruce Publishing Co. Size, 6 x 8 ins., cloth cover, illustrated, 327 pgs. Price, $2.25.

The revised and enlarged edition of "Dictionary of Technical Terms" is an exceptionally comprehensive compilation, taking in as it does the nomenclature of about 70 fields.

The book features more than 1,000 new words, various tables of weights and measures, and many new illustrations. Included in the classifications are radio, electricity, physics, science, ceramics and the plastic art. The dictionary is for the use of students, draftsmen, mechanics, builders, electricians and workmen generally. The author has made the scope broad rather than detailed and hence has not included all the technical terms in any field of endeavor.

HOW TO USE THE CATHODE-RAY TUBE, by J. H. Reyner (1940). Published by Furzehill Laboratories, England. Size, 5 x 7½ ins., paper cover, 33 illustrations, 40 pgs. Price, 1 shilling (about 35c, including postage).

This booklet may be considered a primer on cathode-ray tube operation for technicians who are otherwise "up" on their radio theory.

DO YOU WANT TO GET INTO RADIO? by Frank A. Arnold (1940). Published by Frederick A. Stokes Co. Size, 5 x 8 ins., cloth cover, 140 pgs. Price, $1.50.

For each type of radio work, the author states definitely what temperament, education and experience is required of the applicant and what kind of work and surroundings the beginner may expect to encounter, to get into the respective fields of radio.

A chapter is devoted to personal aptitudes for radio work in general, and whether college training is essential. An appendix lists those colleges which regularly give courses in radio.

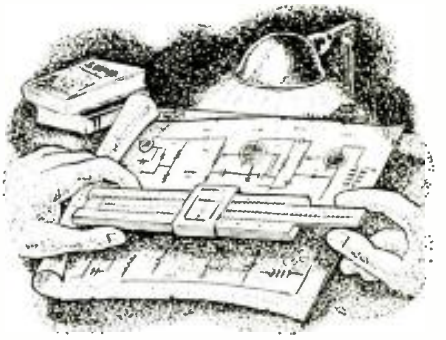
States the author in his preface: "I am writing this volume for the hundreds of young men and women who would like to get into radio but do not know how to go about it. It is intended not as a textbook or a study in psychology; rather as the story of radio broadcasting from the standpoint of its career possibilities, bearing always in mind the training and aptitudes required for success in this field." This non-technical book analyzes business possibilities in broadcasting and television.

(Turn to Pages 95 and 128 for other Book Reviews.)

SOUND ENGINEERING

Free Design and Advisory Service For Radio-Craft Subscribers

Conducted by A. C. SHANEY



This department is being conducted for the benefit of RADIO-CRAFT *subscribers. All design, engineering, or theoretical questions relative to P.A. installations, sound equipment, audio amplifier design, etc., will be answered in this section. (Note: when questions refer to circuit diagrams published in past issues of technical literature, the original, or a copy of the circuit should be supplied in order to facilitate reply.)*

No. 8

20-WATT AMPLIFIER WITH FOUR 6B5'S

The Question . . .

I have a 30-watt amplifier which I wish to rebuild to one of higher gain and more inputs without adding too many transformers. Will you kindly send me a sketch covering this. I wish to have 3 microphone inputs and 1 phono, and would like to use two 6SC7 tubes in the input stage, followed by a 6SC7 used for electronic mixer, and 6SC7 for balanced inverter. The final stage should utilize four 6B5's. For the power supply I would like to use a 5Z3 rectifier. Please furnish high- and low-frequency control circuits.

JAMES MOY,
Chicago, Ill.

The Answer . . .

A schematic diagram of the type of amplifier you desire is given in Fig. 1. Your suggested tube line-up would not provide sufficient gain for low-level microphones. I have therefore suggested a 4-stage amplifier instead of 3 stages.

Because of the interelectrode capacities between the plates and grids of the 6SC7, this tube is not recommended as a dual-channel input, unless the gain controls are connected ahead of the input grid. This circuit arrangement, however, would be particularly susceptible to volume control noise, and is therefore not recommended. By using 6SF5's, however, the preamplifier stage is completely isolated from its adjoining channel, and no cross-talk will be prevalent. Furthermore, the placement of the volume control after the 1st stage, will provide higher-level mixing.

Two 6SC7's are employed as electronic mixers. These in turn feed through the high- and low-frequency equalizers into a 6SC7 inverter. A balanced inverter circuit of the type you require was diagrammed in the April, 1940, issue of *Radio-Craft* (see page 531). The inverter circuit of Fig. 1, however, is of a conventional type and easily constructed and checked. The 7,000-ohm resistor, though, should be made variable for critical adjustments, if perfect inversion is desired. This can best be checked by connecting an oscilloscope to each of the control-grids of the push-pull output stage and adjusting the 7,000-ohm resistor until equal potentials are applied to the push-pull grids.

The power supply should be capable of delivering 220 ma. at 300 volts. The power transformer should deliver about 330 volts under full load. The 1st choke, Ch.1, should be capable of carrying the full output of the supply. The 2nd choke should be capable of handling 50 ma. The output transformer should, of course, be properly matched to the push-pull parallel output stage. You will note that 4 R.F. chokes are inserted in each plate circuit to suppress parasitic oscillations. These, however, may not be necessary. Your preliminary tests will indicate whether or not they should be used.

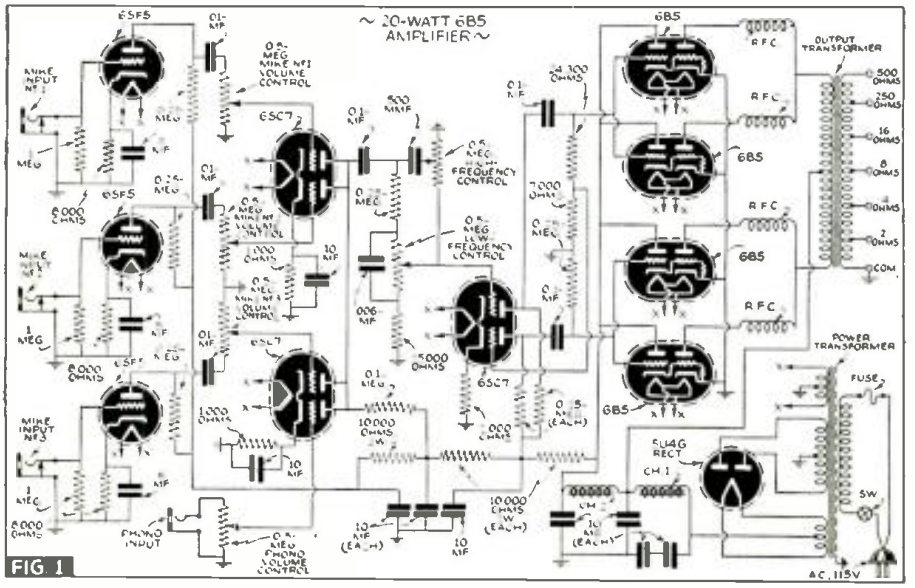


FIG. 1

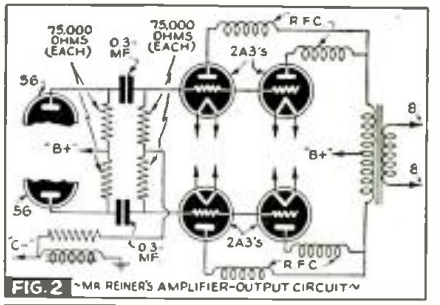


FIG. 2 ~MR REINER'S AMPLIFIER-OUTPUT CIRCUIT~

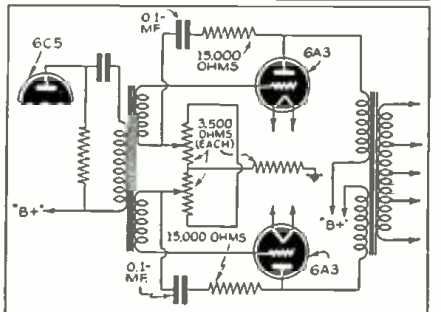


FIG. 3 ~THE FEEDBACK CIRCUIT TO BE INCORPORATED IN THE AMPLIFIER-OUTPUT CIRCUIT OF FIG. 2~

FIG. 4A ~CONVENTIONAL TUBE CIRCUIT~

FIG. 4B ~SOURCE OF FEEDBACK VOLTAGE INDICATED AT "X"~

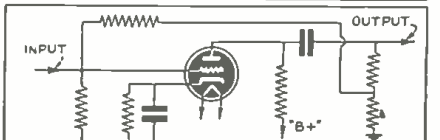


FIG. 4C ~PARALLEL FEEDBACK~

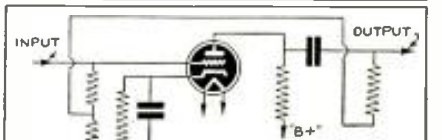


FIG. 4D ~SERIES FEEDBACK~

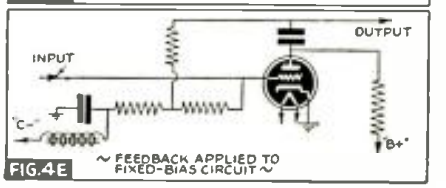


FIG. 4E ~FEEDBACK APPLIED TO FIXED-BIAS CIRCUIT~

You can construct these inductances by winding 500 turns of #30 wire on a form ½-in. in dia. and 1½ ins. long.

All resistors are of the ½-watt type, excepting those marked for higher power.

PRACTICAL APPLICATION OF INVERSE FEEDBACK

The Question . . .

I have an amplifier, as per Fig. 2, to which I wish to add inverse feedback. Will you kindly add to my sketch such an arrangement. (I am not too strong on the theory of such arrangements.)

I am, and have been, a *Radio-Craft* subscriber for years. I came across a circuit similar to Fig. 3, which has inverse feedback. I am not certain, however, about being able to adapt this feedback arrangement to my resistance - capacity coupled amplifier. I am trying to get the best possible hi-fi quality.

I thank you for whatever help you can give me.

L. F. REINER,
Miami, Fla.

The Answer . . .

Inverse feedback can easily be added to your amplifier. There are many ways of doing this, which will present themselves to you after reading the following description of how to apply inverse feedback.

Unfortunately, most discussions involving the theory of inverse feedback have been steeped in mathematics, and are beyond the scope of the average Serviceman. This has undoubtedly seriously hampered the application of this type of circuit to many amplifiers.

SINGLE-ENDED AMPLIFIER

Inverse feedback evolves from the principle of taking some voltage from some point in an amplifier and coupling it back into a previous section of the amplifier, so arranged as to partially buck-out the original signal. This is technically known as feeding the signal back out-of-phase. The trick in its application is to make sure that the signal which is fed back, *is* out of phase. When this is done, a loss of gain should be noted. If, however, the signal is fed back in-phase, then we have a condition of regeneration, which usually produces sustained oscillations.

For ideal performance, the signal that is fed back should be exactly 180° out-of-phase with the input signal. In many circuits the feedback signal is exactly 180° out-of-phase at only one frequency. At other frequencies it gradually shifts around to an in-phase condition. This type of circuit produces sustained oscillations, usually at some very high frequency and is always indicative of varying phase shift within the loop of the feedback circuit. The point from where the feedback voltage is taken to the point where it is applied, is known as the *feedback loop.*

Figure 4A shows a conventional tube circuit. If a voltage-dividing network is connected from plate-to-ground, as in Fig. 4B, a small portion of its total voltage will appear at X. This voltage can then be applied to the grid of the tube in parallel with its original incoming signal, as illustrated in Fig. 4C, or in series, as indicated in Fig. 4D. If a bias is to be applied to this stage, the bias resistor is removed from ground and bias voltage is applied through the bias network, as indicated in Fig. 4E. It is important, however, that the low end of the resistance network be bypassed to ground, so as not to affect the feedback arrangement. In applying these feedback circuits, it is of course important not to excessively shunt either the grid or plate circuit of the amplifier itself.

Feedback is applied for any one or all of the following reasons: (1) Reduce distortion; (2) reduce noise and hum within the feedback loop; (3) reduce frequency discrimination within the feedback loop; or, (4) reduce plate resistance of the stage from which the feedback loop is taken.

From the above, it may be seen that if the feedback loop embraces the output transformer, it will compensate for frequency discrimination and distortion introduced by this element. If feedback does loop the output transformer, it is important that the transformer be designed for minimum variation of phase shift with frequency.

DOUBLE-ENDED AMPLIFIER

Up to now, we have only considered a single-ended amplifier. If feedback is to be applied to a push-pull amplifier, it may be done through one of 2 ways, either (1) from a single-ended signal (as a grounded output transformer secondary) back to a single-ended input stage (as the input of the inverter); or, (2) it may be applied from a push-pull signal (as through a balanced output transformer) back to a push-pull stage, as illustrated in Fig. 5, which is the recommended method for applying inverse feedback to your amplifier.

The value of R1 and R2 should be adjusted for a compromise between the amount of feedback desired and the required stability for the amplifier. The phase of the feedback voltage may be easily reversed by reversing the plate connections of the output transformer.

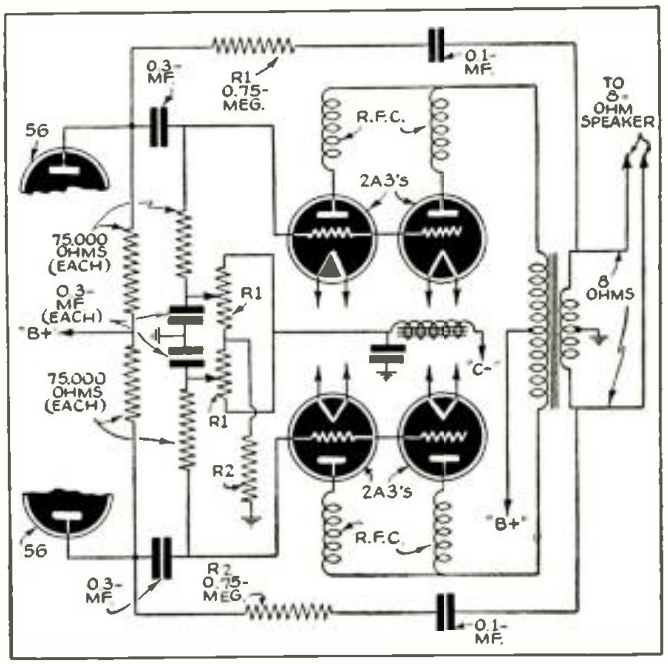


Fig. 5. Balanced inverse feedback applied from balanced output transformer to push-pull stage. Note 1. — The amount of feedback may be varied by varying the 0.75-meg. resistors (R1 and R2). Note 2.—Values of R1 and R2 to be adjusted to provide proper bias for output stage. Balanced tubes should be used in parallel output circuits.

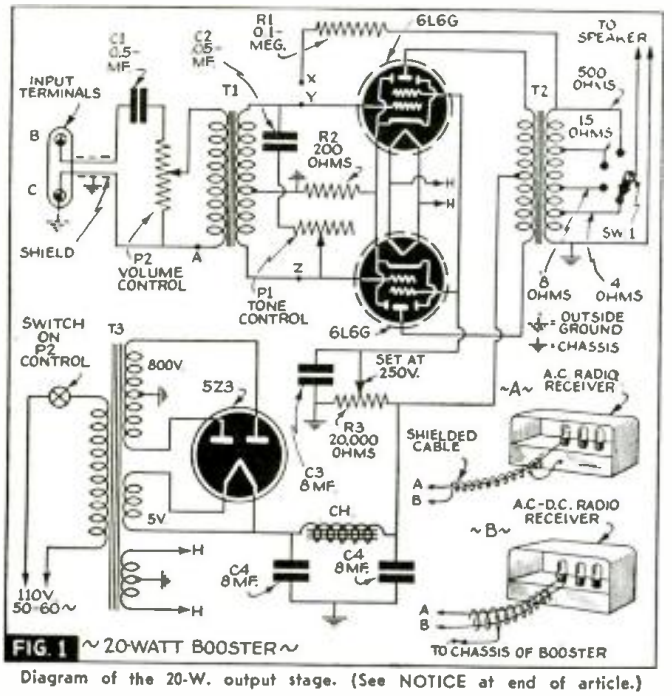
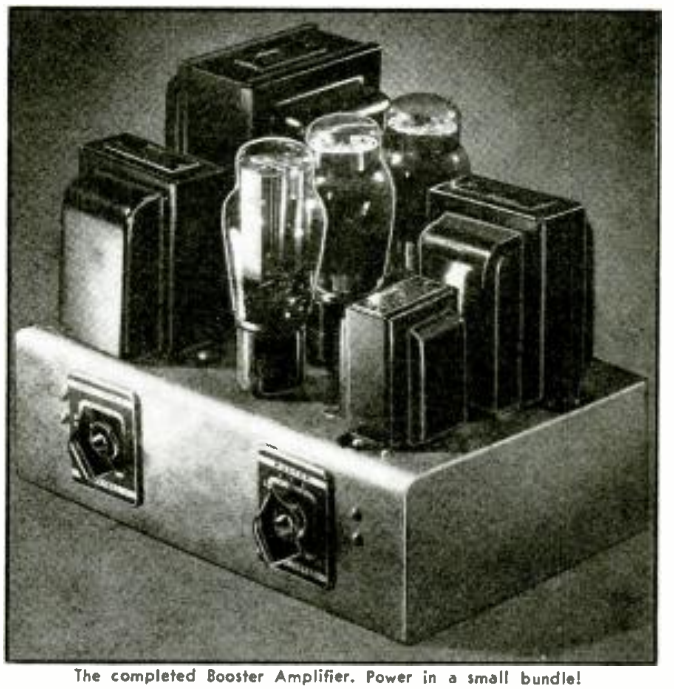


FIG. 1 ~20-WATT BOOSTER~

Diagram of the 20-W. output stage. (See NOTICE at end of article.)



The completed Booster Amplifier. Power in a small bundle!

20-WATT BOOSTER AMPLIFIER

For Radio Receivers, Low-Power P.A. Systems, Etc.

This article describes the construction of an easily-built power output stage which may be added to the "'Transitional' P.A. System" described last month. Connected to a $10 A.C.-D.C. midget, delivering 3 W. with appreciable distortion, this power stage afforded an output of 28 W. with no audible distortion!

H. T. ZIEGLER

SOMETIMES additional power is required for radio reception, especially in public places such as restaurants, clubs, taverns, etc. With this Booster Amplifier even the smallest A.C./D.C. midget will supply sufficient volume for an audience of 5,000 persons! Phonograph music or carbon mike programs which are fed through the radio set can be amplified also.*

This power stage can be used also to increase the output of small A.F. amplifiers.

Modern radio receivers have from 3 to 5 watts output, which is sufficient for all ordinary installations. But where a radio set is operated in a public place, additional amplification is necessary.

There are many radio receivers which are furnishing inadequate volume where crowds gather to dance or listen to sports reports, such as baseball and football games, prize fights, etc. Building this Booster Amplifier and installing it in such places should add considerably to the income of any radio Serviceman.

DESIGN

All unessential parts were left out of the Booster so that it would be installed economically. Fundamentally it is a pair of 6L6G tubes in push-pull, with power supplied from a 5Z3. The entire unit is mounted on a chassis only 10½ ins. long x 7 ins. wide. The overall height, with tubes inserted, is only 8½ ins.

The small size of the amplifier permits it to be mounted in the cabinet of console-model radio sets. When used with table-model receivers it can be installed in a separate cabinet or concealed in any convenient place.

Inverse feedback was used to obtain a flat frequency response and to reduce hum and distortion. This was accomplished by connecting the 100,000-ohm resistor from the secondary of the output transformer to the secondary of the input transformer.

All the first experiments were made with the unit connected to a low-price A.C./D.C. superhet. The tone was really excellent and the hum and other distortion were inaudible.

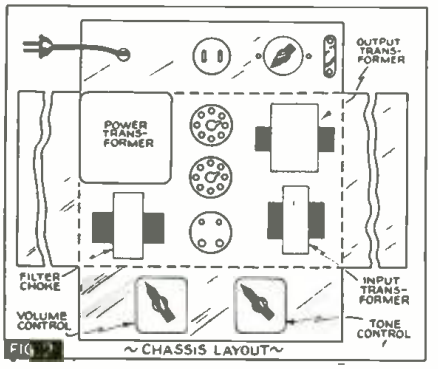


FIG. 2 ~CHASSIS LAYOUT~

We then connected the stage to a good A.C. superhet. and were surprised at the high quality of reproduction and enormous power.

Finally, we connected it to a frequency-modulated receiver just to make sure that we could handle the high-frequency response.

It is necessary, of course, to use good P.M. speakers with the Booster Amplifier if good tone quality is desired. If the full output is to be used, select speakers which will handle the 20 watts. That is, one 20-watt speaker, two 10-watt speakers, etc. Speakers rated higher than this will be even better, such as one 30-watt speaker, two 20-watt speakers, etc. *Do not attempt to use the radio receiver speaker. It will be damaged in a short time.*

PARTS REQUIRED

In the laboratory sample we used the parts recommended in the list at the end of this article. This list need not be followed religiously. Any parts of equal electrical rating may be substituted. Because the average Serviceman will have some of the necessary parts, we decided to give the specifications on all parts which require special explanations.

The input transformer, T1, has a 10,000-ohm primary and a tapped 90,000-ohm secondary.

The push-pull output transformer, T2, is the heavy-duty type to match a pair of 6L6G tubes, having an 8,000-ohm primary,

*See the article "'Transitional' P.A. System" in the July issue of Radio-Craft for adding a mike to any radio receiver. Add this Booster to have a complete, powerful sound system.

and a secondary tapped at 4-8-15-500 ohms. If the amplifier is to be used with a specific speaker or set of speakers, the tapped secondary is not necessary, permitting the use of a lower priced transformer, one which will directly match the speaker system used.

The power transformer, T3, must have a 5-volt secondary winding for the filament of the 5Z3; a 6.3-V. secondary for the 6L6G filaments, and an 800-volt center-tapped secondary winding for "B" current. The high-voltage winding should be capable of delivering at least 180 ma.

CHASSIS LAYOUT

On the top of the chassis are all the transformers, a 4-contact socket for the 5Z3, and 2 octal sockets for the 6L6G tubes.

On the front of the chassis are 2 potentiometers, 1 for the tone control and 1 for the volume control.

On the back of the chassis is a tap switch for matching the unit to the speakers. (Note: The only tap switch available was marked 4-8-15-250-500. If the transformer, like ours, has no 250-ohm tap, this point on the switch is simply left unwired.)

A 2-pole A.C. receptacle is installed on the back of the chassis for connecting the speakers. Two such receptacles can be used, if desired, wired in parallel.

Also on the back of the chassis is a 2-post terminal strip as the connection for the incoming radio receiver wires.

No special wiring instructions are necessary. Simply follow the wiring diagram. Use a shielded lead from the terminal strip to the primary of the input transformer.

The wire marked "X" should be tried at points "Y" and "Z" after the unit is completely assembled and is in operation. At one point regeneration will be introduced and the reproduction will become distorted; at the other point the volume may drop slightly, but reproduction will be improved.

OPERATION

Only a single shielded wire is required to connect the Booster Amplifier to the receiver for A.C. sets. (Connecting to A.C./D.C. radio sets is explained later.) The center conductor is terminated in a clip which slips onto the plate prong of the output tube in the receiver. The shield is connected to the radio receiver chassis. When the receiver uses push-pull tubes, connect the wire to either plate.

For A.C./D.C. radio sets 2-wire shielded cables must be used to connect the set and amplifier. One wire is connected to the plate of the output tube and the other to the cathode. The shield is connected to the chassis of the Booster.

If there is any grid noise present because of the leads between the receiver and the amplifier, connect one side of the power stage input transformer primary to the chassis.

LIST OF PARTS

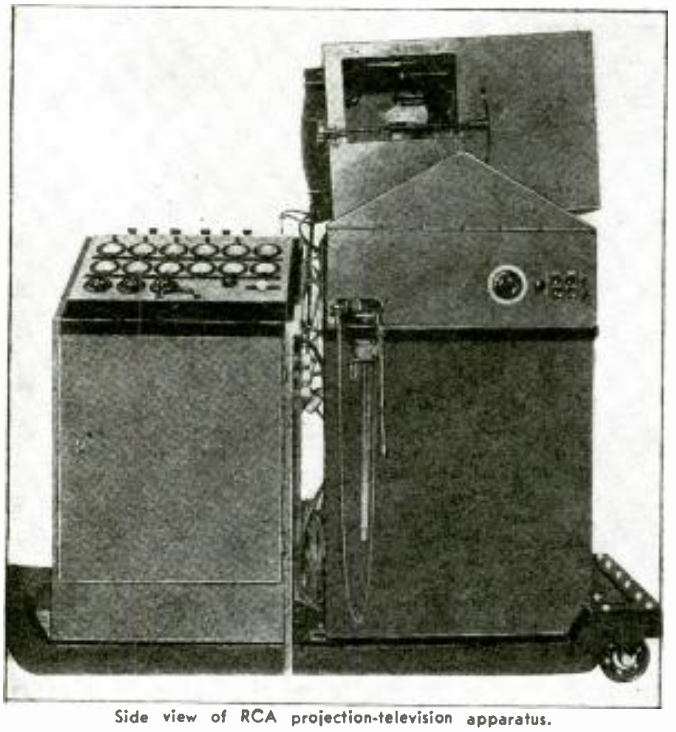
One Thordarson input transformer No. T67A40, T1;
One Thordarson output transformer, No. T65S94, T2;
One Thordarson power transformer, No. T92R21, T3;
One Thordarson choke, No. T17C00-B, ch.;
One paper condenser, 0.5-mf., C1;
One paper condenser, 0.05-mf., C2;
One Mallory electrolytic condenser, No. CS-133, 8 mf., 450 V., C3;
One Mallory electrolytic condenser, No. CN-152, 8-8 mf., 450 V., C4;
One resistor, 0.1-meg., ½-W., R1;
One resistor, 200 ohms, 10 W., R2;
One voltage divider, 20,000 ohms, 25 W., R3;
One Centralab potentiometer with switch, No. 62-116, 1 meg., P1;
One Centralab potentiometer, No. 72-121, 0.25-meg., P2;
Two Amphenol octal sockets, S-8;
One Amphenol 4-contact socket, S-4;
One Amphenol receptacle, 61-F;
One Amphenol polarized plug, 61-MP11;
One Amphenol tap switch marked 4-8-15-250-500, 36-1, Sw. 1;
One line cord with plug;
Misc. (nameplates, knobs, etc.).

(The author offers to answer any inquiries regarding the building or adaptation of the 20-Watt Booster Amplifier to any radio set. If a particular radio receiver is referred to, please give make, model number and tube line up. An addressed, stamped envelope will be appreciated.)

NOTICE.—An error, caught too late to permit changing the illustration, exists in detail drawings A and B in lower-right of the schematic diagram of the complete 20-W. Booster Amplifier. In sketch A a single-conductor shielded cable is used for connecting the Booster to an A.C. receiver. Center conductor of cable is connected from "A" terminal of Booster to plate of receiver output tube.

In sketch B a 2-conductor shielded cable is used to connect the Booster to any A.C.-D.C. receiver. Wire "A" connects plate of receiver output tube to terminal "A" in the Booster. Wire "B" connects to cathode of output tube (or any terminal which is connected to "B-"). This wire "A" connects to terminal "B" of the Booster. The cable shield is not connected to the receiver chassis, but it is connected to the Booster chassis.

This article has been prepared from data supplied by courtesy of Allied Radio Corp.



Side view of RCA projection-television apparatus.

N.B.C.'s Ray Monfort, and projection Kinescope; left, projection lens.

NEWEST SCREEN-SIZE TELEVISION

Not yet on the market, is the newest type of projection television receiver here described, which permits viewing by 150 persons. A feature of the system is the use of an enlarging mirror in place of the lens system ordinarily used!

A NEW large-screen television system of the type designed for use in theaters and before large audiences was demonstrated last month at the annual stockholders' meeting of the Radio Corporation of America in the RCA Building, Radio City, New York.

The demonstration, first public showing of the unit, was featured by an outstanding program of entertainment. Among those who appeared on the television screen were Madame Kerstin Thorborg, distinguished contralto of the Metropolitan Opera Company; Lowell Thomas, 4 1st-chair men of the NBC Symphony Orchestra, and other well-known artists.

WALL-SIZE IMAGES.—Although the RCA Laboratories have been working several years in the field of large-screen television, the particular system shown was completed early this year. A laboratory model, it projects images 4½ x 6 feet in size onto an ordinary beaded motion picture screen. The projected pictures compare in brightness with motion pictures and are considered to have definite entertainment possibilities.

The unit was built as an intermediate step in the development of apparatus for the projection of much larger images, but it has already become apparent that the 4½ x 6 foot image has interesting possibilities for use in clubs, schools and other similar places where the viewing group numbers from 100 to 150 persons. The Company has no immediate plans for marketing this apparatus. At least 12 months would be needed to develop it commercially.

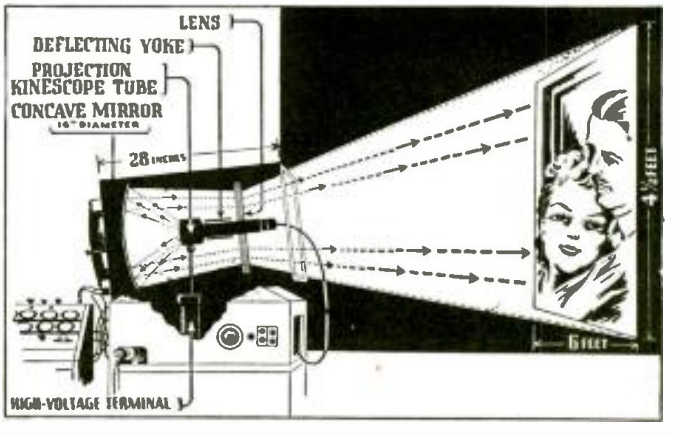
3-UNIT CONSTRUCTION.—The apparatus consists of 3 parts. One contains the newly developed kinescope projection tube and the optical system. Another contains the high-voltage power supply, and the 3rd houses the electrical circuits, amplifiers, and controls. All 3 are assembled on a single mobile platform. The overall dimensions are: length, 6 ft., width, 2 ft., and height, 5½ ft.

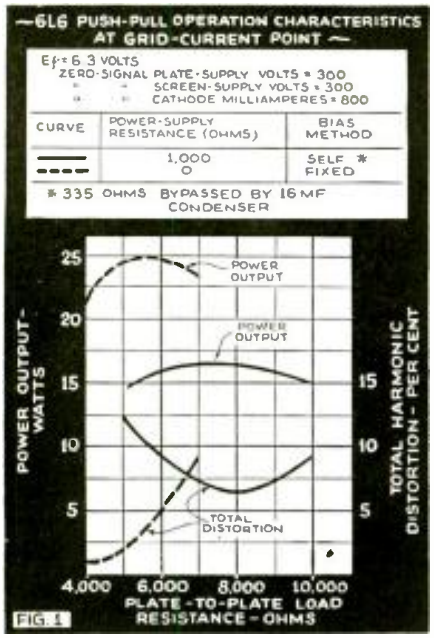
56,000 VOLTS.—The new kinescope uses 56,000 volts as compared with the 6,000 or 7,000 volts used by the kinescope in the ordinary home-type television receiver. The actual size of the image on the face of the kinescope projection tube is 2.4 by 3.2 inches. The television signals are brought to the kinescope by either an antenna system, which takes them off the air, or by a direct wire line from the source of the program. In the demonstration, the signals were taken off the air as broadcast by the National Broadcasting Company's transmitter, W2XBS, atop the Empire State Building.

MIRROR LENS.—The optical system of the unit has an effective numerical aperture of F:0.7, or more than 4 times the speed of the best available projection lenses. This means an increase in screen brightness of more than 4 times.

The brightly-illuminated image on the surface of the kinescope, which faces in the opposite direction to that of the finally projected picture, is thrown upon a *concave mirror* surface measuring 16 inches in diameter. *The mirror collects the light and magnifies the image 22½ times.* The image is then projected back through a glass lens surrounding the neck of the kinescope, and thence 20 ft. through space to a screen mounted on a wall. The system effectively utilizes the industry television transmission standards formulated by the Radio Manufacturers Association: 441-line definition and 30 frames p[illegible] second.

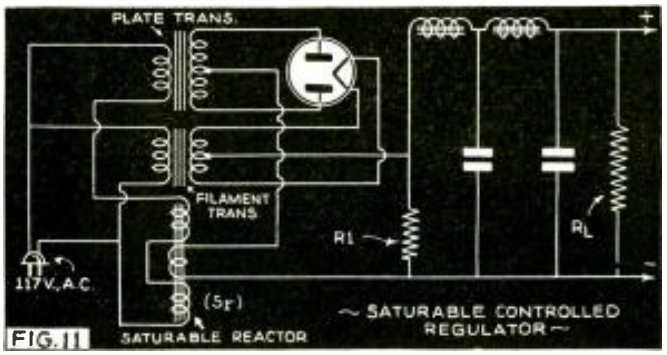
The new RCA large-screen television system, here shown in cross-section, is based on projection optics of extremely wide aperture, a kinescope capable of high-voltage operation, and apparatus suited to these conditions. Most essential elements are the new kinescope projection tube and the optical system. These provide more light and utilize it more effectively than ever before, so that large-screen television becomes practical.





Distortion vs. power output of push-pull 6L6 stage with zero-ohm and 1,100-ohm resistance power supplies.

Controlling the degree of saturation in an ingenious magnetic-circuit arrangement makes possible a power supply having automatic regulation within wide limits.



The Fundamentals of

CONSTANT-OUTPUT D.C. POWER SUPPLIES

This article describes 3 conventional types of regulated power supplies; and concludes with the engineering details of a D.C. power supply unit capable of regulating the output within 1 per cent under a load change of 300 per cent!

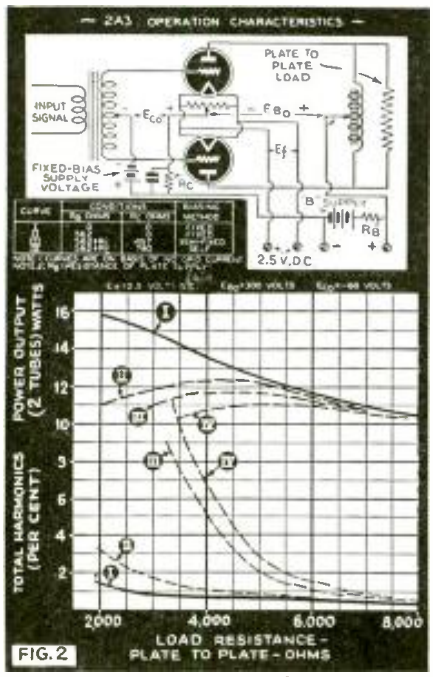
A. C. SHANEY

THE need for a stabilized constant voltage power supply has undoubtedly been felt by many laboratory technicians who are constantly developing new electronic devices for accurate measurements. A constant voltage supply is also necessary for stable operation of communication systems involving the use of oscillators, which are subject to frequency drift with variations in voltage. In addition to these, many precision electronic instruments require a constant voltage under all conditions of operation.

High-power amplifiers operating in A1, AB1, AB2 or class B similarly require a stabilized voltage supply for attainment of maximum power output with minimum distortion. In fact, the importance of power supply regulation is usually overlooked by many amplifier design engineers.

Figure 1 shows the power output versus total distortion of a class A1, 6L6 amplifier operating with a power supply having perfect regulation (or 0 internal resistance), as against the same circuit with a more or less standard power supply having an internal resistance of 1,000 ohms. A careful examination of the dotted curves (which is the condition obtained with a 0-resistance power supply) will disclose that approximately 23 watts is available at 1.5% of total distortion. An output of 25 watts is available at 3.5% distortion. The solid curves show that with a conventional power supply, this same circuit, under optimum conditions, will produce only 16.5 watts at 6.7% total distortion. These characteristics should not be construed as applying to a 6L6 amplifier only. In fact, the 2A3 tube is subject to the same detrimental effects of poor regulation.

Figure 2 indicates power output versus distortion curves for various types of supplies for a push-pull 2A3 amplifier. It will be noted that a plate and bias supply having 0 resistance (see curve 1) will enable the attainment of 16.6 watts at 1.4%, whereas a plate and bias supply, having internal resistance of 780 ohms, will attain only 11 watts at 2% distortion. Naturally, poorer power supplies will produce more distortion at equivalent power levels.



Distortion vs. power output of push-pull 2A3 amplifier with various types of power supply.

REGULATION

Regulation of a power supply may be expressed as the ratio of the change in output voltage to the highest output voltage. Expressed mathematically, this ratio may be written as $\frac{E\Delta}{E_o}$. Percentage of regulation can be calculated from the following formula:

$$\% R = \frac{E\Delta}{E_o} \times 100 \qquad (1)$$

where

E_o = Highest voltage output
$E\Delta$ = Output voltage change

If a power supply produces no voltage change under full- and no-load conditions, it naturally would have "*0 regulation.*" The term "regulation" does not always give a true picture of the operating characteristics of the power supply, unless the changes in current are taken into consideration. The regulation of a power supply may also be expressed as a function of its internal resistance. For example, a power supply which delivers 200 volts under no load, and 195 volts under the full load, would be said to have a regulation of $\frac{200-195}{200} \times 100 = 2\frac{1}{2}\%$.

Its internal resistance, however, can be calculated from the following formula:

$$R_i = \frac{E\Delta}{I\Delta} \qquad (2)$$

where

R_i = internal resistance
$E\Delta$ = change in output voltage
$I\Delta$ = change in output current

For example, a power supply which delivers 205 volts at a load current of 100 milliamperes, and 200 volts at a load current of 125 ma., would have an internal resistance of $\frac{205-200}{.125-.100}$ which is equal to $\frac{5}{.025}$ = 200 ohms. It will be noted that the internal resistance of a power supply combines in one term, the ratio of voltage regulation to current change.

CLASSIFICATION OF D.C. REGULATED POWER SUPPLIES

Regulated D.C. power supplies may be broadly classified into 3 groups. Group No. 1 employs a cold-cathode glow discharge tube similar to the ordinary neon lamps, or other radio versions of the Sylvania VR90, VR150, and the RCA 874.

Group No. 2 employs a grid-control vacuum tube, the exact type, depending upon the control range desired.

Group No. 3 employs a saturable reactor in series with the plate supply transformer. It will be noted that all 3 are of the electronic type and employ no moving parts. A discussion of the fundamental circuits and

operating principles, as well as limitations of application of these 3 types follow:

COLD-CATHODE GLOW DISCHARGE REGULATORS

To best understand the operating characteristics of this type of a regulator, let us refer to Fig. 3, which shows a D.C. generator in place of the conventional power supply filter network feeding a resistor, R_b, in series with the load R_L, having an additional variable resistor R_c connected across it. If a milliammeter is inserted in the load circuit, and if the load is varied, so as to draw more or less current, it can be seen that an appropriate adjustment of R_c will always maintain a constant voltage across R_L within the operating limits of the circuit.

When the load draws more current, it means that its internal resistance is decreased. Now, if the control resistor R_c is increased, by a compensatory amount, the voltage E_O across the load will remain constant. Resistor R_b is inserted into the circuit to act as a "ballast" so that excessive voltage may be "absorbed." If a grid-glow discharge tube is inserted in place of R_c, Fig. 4 results. This is a characteristic grid-glow discharge circuit.

A casual study of regulating characteristics of both the Sylvania VR90 and VR150 (see Fig. 5), will disclose that a practically constant drop is maintained across these regulators under wide conditions of variations of current through them. Another way of looking at the regulating characteristic of this type of tube, is to view the regulator as being able to maintain a constant voltage drop across itself.

It is to be noted, however, that these tubes operate in a comparatively limited range. In other words, more than 30 ma. should never be passed through them. It will also be noted that the operating range of the VR150 is from 5 to 30 ma., which gives us an effective range of 25 milliamperes. Under these conditions of operation, the voltage across the tube will change from approximately 146 to 150. If this tube is placed across the output of a regulated supply, the internal resistance of the supply (within the operating range of the regulator) will be according to formula (2)

$$\frac{150-158}{30-5} = 80 \text{ ohms.}$$

The internal resistance of a power supply utilizing VR90 would be approximately 300 ohms.

The advantage of this type of circuit is that it compensates for variation in line voltage, as well as for variations in load current. The effective control range is materially reduced, if large variations in power line supply voltage occur. The disadvantage of this type of regulator is that it operates over a comparatively limited range, wastes an appreciable amount of power in the series resistor (R_b), and it can only be applied to supplies that are to deliver 90 volts, 150 volts or multiples of these voltages.

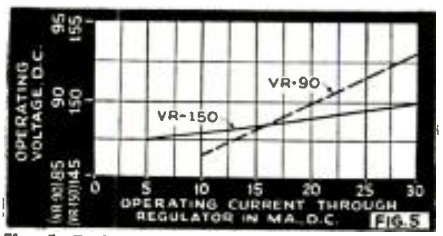


Fig. 5. Typical regulation characteristics of cold-cathode glow discharge tubes.

GRID-CONTROLLED VACUUM TUBE REGULATOR

To simplify the explanation of the operating principles of this type of regulator, let us refer to Fig. 6, wherein R_c is connected in series of R_L. The voltmeter E_O is connected across R_L and an ammeter, I_O, connected in series with R_L. Under this condition of operation, it can readily be seen that if the load current increases (R_L decreases), the voltage across R_L (E_O) may be brought back to its original value by decreasing R_c. Similarly, if the load current decreases (R_L increases) then the voltage E_O may be decreased by increasing R_c.

If R_c is now supplanted by a tube, as illustrated in Fig. 7, the plate resistance of the tube (from plate to filament) may be controlled by the bias applied to the controlled grid. Figure 8 shows such a circuit. To increase the sensitivity of the control voltage, a voltage amplifier (6F5) is employed to amplify the variation in line voltage. This, in turn, changes the bias in the regulator tube, which increases or decreases its plate resistance.

It will be noted that a number of grid-glow discharge tubes are used in this circuit to maintain a constant voltage across critical points. (These grid glow discharge tubes may be the small 2-watt neon lamps with their internal resistors removed.) For example, 1 tube is employed in series with the cathode of the 6F5. This insures a constant cathode voltage. Three additional tubes are connected in series from the high side of the supply directly to the grid. This arrangement insures that the total voltage change at the output is applied to the grid of the voltage control amplifier.

If we assume that the output voltage should drop from 300 to 290 volts, this 10-volt total change is applied to the grid of the 6F5 because the voltage drop across the 3 series neon tubes remains 180 volts at all times. This 10-volt change decreases the bias on the 6F5 (the neon tube in the cathode circuit keeps the cathode potential constant under all conditions of voltage variation of the output circuit), which increases the plate current through the control amplifier, this in turn, increases the drop across the 1-meg. series resistor of the control tube. This increase in drop decreases the bias of the control tube, which in turn decreases its plate resistance, and enables more current to flow through it to compensate for the increased current of the output, so as to bring the voltage back to its normal point.

The type of control tube employed, depends upon the amount of current desired from the regulated supply. A 2A3 is normally employed to control changes in current up to 60 milliamperes. The normal voltage drop from plate to heater of the control tube, should be adjusted so that maximum plate dissipation is not exceeded under any condition of operation. The maximum regulating range of a single 2A3 tube is approximately 60 milliamperes. A fixed resistor across the controlled tube will increase the available current, but will not increase the regulating range. Where increased regulation is essential, 2 more control tubes may be connected in parallel. An experimental model employing a single regulator tube with a shunt resistor across it, delivers 400.5 volts at 230 ma. and 399.7 volts at 280 ma. This would indicate an internal resistance of 16 ohms. Another variation of this circuit employing a 6J7 pentode voltage control amplifier tube is given in Fig. 9. This circuit employing a single 2A3 is capable of delivering 202 volts at 10 ma., and 199.5 volts at 70 ma., which is equivalent to having an internal resistance of approximately 41.7 ohms. With two 2A3's connected in parallel, this same circuit delivers 205 volts at 20 ma., and 200 volts at 140 ma. Its internal resistance remains the same.

The advantage of this type of circuit is that it provides regulation for variations in load current and variations in line voltage. Its disadvantage, however, is its comparatively limited operating range, appreciable waste of power across the controlled tube, and the necessity to stabilize the operation of the neon tubes.

This type of regulated power supply has become very popular because of its comparative simplicity and economy.

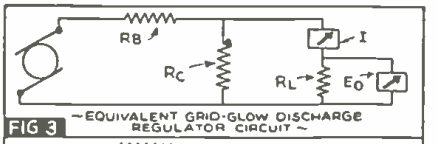


FIG 3 ~EQUIVALENT GRID-GLOW DISCHARGE REGULATOR CIRCUIT~

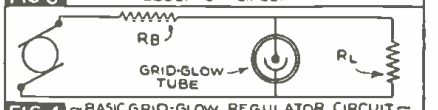


FIG 4 ~BASIC GRID-GLOW REGULATOR CIRCUIT~

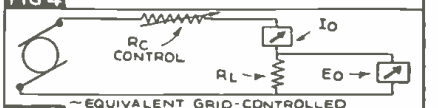


FIG 6 ~EQUIVALENT GRID-CONTROLLED VACUUM-TUBE REGULATOR CIRCUIT~

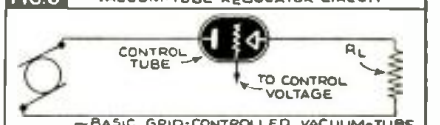


FIG 7 ~BASIC GRID-CONTROLLED VACUUM-TUBE REGULATOR CIRCUIT~

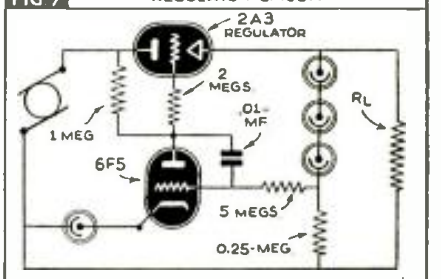


FIG 8 ~GRID-CONTROLLED VACUUM-TUBE REGULATOR CIRCUIT~

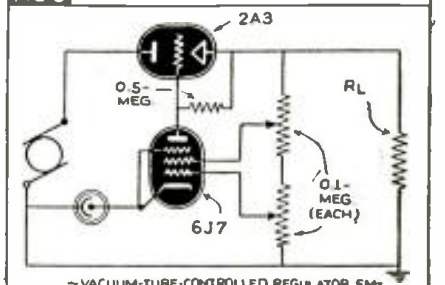


FIG 9 ~VACUUM-TUBE-CONTROLLED REGULATOR EMPLOYING A PENTODE-CONTROLLED VOLTAGE AMPLIFIER~

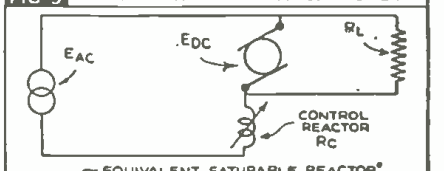


FIG 10 ~EQUIVALENT SATURABLE REACTOR CONTROL CIRCUIT~

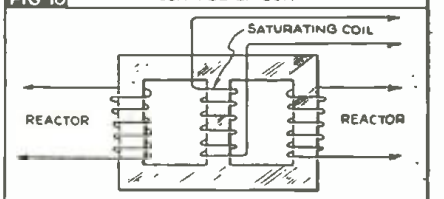


FIG 12 ~SATURABLE REACTOR CONSTRUCTION~

SATURABLE REACTOR VOLTAGE REGULATOR

The saturable reactor type of regulator employs a distinctive principle of operation. The fundamentals involved can easily be understood by referring to Fig. 10, wherein an A.C. supply, Eac, is connected in series with the control reactor, Rc, and a rotary converter, Edc, which produces direct current for the load Re. If the current through Re is increased, the voltage across Edc will naturally decrease. However, a decrease in the control reactor will increase the A.C. potential across the rotary converter, so as to increase its output back to its original value. Similarly, a decrease in load current will tend to increase the output of the rotary converter. However, by increasing Rc, the voltage applied to the converter would be decreased and its output would be likewise affected. If we now substitute a conventional power supply for Edc and a saturable reactor Sr for Rc, as diagrammed in Fig. 11, we have the fundamental circuit of a saturable reactor voltage regulated supply.

The operation of the saturable reactor, Sr, can best be understood by referring to Fig. 12, wherein it will be noted that 3 coils are wound on the 3 legs of a standard type EI lamination. The outer 2 coils, known as the *reactors*, are connected in series-aiding. The drop across the reactors will be proportional to the permeability of the core.

This in turn, however, is controlled by the amount of current passing through the center winding, called the *saturating coil*. The more D.C. that flows through this coil, the lower will be the permeability of the entire core. As this permeability decreases, the inductance of the reactors decreases, and the voltage drop across them decreases.

As the saturable reactor is connected in series with the primary of the plate transformer, any decrease across the saturable reactor appears as an increase across the primary of the plate transformer. This in turn increases the plate voltage supplied to the rectifier which raises the output of the power supply.

This control action can be made entirely automatic by passing a portion of the output current through the saturating coil. Referring back to Fig. 11, it will be noted that the center-tap of the high-voltage A.C. winding is connected through the saturable coil into the load. Resistor R1 is placed across the output of the rectifier, but in series with the saturable coil so as to set the permeability of the saturable reactor at its correct operating point on its permeability curve. If the load current through R_L is increased, an increase in voltage drop takes place in the filter choke Ch1, Ch2. The increased current, however, saturates the series reactor, decreases the voltage drop across the reactor coils, increases the voltage across the primary of the plate transformer, and across the rectifier plates, which in turn appears as increased voltage at the input of the filter, to cancel the normal drop across the filter chokes.

The range of this type of reactor is limited only by the type of rectifier tube employed. It can easily be extended up to many amperes. It likewise operates efficiently at currents commonly encountered in laboratory equipment or commercial amplifiers. Typical regulation characteristics of experimental models follow:

Regulation Current Range (in Ma.)	*Voltage Output*	*Internal Resistance (in Ohms)*
20 to 140	206–204	33.4
0 to 80	169–168	12.5
120 to 240	212–210	16.7
140 to 300	204–202	12.5
100 to 300	201–200.5	2.5
0 to 300	200–197	10.0

With slight variations in circuit design, the power supply can be made to have a negative resistance characteristic. In other words, the output voltage may be made to rise with an increase of load current.

Characteristics of still another type produces the following rise in voltage with an increase of current:

Output Current	*Voltage*	*Output Current*	*Voltage*
20	140	180	173
40	143	200	175
60	148	220	176
80	154	240	176.5
100	158	260	177
120	164	280	177.5
140	168	300	178
160	170		

This type of regulation characteristic is only available with power supplies having a *negative internal resistance*. The actual negative resistance can be calculated from (2) as follows:

$$R = \frac{140-178}{.300-.020} = \frac{-38}{.280} = -136 \text{ ohms (approx.)}$$

A great advantage of this circuit is that no power is dissipated. The voltage drop which appears across the saturating coils, is not in phase with its current, because the load is of an inductive nature. The disadvantage of this supply, however, is that it does not compensate for line voltage fluctuations. This condition may be corrected by using a conventional A.C. voltage regulator ahead of the power supply.

The author will be pleased to answer any questions relative to this article, if a stamped addressed envelope is enclosed. Simply address inquiries c/o *Radio-Craft*.

WHAT CAUSES ECHO, FADING?

NEXT time your customer waxes irate at the results he gets on his allwave radio receiver, let him see this item, which tells in the words of the Engineering Division of the British Broadcasting Corp. some of the reasons why listeners may sometimes experience echo, fading, distortion and other effects when listening to, let us say, one of the B.B.C.'s Overseas Stations.

"Echo" effect is rarely to be observed on waves longer than those in the 19-meter (15 megacycles) band, which means, usually, that on transmissions from one of the B.B.C.'s Overseas Stations the effect is most likely to be observed by listeners in India, Malaya, and Australia—and possibly the West Indies—during Transmissions 2 and 3. (The same principles apply in receiving short-wave programs in America, of course. —*Ed.*)

All the aerials used at the B.B.C. short-wave station for wavelengths below 20 meters are fitted with reflectors, the effect of which is to concentrate the radiated energy in one direction when it leaves the aerial. When propagation conditions are particularly favorable, it may happen that a frequency in, say, the 13-meter band, such as GSJ, may provide strong signals in India, and still be of sufficient strength to travel onward, until, having completely encircled the globe, it provides a second signal at the same point of reception.

When such "round-the-world" or "forward" echo takes place, the interval between successive signals is of the order of 1/7-second—there are authentic accounts on record of as many as 5 or 6 separate repetitions of a single signal. It will be seen that if a news bulletin, for example, is being read, and conditions bring about the echo effect described, then the distortion produced may make the program practically unintelligible. Although, as is shown below, certain types of echo may be overcome by the use of reflectors at the *receiving* end, the type referred to here cannot be suppressed in this way.

A 2nd form of echo, sometimes called "backward echo," takes place when the transmitting aerial used is not equipped with a reflector. From such aerials energy is radiated in equal amounts in opposite directions. If the point of reception is not equi-distant from the transmitter over both paths, and if conditions are well suited to the frequency concerned, then signals may be received from both directions. Since the 2 paths are of unequal length, the time taken for the signal to arrive will not be the same from both directions, and echo may again be produced, the time interval being determined by the difference in the 2 path lengths.

This effect can also be produced even when the radiating aerials are equipped with reflectors, for it would be both difficult and costly so to design them that the whole of the energy radiated would be concentrated in the one direction. With the arrays actually used by the B.B.C., a small amount of energy escapes in the direction opposite to the line of maximum radiation.

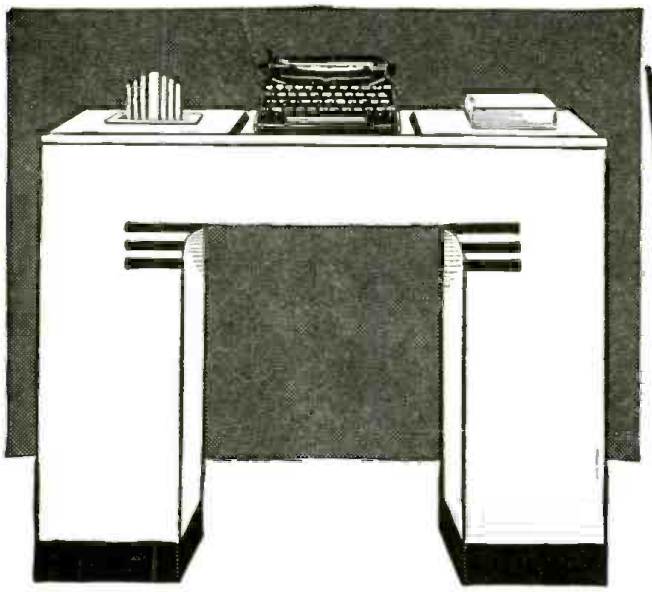
When conditions are suitable, as, for instance, on 13 meters and 16 meters in Transmissions 2 and 3, serving India, this small amount of escaping energy is sufficient to provide useful signals at relatively great distances from the transmitters. The "Great-Circle" route from Britain to the West Indies happens to be almost exactly in the opposite direction to the route to India, and listeners in the West Indies will, no doubt, be well aware that frequencies GSJ and GSG often provide useful signals there when primarily intended to serve India.

It may be possible, when propagation conditions are particularly suited to those frequencies, for listeners in the West Indies to observe the effect of echo due to the signals' arriving by the shorter route direct from Britain, and also by the long path across India and so round the globe. This type of echo may be reduced by the use of reflectors on the receiving aerials.

• • •

MORE BROADCASTING

HERE'S a toast to folk like Mickey Rooney, a fellow of simple tastes, who has 15 "radios" in his 18-room mansion. . . . Listen-in for Morton Gould's series of compositions, "Experiments for Radio Orchestra." This young composer-conductor plans to air over WOR-Mutual a series of 2-minute "experiments" which "emphasize the tonal configurations that previously served only as a lace-like fillet" (my, my). Such compositions as "4 Flutes and a Filter-Mike," and "Bassoon, Viola and Echo-Mike Study," he hopes will aid young composers who are studying effects possible in radio. The heretofore background sounds will be acoustically spotlighted. . .



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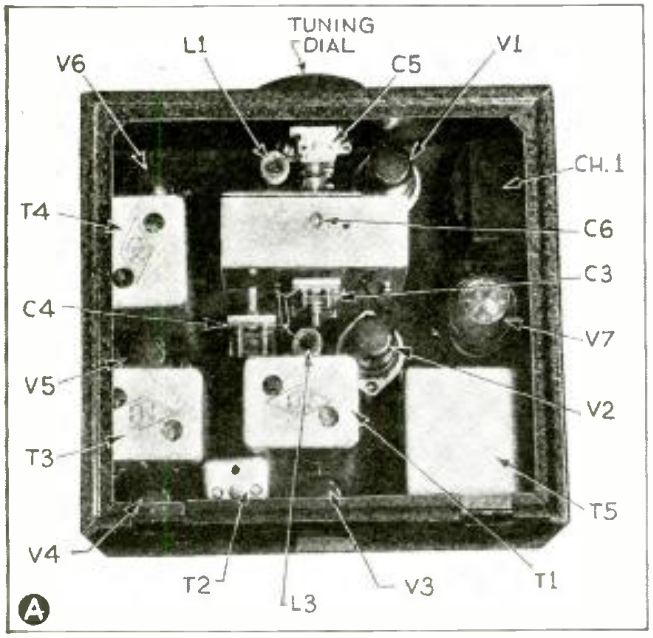
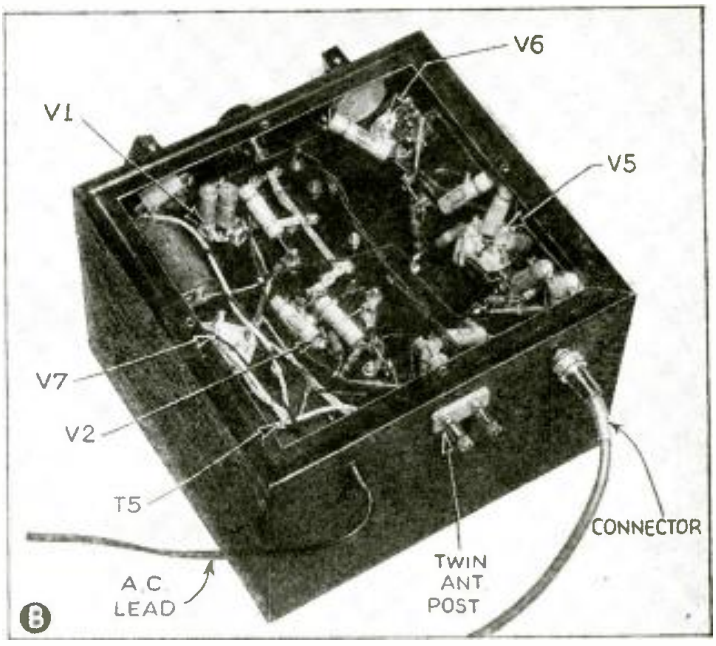




The neat and compact construction of this new F.M. Adapter is illustrated in photo A. Even an underview, photo B, will not scare the constructor.

BUILD THIS PRACTICAL F.M. ADAPTER

Complete directions make it easy for any constructor to build and align this Frequency Modulation Adapter. Use it with any radio set or P.A. system. Add headphones and it functions as a complete F.M. receiver.

ARTHUR H. LYNCH

WITH the advent of Summer, the value of programs over the new frequency-modulated broadcasting stations will become more and more apparent. Our own investigation of this new field bears out the statements which have been made by the engineers of several of the large companies which now have frequency modulation receivers and frequency modulation adapters for use with regular broadcast receivers available.

The claim, of course, which seems most important with Summer and the thunderstorm season coming on, is that frequency-modulated broadcasts can be received through the most severe thunderstorm with no interference whatever.

Here's an interesting story that illustrates this feature, which Frank Gunther, the Chief Engineer of Radio Engineering Laboratories, the organization which has built most of the equipment for Major Armstrong, as well as for many other frequency modulation broadcast stations, told us that one day last Summer.

When a crowd of visitors had climbed the mountain to the location of the Yankee Network's station at Paxton, Mass., a very severe lightning storm came up. The children of the group were obviously frightened. The engineer in charge connected an extra, remote loudspeaker to the F.M. receiver used to pick up the transmissions of the relay station, which was sending onward to Paxton the program from Boston, and raised the output volume of the loudspeakers to a point where it overshadowed the thunder. While the storm was going on, the visitors enjoyed the music and paid little or no attention to the conditions outside, while previous to that time their attention was all on the outside.

CONSTRUCTION

From the accompanying photographs and drawings it will be possible for the experienced constructor to duplicate the Frequency Modulation Adapter which we have built. By comparing the pictures, the circuit diagram and the List of Parts, it should be a simple matter to identify the location of all the component parts. The construction and the circuit are entirely straightforward and adjustment of the completed receiver follows normal practice. It will be observed that a view of the receiver has been made from the bottom, so as to enable the constructor to see those parts which would otherwise be obscured by a portion of the cabinet.

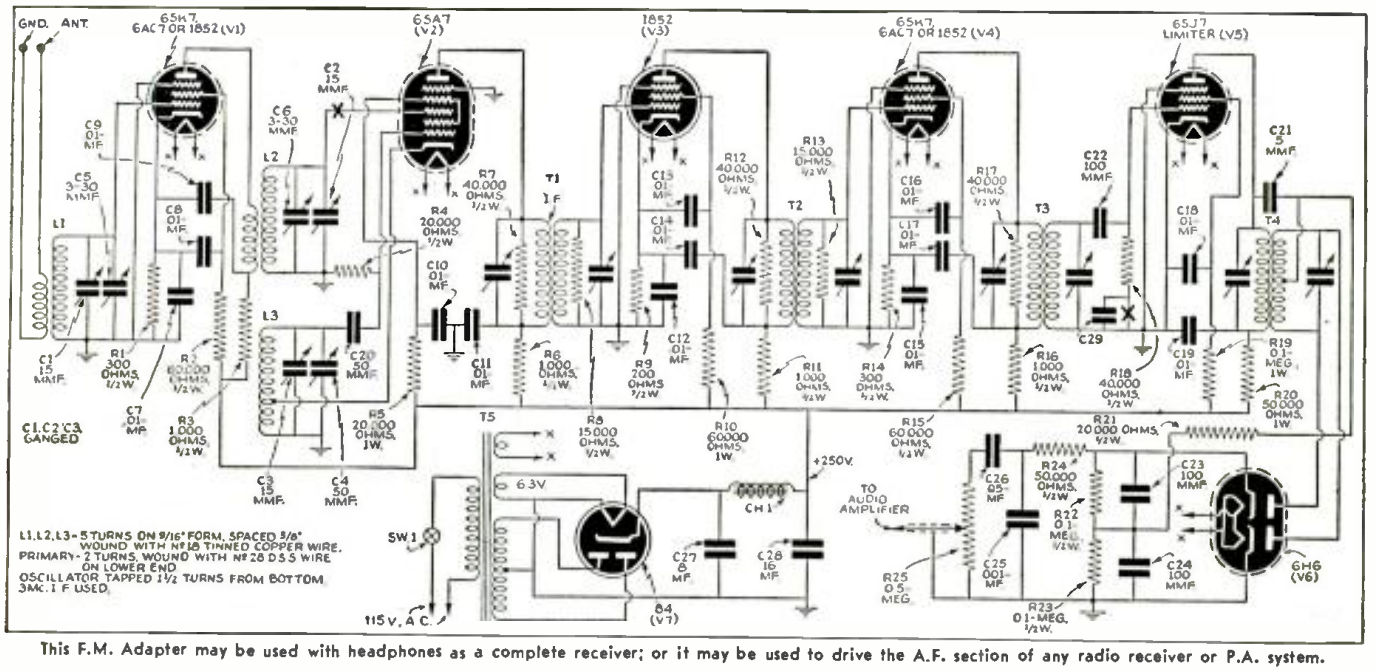
Considerably better performance is provided where an 1852 (6AC7) tube is employed in place of the 6SK7 in the radio frequency stage. The improvement is found in much better gain and results in considerably better limiter action. Another 1852, (6AC7) may be used in place of 6SK7V4 as indicated in the circuit diagram but it is sometimes found that this changeover results in oscillation. In any event, it is worth a trial.

ALIGNMENT

The materials needed for aligning the completed F.M. Adapter are a service oscillator and a 200-microamp. galvanometer. For aligning the discriminator, T4, a 0.1-meg. resistor must be inserted in series with the meter. With meter and series resistor connected across R23 apply a signal to control-grid of the 6SJ7. Using 2,100 kc. as the frequency of the I.F., and modulating with 400-cycle note, adjust the primary of T4 for maximum reading of the galvanometer.

The meter with its series resistor should now be connected to both cathodes of the 6H6. Apply an unmodulated signal to the control-grid of the 6SJ7 and adjust the secondary trimmer of T4 for zero reading on the galvanometer. Rock the oscillator back and forth 100 kc. each side of 2,100 kc. and note that *the galvanometer should show an equal deflection either side of zero* as the frequency is changed. There should be a change of voltage proportionate to the change in frequency either side of the "center" frequency.

Now remove the series resistor and insert a meter in series with R18 at the point marked X. Apply an unmodulated signal to the control-grid of V4. Set the oscillator to 2,150 kc. and adjust the



This F.M. Adapter may be used with headphones as a complete receiver; or it may be used to drive the A.F. section of any radio receiver or P.A. system.

primary trimmer of T3 for maximum deflection of the meter. Next set the oscillator to 2,050 kc. and adjust the secondary trimmer for maximum reading. The oscillator should now be rocked 100 kc. either side of 2,100 kc., and meter readings taken at various positions, to make sure the transformer shows a symmetrical resonance curve. It is not necessary that the transformer have a flat top (of 200 kc.) but that it should be symmetrical. It is desirable that the signal should attenuate rapidly beyond the 2,000 kc. and 2,200 kc. points.

Apply a signal to the control-grid of V3 and proceed as above.

Short the oscillator coil to V2, apply a signal to the control-grid of V2, and adjust T2 as before. Next disconnect the short on the oscillator coil and apply a modulated, 43-mc. signal to V2 and turn C4 until the meter in the control-grid circuit of V5 registers a reading. Now adjust trimmer C6 for maximum reading. Finally, apply a 43-mc. signal to the antenna terminal and adjust C5 to maximum. The band-width of R.F. is sufficient to pass the broad band.

When using a 6AC7/1852 in place of the 6SK7 more care must be taken in the placement of parts and in the laying of ground wires. Each circuit must be grounded at the socket to chassis and all points on the chassis connected together with ¼-in. braid. It may be desirable to use braid to ground the shield of the tube as wire has a higher R.F. resistance.

It may be necessary to insert a 15- to 25-ohm resistor in series with the control-grid of V2, at point X, to suppress parasitic oscillation.

Coil construction: L1, L2, L3—5 turns, on 9/16-in. form, spaced ⅝-in. and wound with No. 18 tinned wire. Primary—2 turns wound with No. 28 D.S.S. on lower end. Oscillator tapped 1½ turns from bottom. An I.F. of 2.1 mc. is used.

CREDITS

It was our purpose in providing this design to make the advantages of frequency modulation reception available to the more experienced constructor. It will be recognized that the receiver has been designed to use items which will be found in stock in most of the leading radio stores. The Serviceman should find this design extremely interesting because the construction of such a unit will give him an insight into the operation of the receivers of this nature and will be very beneficial to him in handling service problems on the various F.M. sets now on the market. Connect a doublet antenna to terminals Ant. and Gnd.

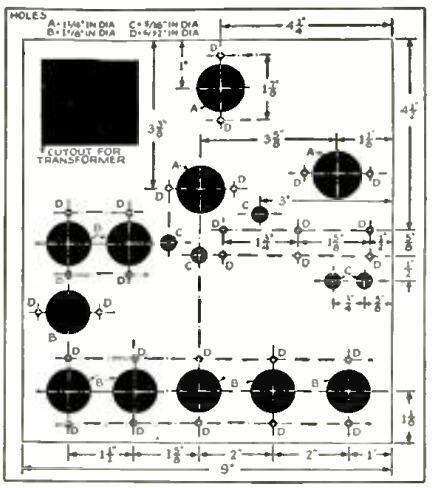
The author desires to express appreciation for the assistance given him by Messrs. Shaughnessy, Day and Stiles, of Major Armstrong's laboratory.

The actual building of this receiver was done for the writer by Mr. Anton Schmitt, W2KWY, of the Harvey Radio Company of New York City; and the receiver has been thoroughly tested not only in the laboratory of the National Company at Malden, Mass., but also in the laboratory of Major Armstrong at Columbia University in New York City, and in the Radio Engineering Laboratories, Long Island City, N. Y.

LIST OF PARTS

CONDENSERS

Three National Co., type UM-15, C1, C2, C3;
One National Co., type UM-50, C4;
Two National Co., type 3-30, C5, C6;
Fourteen Cornell-Dubilier, type DT-6S1, 0.01-mf., 600 V., C7, to C19 (incl.), C29;
Two Cornell-Dubilier, type 5W-5Q5, 50 mmf., C20, C21 *(erroneously indicated in diagram as 5 mmf.)*;



Three Cornell-Dubilier, type 5W-5T1, 100 mmf., C22, C23, C24;
One Cornell-Dubilier type, 1W-5D1, 0.001-mf., C25;
One Cornell-Dubilier, type DT-4S1, 0.05-mf., 600 V., C26;
One Cornell-Dubilier, type BR-845, 8 mf., 450 V., C27;
One Cornell-Dubilier, type BR-1645, 16 mf., 450 V., C28;

RESISTORS

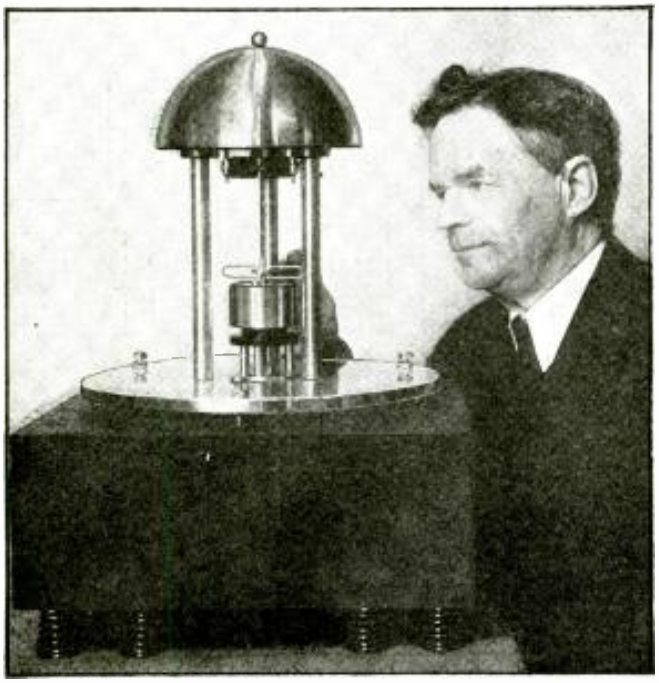
Two I.R.C., type BT½, 300 ohms, R1, R14;
Four I.R.C., type BT½, 1,000 ohms, R3, R6, R11, R16;
Two I.R.C., type BT½, 20,000 ohms, R4, R21;
Four I.R.C., type BT½, 40,000 ohms, R7, R12, R17, R18;
Two I.R.C., type BT½, 15,000 ohms, R8, R13;
One I.R.C., type BT½, 200 ohms, R9;
Two I.R.C., type BT½, 0.1-meg., R22, R23;
One I.R.C., type BT½, 50,000 ohms, R24;
Three I.R.C., type BT1, 60,000 ohms, R2, R10, R15;
One I.R.C., type BT1, 20,000 ohms, R5;
One I.R.C., type BT1, 0-1-meg., R19;
One I.R.C., type BT1, 50,000 ohms, R20;
One I.R.C. potentiometer, type 13-133, 0.5-meg., R25;

TUBES

One Sylvania or RCA 6SK7, or 1852 (see text), V1;
One Sylvania or RCA 6SA7, V2;
One Sylvania or RCA 1852 (see text), V3;
One Sylvania or RCA 6SK7, or 1852 (see text), V4;
One Sylvania or RCA 6SJ7, V5;
One Sylvania or RCA 6H6, V6;
One Sylvania or RCA 84, V7;

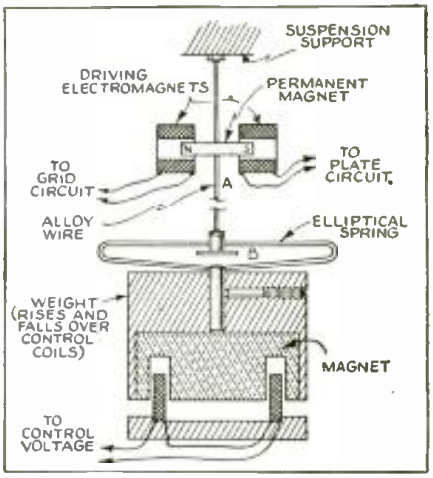
MISCELLANEOUS

Three National Co. I.F. transformers, T1, T2, T3;
One National Co. discriminator transformer, T4;
One United Transformer, A.F. transformer type R-54, T5;
One Thordarson choke, Ch.1;
One Hart & Hegeman roto switch, Sw. 1;
One National Co. steel cabinet, type C5W-3 (the subpanel comes with this cabinet);
One National Co. dial, type 0, with No. 2 scale;
One National Co. dial drive, type ODD;
Two National Co. knobs, type HRP.



← The "singing-string" secondary time standard, and its originator Mr. Henry E. Wilson.

The voltage generated in a magnetic circuit by a vibrating alloy wire helps keep the wire humming. →



AN A.F. CLOCK!

Musical Time Standard

CLOCKS are "accurate" only to the extent that they remain exactly in step with some known frequency reference or "time standard." A time standard, remember, is the basis of our computations of the frequencies of radio channels, the speed of radio propagation, etc.

The earth revolving on its axis constitutes our primary or astronomical standard. Secondary standards include the *pendulum* (accurate to about 1 sec./yr.); the *vibrating quartz crystal* (accurate to about 1/6-sec./yr.); the *tuning fork* (accurate to about 1/10-sec./day); and, the new* *singing string*, with an accuracy about equivalent to the *tuning fork*. Virtually a vibrating violin string, it sets up and maintains oscillations, in a vacuum-tube circuit, at a predetermined frequency.

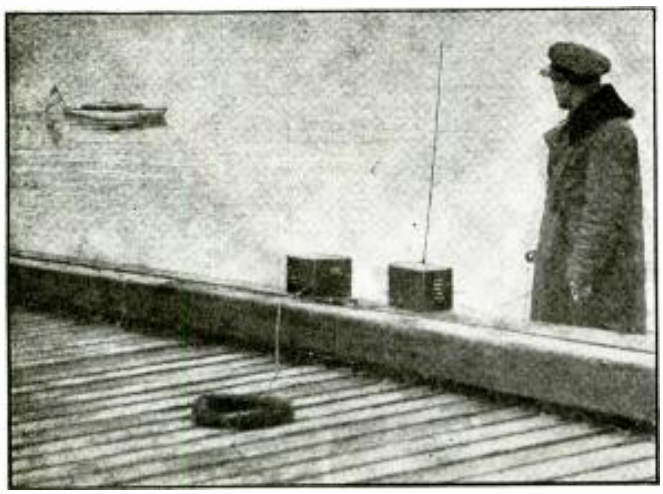
The first consideration is the string. Under ordinary conditions it would be impossible to keep it in tune, as anyone familiar with string instruments will attest, but this problem was solved by several expedients, A dual-wire string, consisting of a nickel-steel alloy and a beryllium-copper alloy, maintains uniform length, and hence frequency, with changing temperature. Any slight changes that remain are ironed-out by placing a light spring at the lower end to aid or oppose the gravity force exerted by a heavy weight (used for major tuning of the string). Coils which project into an alnico magnet set in the base of the weight, and which connect to a voltage source, establish a magnetic pull or push on the weight to further tune the string.

Now that we have a string capable of vibrating, it only remains to drive it. This is conveniently accomplished in somewhat the manner utilized in tuning-fork oscillators (†). In the case of the musical-string oscillator, a cobalt-steel bar-magnet is rigidly fastened to the center of the string. One pole projects into a pick-up coil connected to the grid of a triode, and the other, into a driver coil in the plate circuit of the same tube. The A.F. output, which is nearly sub-audible, is then amplified to any desired degree; 2 watts, for example, will run a Telechron clock motor.

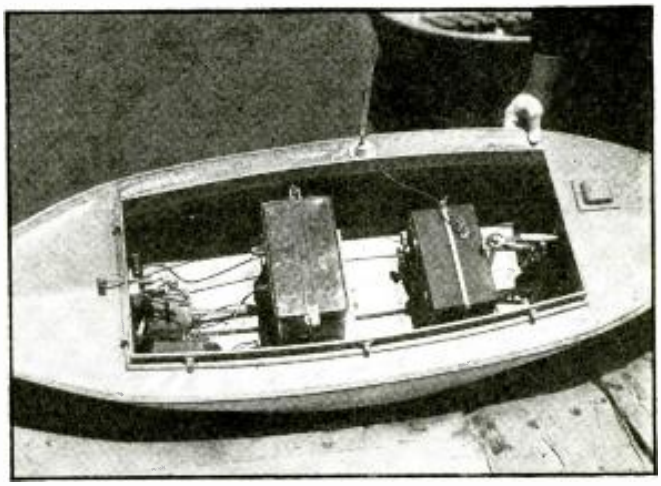
*See "A New Time Standard," by Henry E. Warren, Assoc., A.I.E.E. (Pres., Warren Telechron Co.); this paper was presented at a meeting of the A.I.E.E.

†See "Oscillators at Work," by John Rider.

RADIO-CONTROLLED BOAT



A "jam session" would not disturb the performance of the 6-ft. radio-controlled boat shown above. Due to its extreme selectivity, the ultra-shortwave receiver is practically immune to interference (jamming); however, any transmitter, knowing the combination, may pick up control and put the boat through its maneuvers at 5 m.p.h., up to a range of 11 miles, says its designer, Henry W. Wickes, a Lieutenant in the U. S. Naval Reserve, stationed at Floyd Bennett Field, Brooklyn, N. Y. Will the United States Navy take over this robot craft?

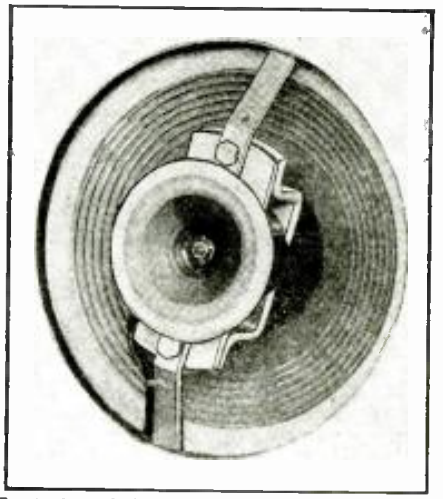


(Rudy Arnold Photos)

A flotilla of such radio-controlled boats, arranged to travel silently just below the surface of the water and each carrying a contact bomb in its snout, would seem to be a coastal defense weapon well worth developing—NOW. An airplane beyond effective range of anti-aircraft guns still could unerringly direct to its objective a torpedo-boat of this design. The 2nd photo shows the "works" in close-up. The receiver has a rod antenna. A storage battery powers set and boat for 3 hours.

DUAL-COAXIAL SPEAKER

The Armstrong Wide-Swing Frequency Modulation System, which has made practical for the first time utilization of the full audible range in broadcasting, has created a desire by broadcasting stations for an exceptionally wide-range Monitor Speaker. To meet these requirements, the Dual Coaxial Loudspeaker, here described, was developed. The speaker, although essentially for F.M. Monitoring, too, is excellent for A.M. Monitoring.



Front view of the Stromberg-Carlson No. 35 carpinchoe-leather Monitor Speaker in the new *dual-coaxial* design.

THE model 35 Dual-Coaxial Monitor Speaker, here described, is probably the most recent attempt to solve in convenient, economical fashion, the problem of high-fidelity reproduction as afforded in "F.M." reception. This reproducer employs a new dual loudspeaker system which has an exceptionally wide frequency range. Both speaker units are of the direct-radiator cone type, the small, high-frequency speaker being mounted coaxially with the low-frequency speaker and within the hollow of its cone, the 2 thus closely simulating a unit source. A marked increase in naturalness is thereby attained over the reproduction afforded by the usual side-by-side arrangement having a comparable cross-over frequency. The cones of both loudspeakers are equipped with carpinchoe-leather edge supports to control diaphragm resonances.

The high-frequency radiator is only 2½ ins. in dia., providing not only desirably small mass but also wide-angle radiation over an extended frequency range.

CROSS-OVER AND RESPONSE

It is caused to function adequately down to the cross-over frequency of 1,500 cycles by broadly resonating at an appropriate frequency the mass of the moving system with the stiffness of the air in a tight-back enclosure. This stiffness also serves as a protective feature in preventing acoustic driving of the high-frequency speaker by the adjacent low-frequency speaker.

The presence of the high-frequency speaker structure in front of the 8-in. low-frequency cone acts as a spreader for the radiation of the latter in its upper frequency range, where concentration around the axis otherwise would become effective. The back of the low-frequency cone works into an acoustical labyrinth, which effectively extends the low-frequency response, prevents resonance in the enclosing cabinet, and provides a suitable acoustic load for the diaphragm.

The response of this speaker is substantially uniform from 70 cycles to 10,000 cycles, and significant response is obtained below 65 cycles and above 15,000 cycles.

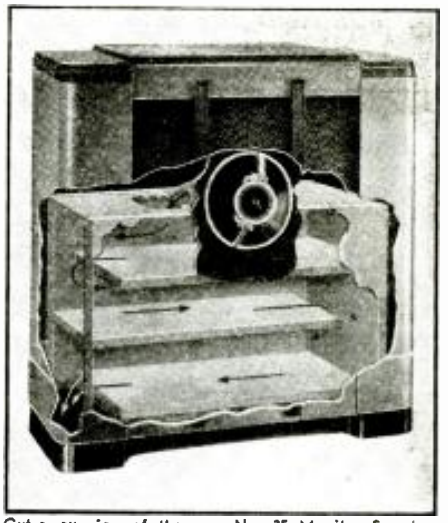
COVERAGE

The angular distribution is exceptionally wide, the response at 6,000 cycles, for example, at an angle of 50 degrees to the axis being down only 3 db. from that on the axis. The apparent efficiency of the system is from 4 to 6 db. higher than that of the usual radio loudspeaker. The input impedance is 24 ohms and the power-handling capacity on speech and music is adequate for, as example, the largest home rooms.

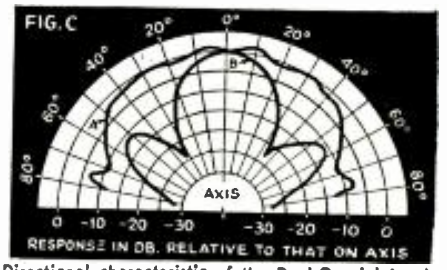
The No. 35 monitor speaker is designed to handle the output of a 15-watt audio-frequency amplifier. However the apparent power output of the complete loudspeaker assembly (loudspeakers and baffle) will be greater than the apparent output of a single speaker and baffle assembly operated at the same power because of the increased frequency range made possible by the use of 2 loudspeakers arranged for wide frequency response. Although the frequency range required for voice re production ordinarily is considered to be quite narrow, this is true only for the fundamental voice frequencies; it is the *harmonics* which serve to set one voice apart from another and these harmonics may extend to quite high frequencies. Exceptional naturalness in voice reproduction therefore may be expected from a sound reproducing system such as the dual coaxial speaker having wide frequency response. This is actually the case. Add to this characteristic of voice realism the advantage of still wider frequency response in the reproduction of music together with the almost complete lack of background noise, in startling contrast with ordinary A.M. reception, which characterizes the performance of F.M. receivers and you have a new merchandising possibility.

In the No. 35 Monitor Speaker the apparatus complete with dividing network and field supply rectifiers is housed in an attractive modernistic cabinet finished in metallic beige lacquer with black trim. Height, 29¼ ins.; width, 27½ ins.; depth, 15½ ins.

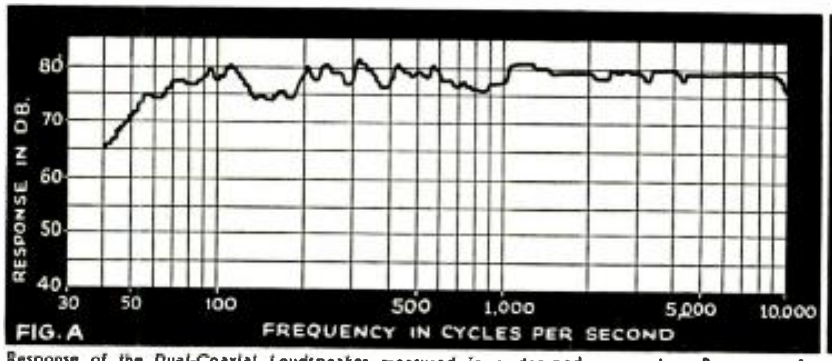
This article has been prepared from data supplied by courtesy of Stromberg-Carlson Telephone Manufacturing Company.



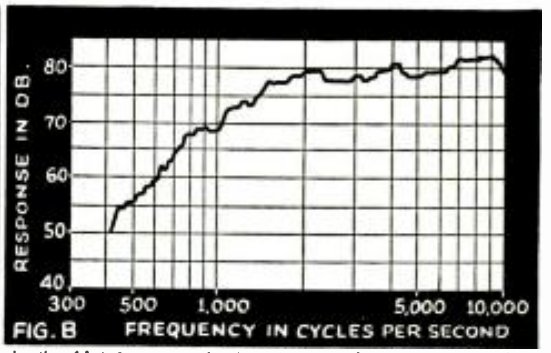
Cut-away view of the new No. 35 Monitor Speaker showing the location of the dual-coaxial speakers in relation to the patented *labyrinth* (to aid low-frequency reproduction) enclosed in the cabinet cavity.



Directional characteristic of the Dual-Coaxial Loudspeaker (A) at 6,000 cycles compared with that of a single 8-in. cone speaker (B). Measurements made on 18-in. radius.



Response of the Dual-Coaxial Loudspeaker measured in a damped room at 10 ft. average distance, and with the microphone rotated on an 8-ft. radius.



Response of only the high-frequency loudspeaker, of the No. 35 assembly, measured on axis at 18 ins. distance. (The 2-unit assembly handles 15-W.)

•LATEST RADIO APPARATUS•

HIGH-VOLTAGE WET ELECTROLYTICS

Aerovox Corp.
New Bedford, Mass.

THESE units are available in 4, 8 and 16 mf. capacities, with a 600-V. D.C. surge rating as compared with 350 and 500 V. ratings heretofore available. Units are self-healing. Can sizes are 1⅜ and 1½ in. dia., and 3 7/16, 4 7/16 and 4 15/16 ins. high.

ADJUSTABLE-LINK OSCILLATOR AND BUFFER COILS

Bud Radio, Inc.
5205 Cedar Ave., Cleveland, Ohio

COILS are designed for use in circuits where it is desirable to adjust excitation or antenna loading by varying the link coupling. Each coil is individually linked and coupling is varied by pushing the link in or out of the main winding. All coils in this series fit standard 5-prong sockets and are designed for stages where the input power does not exceed 50 W. Coils are available for all amateur bands.

NEW MIKE STAND

Eastern Mike-Stand Co.
56 Christopher Ave., Brooklyn, N. Y.

THIS new-type mike stand has a hollow base made of die-cast metal to which a highly polished chromium finish is applied instead of the usual method of using a thin metal shell around an iron casting. The edge of the base is fitted with a rubber link which acts as a base guard and shock absorber. The stand weighs 6 lbs. but its weight can be increased when desired by filling the hollow base with sand, buckshot, etc. Light to carry, it may be weighted "on location."

NEW PHOTOELECTRIC CONTROL

United Cinephone Corp.
43-37 33 St., Long Island City, N. Y.

THESE controls are housed in compact (9 x 6½ x 4¼ ins.) enclosures having knockouts in the bottom for power connections and a knockout on top for wiring-in external photocells. Various models are available, some with external photocells, others with collector lenses. All units utilize a type 6J5 amplifier tube; the photocell-tube life is about 10,000 hours. Designed to operate on 110 V. A.C. line, 50 to 60 cycles. Also available in D.C. models.

30-W. AMPLIFIER WITH AUTOMATIC RECORD CHANGER

Allied Radio Corp.
833 W. Jackson Blvd., Chicago, Ill.

THIS unit features an RCA record changer which operates from 6 V. D.C. or 110 V. A.C. Features of the amplifier are 37 W. undistorted (37 W. peak), output impedances of 2, 4, 6, 8, 16 and 500 ohms available on a selector switch. Four input channels, namely, 2 for use with high-impedance mikes (each with individual volume controls), 2 for phono inputs with wider control; 2 tone controls of the attenuator type, 1 for treble and 1 for bass. The gain for microphone is 135 db., and phono, 80 db. Frequency response is 30 to 12,000 cycles per second (for the amplifier). Standby switch helps reduce power consumption.

3-TUBE SMALL-SIZE HEARING-AID

TayBern Equipment Co., Inc.
135 Liberty St., New York, N. Y.

KNOWN as the "Ultra-Ear" this compact hearing-aid is easily concealed on both men and women. Although measuring but 4½ ins. long, 2¼ ins. wide and 15/16-in. thick, it incorporates a 3-tube high-gain audio amplifier and crystal microphone; this design assures adequate sensitivity, fidelity and volume.

Sensitivity is said to be sufficient for normal conversation up to 30 feet. Its frequency response is so designed as to benefit 80 per cent of the hard-of-hearing cases. Power output better than 50 milliwatts (ample for properly actuating not only earphones but also all *bone conductors*). Small-size "A" cell and 30-V. "B" battery are in a separate, compact case.—*Radio-Craft*

NEW RELAYS

Standard Electrical Products Co.
317 Sibley St., St. Paul, Minn.

ILLUSTRATED is one of a series of new relays designed especially for radio frequency and high-voltage applications. Types BBA (for use up to 15 mc.) and BMA (for use up to 60 mc.), illustrated, are the break-in type known more commonly as the push-to-talk relays. The amateur radio operator merely presses a pushbutton while transmitting and releases it when receiving. The relay has 4-ampere, 3/16-in. pure silver contacts. Available with 110 V. A.C. or 6 V. D.C. coils. Insulation is Mycalex, on type BMA. Other types of relays are available for intercommunication units, remote-control circuits, and antenna change-over.

THIN-CASE PORTABLE

Philco Radio & Television Corp.
Tioga & C Sts., Philadelphia, Pa.

ILLUSTRATED is one of a new line of Philco 1941 portables. It is model 81-T having self-contained batteries. Other features include 4 tubes, built-in loop antenna, lightweight full-vision dial and slender case.

VARIABLE CRYSTAL OSCILLATOR

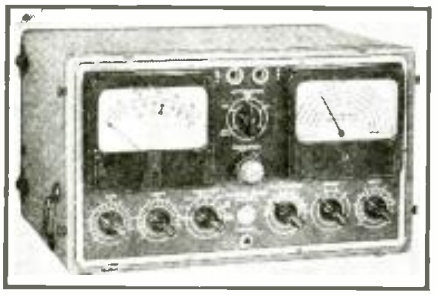
Bliley Electric Co.
Union Station Bldg., Erie, Pa.

THIS "Vari-X" instrument is a variable frequency exciter with self-excited oscillator which affords excellent frequency flexibility with full quartz crystal stability flexibility for the amateur's transmitter. Its power output is 2¾ W. at either 40 or 80 meters. It is worked from the station operating position and is easily installed. Pentode, tetrode and low-power triode tubes customarily employed in the normal oscillator

stage will be easily driven as an amplifier by the Vari-X. Either one of the 2 crystal units plugged into the socket on the Vari-X panel is instantly chosen by a convenient selector switch. Total adjustable frequency range at 80 meters, about 12 kc.; frequency doubling (40 meters), about 24 kc.; quadrupling (20 meters), about 48 kc. Metal cabinet is 8 ins. sq.

RADIO NOISE METER

RCA Mfg. Co., Inc.
Camden, N. J.



TYPE 312. Built around a superhet. receiver. Its principal uses include measuring the noise levels of transmission lines and electrical apparatus, and field strength of radio signals in comparison with noise levels. When equipped with a directive loop antenna it indicates the direction of signals and interfering noises. Size, 13¾ ins. high, 13¾ ins. wide and 9¼ ins. deep.—*Radio-Craft*

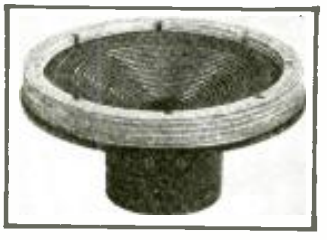
NEWEST 3-WAY PORTABLE

Allied Radio Corp.
833 W. Jackson Blvd.
Chicago, Ill.

NEWEST portable radio set merchandised by this company incorporates automatic change-over from battery to electric (A.C.-D.C.) operation, and vice-versa. Tuning range, 540-1,550 kc.; has 5 tubes, A.V.C., and sliderule dial; wgt., 15 lbs.—*Radio-Craft*

NEW CONE LOUDSPEAKER

RCA Mfg. Co., Inc.
Camden, N. J.



MODEL MI-6233. A new P.M. dynamic loudspeaker which makes effective use of a folded or "accordion edge" cone support principle. This permits the cone to move more freely when driven by the permanent-magnet speaker mechanism. It is claimed to reproduce low frequencies with a fidelity never before obtainable with a small speaker in a small cabinet. Its frequency response is from 80 to 7,000 cycles. Its diameter, 7 ins.; weight, 3 lbs. Handles 3 W. continuously.—*Radio-Craft*

PORTABLE RECORDING STUDIO

Speak-O-Phone Recording & Equipment Co.
23 W. 60th St.
New York, N. Y.

NOW available is a complete Recording Studio incorporating a collapsible booth and recording equipment. Booth measures 57 x 30 x 78 ins. high; easily assembled; soundproof; accommodates 2 persons in recording section; has 2-way interphone between customer and technician; easily carried by car. Has built-in P.A. system for ballyhoo. Comes wired complete with lights and recording equipment.—*Radio-Craft*

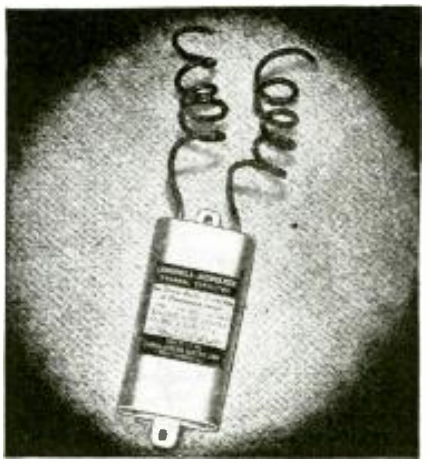
MULTITESTER MODEL 414

Radio City Products Co.
88 Park Pl., New York, N. Y.

MODEL 414 Universal Deluxe Multitester is now available in 4 additional series. Series V7 has a large 7¼ in. bakelite square meter, jewel indicating light, and front-panel fuse holder. Series V9 is the same except that meter is 9-in. jumbo round type. Series RP7 is similar to V7 except that the panel is arranged horizontally for rack mounting and has no case; meter is instantly removable for use at a remote point. Series RP9 is identical to series RP7 with the exception of the meter which is a 9-in. round type.

FLUORESCENT-LAMP CONDENSERS

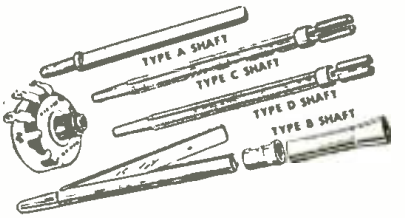
Cornell-Dubilier Electric Corp.
S. Plainfield, N. J.



DESIGNED especially for power factor correction which is necessary when using the new fluorescent lamps. "Dykanol" impregnated. Three general types—KF, KS, KW—available to fit all standard wiring channels and in capacity values to satisfy the power factor correction requirements of any installation.

MIDGET PLUG-IN-SHAFT POTENTIOMETERS

International Resistance Co.
401 N. Broad St., Philadelphia, Pa.



MANUFACTURER recommends these for universal use in volume control replacements. Installation is simplified through the use of plug-in type shafts making a small stock of these units handle a large variety of receivers.

RUNS PHONOS ON D.C.

American Television & Radio Co.
300 E. 4th St., St. Paul, Minn.

MODELS PCP, -F, and -R Phonograph Inverter permits the operation of 110-V. A.C. phono motors on 110-V. D.C. Used primarily in phono-radio combinations and portables of the A.C.-D.C. variety. A good item for Servicemen to sell to owners of A.C.-D.C. sets. Size, 2⅝ x 2⅝ x 2 5/16 ins.; weight, less than 1 lb. —*Radio-Craft*

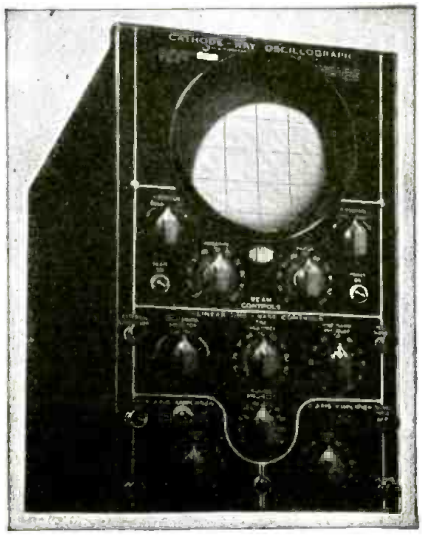
3-UNIT ANALYZER KIT-SET

Simpson Electric Co.
5216 W. Kinzie St., Chicago, Ill.

COMPRISES 3 small matched meters, in a single carrying case, per kit; 3 different kits (9 meters) are available. The meters are available in combinations to measure current, voltage and resistance for all requirements. This grouping of individual meters it is claimed increases flexibility, reduces cost and makes readings easier. All meters may be used separately. Each meter is the same (uniform) size, 5¼ ins. x 2⅞ ins. x 1¼ ins. and none weighs more than 20 ozs.—*Radio-Craft*

NEW OSCILLOSCOPE

Allen B. Du Mont Labs., Inc.
2 Main Ave., Passaic, N. J.



TYPE 208. Designed with sufficient flexibility, associated circuits and controls to facilitate its application to the great majority of laboratory requirements. Utilizes an intensifier-type cathode-ray tube with electrostatic focusing and orthogonal electrodynamic deflection. Its amplifiers are flat to 100,000 sinusoidal cycles per second. Its sweep frequency range is 2 to 50,000 cycles per second. These response ratings are entirely independent of attentuator settings. Incorporates many other new features.—*Radio-Craft*

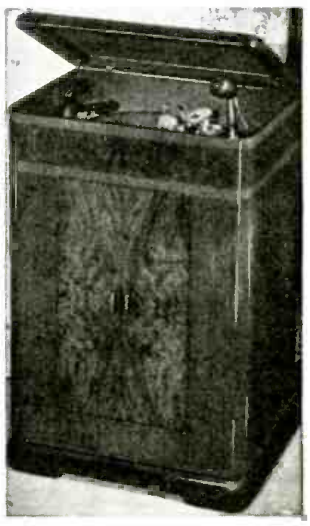
NEW SOUND PROJECTORS

Jensen Radio Mfg. Co.
6601 S. Laramie Ave., Chicago, Ill.

TYPE "S" peri-dynamic projector. Employs a heavy-duty P.M. speaker capable of handling 15 to 25 W. of input power. The speaker is sealed within an enclosure and utilizes the peri-dynamic principle, resulting in a sharp improvement in the middle frequency response. Lack of radiation from the back of projector helps eliminate feedback troubles.—*Radio-Craft*

"RADIOCORDER"

Radio Wire Television, Inc.
100 Sixth Ave., New York, N. Y.



LAFAYETTE model BB-96. A combination which includes a high-fidelity radio, recorder and playback equipment. The radio set is a 12-tube, 3-band chassis, including 6-button station selection, built-in broadcast and shortwave loop antennas, tuning indicator. Recordings may be made of radio programs and local talent via a microphone. Entire combination may also be used as a public-address system.—*Radio-Craft*

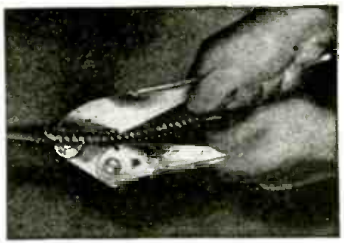
10-W. AMPLIFIER

Terminal Radio Corp.
68 W. 45 St., New York, N. Y.

MODEL T-8. A neat 8- to 10-W. amplifier for public-address work or for use in homes with good record players and frequency modulation tuners. Has 2 high-impedance input channels for microphone and record player, and provides for compact mixing and fading operations.—*Radio-Craft*

BX CUTTER

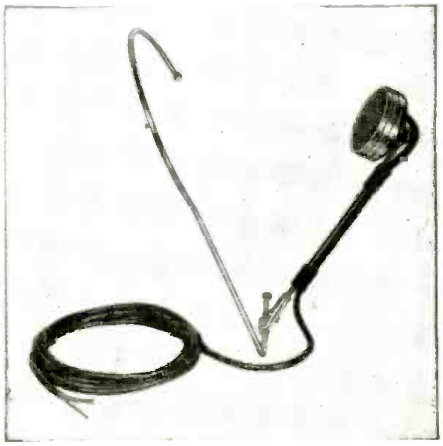
Ideal Commutator Dresser Co.
3067 Park Ave.
Sycamore, Ill.



THE time- and labor-saving BX Armor Cutter here illustrated has jaws that fit BX cable of any make, and 2- or 3-wire No. 12 or No. 14. Cutting blade is removable. Does not nick wire. Eliminates waste.—*Radio-Craft*

"CHEST MIKE"

Universal Microphone Co.
Inglewood, Calif.

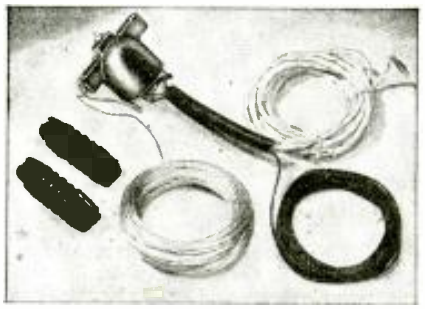


CLOSELY resembles the breastplate arrangement used by telephone operators.

Enables the operator to have both hands free. Adapted for sound trucks, mobile transmitters, etc. Its frequency response is ample for all usual requirements; the output is 48 db. below 1 V. per bar. Known as model N-3. Weighs less than ½-lb.—*Radio-Craft*

F.M.-A.M. MASTER ANTENNA

Technical Appliance Corp.
17 E. 16 St., New York, N. Y.



ALTHOUGH usable for A.M. receivers, this system provides for an expanded frequency range to include F.M. reception. The use of iron-dust cores permits full isolation of primary and secondary transformer windings without loss in signal strength; 15 to 25 receiver coupler units may be fed from 1 master antenna.—*Radio-Craft*

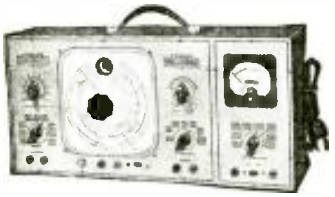
NEW SQUARE METER

Burton-Rogers Co.
857 Boylston St., Boston, Mass.

TYPE 600. A 4½-in. square molded case meter which provides for illumination if desired. The face is open, the corners are rounded. Circular back is 2¾ ins. in dia., 1 1/16 ins. deep. The movement has an accuracy of 2 per cent; sensitivity 42 mc. at 1 ma. Scale is 3½ ins. long.—*Radio-Craft*

DELUXE "TEL-OHMIKE"

Sprague Products Co.
North Adams, Mass.



THE instrument includes a built-in voltmeter and milliammeter with switch and pin-jacks for external measurements. Meter ranges, selected through an 8-position switch, are 15, 150, 500, 1,500 V., D.C.; and, 1.5, 15 and 50 ma., D.C. The instrument tests all condensers and resistors, and indicates "intermittent-open" condensers and resistors. Balance is indicated on an "eye" tube.—*Radio-Craft*

"BREAK-IN" SWITCH

Atlas Sound Corp.
1447 39 St., Brooklyn, N. Y.

THIS switch offers in a single unit both "on-off" and press-to-talk operation. The button is pressed to talk; and turned, to shut off the mike. Designed to modernize mikes which do not have close-at-hand switches.—*Radio-Craft*

POCKET MULTIMETER

Supreme Instruments Corp.
Greenwood, Miss.

MODEL 543. A small-size pocket multimeter using a 3-in., 1-ma. meter. Single rotary selector switch provides functions and ranges of: Resistance—0/2,000/200,000 ohms; D.C.—0/6/60/600 ma.; A.C.—0/15/150/600/3,000 V.; D.C.—0/15/150/600/3,000 V. Batteries are self-contained. Ranges at 1,000 ohms/volt (standard) sensitivity.—*Radio-Craft*

DOUBLE-TUNED I.F. TRANSFORMERS

Radex Corp.
1733 Milwaukee Ave., Chicago, Ill.

THESE units duplicate electrically I.F. transformers used in the majority of receivers. Provisions are made to bring the

gridleak out from either the bottom or top of the shield can. The unit may be mounted either by the top or bottom of the can. Only 3 different units are required to cover practically all intermediate frequencies. Type A has a range of 150 to 250 kc.; type B, 240 to 300 kc.; type C, 430 to 500 kc.—*Radio-Craft*

PORTABLE RADIO BATTERIES

Bright Star Battery Co.
Clifton, N. J.

SEVEN new types of portable "A" and "B" batteries are added to this company's line which now comprises 4 types of 45-V. "B" batteries and the following "A" cells and batteries: 6 types of 1½ V., 1 type, 4½ V.; 4 types of 6 V. and 1 type of 7½ V.—providing replacements for a good percentage of portable radio receivers.—*Radio-Craft*

DYNAMIC CUTTING HEAD

Sound Apparatus Co.
150 W. 46 St., New York, N. Y.

DESPITE its small size of 1 x 1½ x 2 ins. and its light weight of 7 ozs., this cutting head, designed on the dynamic principle, has comparatively high efficiency (1-W. driving). Its damping is obtained entirely by air which results in extended frequency range which is claimed to be 9,000 cycles. Its impedance is 6 ohms and can be readily connected to any loudspeaker (low-impedance output). The impedance does not vary with frequency which is said to eliminate matching problems.—*Radio-Craft*

"FLOCKING" REPAIR KIT

Stromberg-Carlson Telephone Mfg. Co.
Rochester, N. Y.

"FLOCK" is the fuzzy, suede-like finish used on many phono turntables and in Stromberg-Carlson receivers (in the interiors of cabinets), partly to act as a finish and partly to help absorb the noise that comes directly from the needle. This kit ("flocking" gun, jar of binder, brush, a supply of green and brown flock, and instructions) is designed for the repair of damaged or worn "flock". It is known as No. SD-210.—*Radio-Craft*

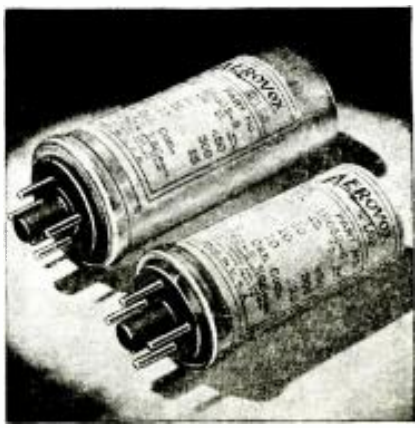
VIBRATOR POWER SUPPLY FOR PORTABLES

Electro Products Labs.
549 W. Randolph St., Chicago, Ill.

THE Synchro model Q (model R, for 2-V. sets) "A-B" power supply operates from any 6-V. D.C. power source (drain, 0.75-A.). Supplies "A" and "B" voltages to 1½-V. receivers of 4, 5 and 6 tubes—*without circuit changes*. Measures 5½ x 5 x 2⅜ ins. Separate plug-in sockets provide correct filament voltages for the receivers; 90 V. of "B" at 18 milliamperes are provided.—*Radio-Craft*

PLUG-IN ELECTROLYTICS

Aerovox Corp.
New Bedford, Mass.



PERMITS electrolytic to be instantly removed without tools or trouble, for testing and replacement. Now used extensively by the U.S. Signal Corps and for aircraft police radio and sound system equipment where continuity of service is important. Available in etched foil and plain foil, in 2 can diameters, 1-3/8 and 1-5/32 ins., and by the U.S. Signal Corps and for aircraft, in heights from 2¼ to 4¼ ins.—*Radio-Craft*

NON-INDUCTIVE RESISTORS

Clarostat Mfg. Co., Inc.
285 N. Sixth St., Brooklyn, N. Y.

SERIES Z. These are wire-wound units —necessary in many special applications —available in the following values: 10 W., maximum resistance 3,000 ohms; 25 W., 7,500 ohms; 50 W., 12,500 ohms; 100 W., 25,000 ohms. For ½ these power ratings multiply the maximum resistance available by 4.—*Radio-Craft*

POWER TAP SWITCHES

Ohmite Mfg. Co.
4835 Flournoy St., Chicago, Ill.

HIGHER ratings have been set for each of the 5 high-current tap switches recently announced. Model 111 is rated at 10 A., 150 V. A.C.; model 212 at 15 A., 150 V.

A.C.; model 312, 25 A., 300 V. A.C.; model 412, 50 A., 300 V. A.C.; model 608, 100 A., 300 V. A.C. These ratings apply to A.C. circuits operating at any power factor. Units are single-pole rotary selectors, multi-point, load-break, and non-shorting.—*Radio-Craft*

"B"-BATTERY-LESS "4-WAY" PORTABLE

Setchell Carlson, Inc.
2233 University Place, St. Paul, Minn.

A PORTABLE radio receiver, model 66, which operates from (1) a self-contained "A" battery (as a portable on outings, etc.); (2) 110 V., A.C. (home or cottage); (3) 110 V., D.C. (office or hotel); or (4) 6 to 8 V., D.C. (car or boat). No "B" batteries of any kind are used; vibrator unit furnishes "B" power from the "A" supply.—*Radio-Craft*

WIND-UP AUTO ANTENNA

Radiart Corp.
Shaw Ave., at East 133 St., Cleveland, Ohio

KNOWN as the Ro-Tenna this auto-radio antenna is a mechanical wind-up aerial which is controlled entirely from inside the car. A handy knob raises or lowers the aerial to the exact height desired for peak reception or for clearing overhead obstacles. —*Radio-Craft*

5-10 METER CONVERTER

Browning Laboratories, Inc.
750 Main St., Winchester, Mass.

MODEL BL-510. A compact 5-10 meter converter for receiving 2 bands of frequencies when used in conjunction with any mobile, home, or aviation receiver; 4 separate low-loss tuned circuits result in exceptional performance.—*Radio-Craft*

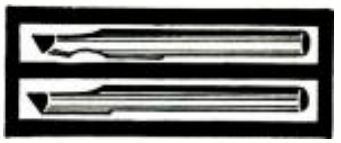
MARINE RADIO TELEPHONE

Jefferson-Travis Radio Mfg. Corp.
198 Milburn Ave., Baldwin, N. Y.

"UTILITY" model 80. A crystal-controlled 5 to 7 W. marine radio telephone for use on all types of small sail and power boats. Designed for short-range service on a single, fixed-frequency channel such as ship-to-ship. Normal range, 25 miles. Consists of a radio transmitter, receiver, power pack, loudspeaker and microphone.—*Radio-Craft*

CUTTING NEEDLES

Recoton Corp.
178 Prince St., New York, N. Y.



MADE of Swedish steel alloy, and diamond-dust polished to a perfect cutting edge, these needles give exceptionally quiet performance. Each needle has a flat portion on the shank, making it impossible to insert it at the wrong angle.—*Radio-Craft*

NEW ACORN SOCKET

Hammarlund Mfg. Co., Inc.
424 W. 33 St., New York, N. Y.

MODEL UHS-900. These sockets are designed to clamp the acorn tubes so they do not work loose. Contacts are silverplated beryllium. Socket has a metal shield for use with the pentode-type acorn tube. The base is made of super-Isolantite, called "Iso-Q". Size, 1-9/16 ins. dia., 1-3/16 ins. mounting centers.—*Radio-Craft*

A Radio "Ham" Writes to Radio-Craft

Fenton, Michigan
105 Pine Street

S W L

Date Jan 27, 1940 Station Radio Craft

Your Report Let's have some plans with older type tubes

My Receiver 42-606-6C6-80

QSL Pse

David Stiff
DAVE

"Dave," a member of the Short Wave League, is interested in radio sets that will enable him to use some of those older tubes he has on hand, we should judge from his card. However, back issues of *Radio-Craft* contain circuits using older equipment; most readers prefer to learn how to apply the new tubes as rapidly as they appear —or sooner!

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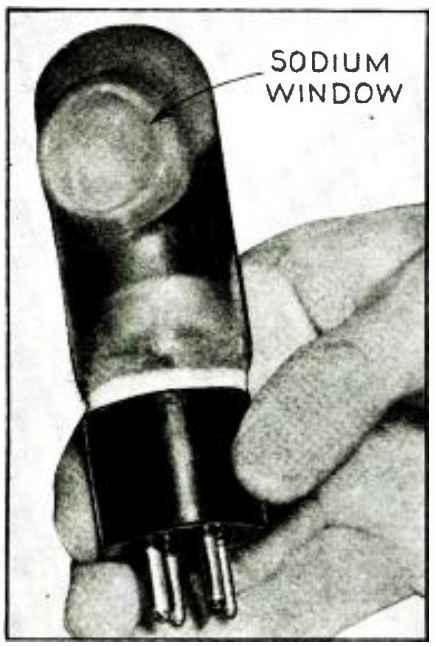
SOME RECENT ENGINEERING DEVELOPMENTS

MOST difficult to appraise are contributions of research to any one year's advances. Major advances from the laboratory may be reflected in a product commercially introduced during the same year, but it is much more likely that the research and fundamental engineering will be more apparent in the products of future years. In the research and other laboratories and in the engineering departments, investigations continue unabated—investigations in some cases reflected in a product commercially introduced during the year, but most commonly apparent in technical-society papers and presentations and, for the moment at least, more quickly recognized as pure or unapplied science.

To describe all of these developments in a single field, or even a few in a number of related fields, would consume more space than is here available. However it is possible to brief some of the most interesting engineering developments made during a limited period by a single research group.

Description of the unusual photoelectric tube here illustrated therefore affords an opportunity to mention, for such interest as it may hold for technicians, comparatively recent developments of General Electric Company.



Window "bubble" passes U.-V. rays to sodium cathode.

Electronics.—To start, we analyze the outstanding feature of the *bubble-window tube* here illustrated. The window which is only 0.002-in.-thick is made of special ultra-violet-transmitting glass which passes light, at wavelengths up to 2,500 A.U., to a sodium cathode. A tube of this construction replaces a more expensive quartz-bulb tube. The new tube may be used in mercury-vapor detection, and the measurement of low-pressure mercury germicidal lamps.

Metals.—By utilizing a steel sheath, to direct the magnetic flux against the keeper, around an alnico pellet using a new grade of alloy called Alnico IV, made by the *powder* process, it is possible to lift a weight approximately 1,500 times heavier than the magnet.

Printing.—There was produced a *photoelectric system of color register control* whereby registration of 4 colors can be maintained automatically within the toler-

ance permissible in Intaglio or rotogravure printing when operating at web speeds of approximately 1,000 feet-per-minute. Paper loss is greatly reduced and the quality of the product is considerably improved by this use of the "electric eye."

The control system incorporates 2 photo-electric scanning heads for each color unit. One head is aligned to scan the margin of the web, on which equally-spaced register or index marks are printed simultaneously with the 1st color impression. The 2nd head is arranged to scan a disk attached to the printing cylinder. Should the printing cylinder be slightly ahead of or back of true register position, the impulses from one head will be correspondingly ahead or back of the impulse from the other head, causing an unbalanced condition in a "mixing panel." A correction is then automatically applied by a reversible pilot motor in response to the corrective impulses from the "mixing panel" relayed through close-coupled thyratron power tubes.

Therapeutic X-Ray.—A new *gas-insulated* 1,000,000-volt X-ray therapy apparatus ulilizes a transformer designed to operate at resonance, thus eliminating the iron core and permitting the multisection X-ray tube to be placed in the center of the transformer coil system.

This feature of design, together with the use of *freon gas* as an insulating medium, results in a big saving in size and weight.

Diagnostic X-Ray.—An important addition to the family of G-E Coolidge X-ray tubes is a diagnostic unit. Shockproof and *oil-immersed*, this tube unit is much more compact and lighter in weight than its predecessors. It is the first diagnostic tube to incorporate an *oil-cooled cathode* for rapid removal of heat from this structure, thereby eliminating cathode-gas problems to improve tube performance and increase working capacity.

Fluoroscopic X-Ray.—The new X-ray Tire-o-scope shows the car owner where and why a "puncture" or "blow-out" may occur. Without removing the tires from the automobile, a service station or garage operator now may, by X-ray, look into the tire to detect breaks, bruises, cord separations that are otherwise hidden, and such foreign material as tacks, nails, wire, screws, glass, and stones imbedded in the casing. The driver is assured that his tires are safe, or is given warning with definite proof that tires are unsafe and should be replaced or repaired to provide safe riding.

Varnished Cambric Insulation. — Heavier loads may be used, higher voltages withstood, and more severe operating conditions met with a new varnished cambric for cable insulation. Similar in appearance to the black (or "Empire"—*Ed.)* cloth previously used, the new high-temperature varnished cloth permits cable to be operated at a maximum copper temperature approximately 10° C. higher than the old cloth. It also has lower dielectric losses, and is as good or better in all other respects than the old type of cloth.

Carrier Current—Communication. — In the standard line of single-frequency simplex and 2-frequency duplex communication equipment the incorporation of *automatic modulation control* has not only increased the range of communication by raising the strength of weak modulating signals but also prevented cross-modulation on closely-adjacent channels.

Need for expensive dial-calling methods was reduced by the introduction of a *60-cycle code-bell calling system*, similar in performance to standard metallic magneto calling and employed in place of loudspeaker voice-calling.

Carrier Current — Relaying. — Transmitters and receivers were developed to facilitate use of the same channel for simplex point-to-point communication, control, or telemetering in addition to relaying, with increased receiver selectivity and higher transmitter output when operating from station control batteries.

Carrier Current—Control.—New circuits and mechanical arrangements were developed to provide fixed audio-tone modulation of essentially standard telephone transmitters and receivers up to a maximum of 4 simultaneous impulses, for telemetering, control, and indication, thus greatly expanding the services available over a single power-line carrier channel.

A medium-frequency transmitter and receiver was developed to provide telemetering and similar services over suitable telephone circuits where the absence of power lines or unusual conditions prevent the use of a power-line channel.

Accessories. — Investigations into the dielectric properties and propagation characteristics of concentric (coaxial) cable led to the adoption of a *tellurium compound-covered cable* suitable for overhead or underground construction, and possessing a new concentric dielectric of great permanence, stability, and low losses.

All the worthwhile Radio Trade News of the past Month—Digested for busy radio men.

RADIO Trade Digest

IMPORTANT HAPPENINGS OF THE MONTH IN THE RADIO INDUSTRY

A PLEDGE: — To print the important news of the radio industry; to review major news events; to help point a path to radio profits.

No. 24 AUGUST, 1940 No. 24

F.C.C. AUTHORIZES COMMERCIAL F.M.

Forty U.H.F. Channels Assigned for the New Broadcasting Art. Five Channels Are Non-Commercial

Acting with unusual speed the Federal Communications Commission has given frequency modulation the green light to go ahead with commercial operation. Forty U.H.F. channels have been assigned this type of broadcasting and only 5 of them are retained for non-commercial work. The Commission does not feel that present-day radio sets will be made obsolete at least for a period of years.

The major portion of the radio industry was highly elated at the news and some spokesmen foresaw a "life-saving boom."

A prominent consultant to the trade foresees a great opportunity for sales in South America. Most manufacturers, he points out, will be concentrating on the domestic market. However, he stresses that South America with its heavy static is an ideal spot for the sale of F.M. transmitters and receivers, as these are less affected by electrical and magnetic disturbances.

With the European and patent situations as they are, he suggests that now is the time for American mfrs. to introduce F.M. to the Western Hemisphere and absorb the market.

WAR SITUATION FORCES F.C.C. TO RESTRICT "HAM" BROADCASTS

Sales of Amateur Radio Equipment Expected to Take Sharp Drop. Contacts Limited to U.S.A. and Possessions Only

Stringent new regulations governing ham activities have just been announced by the F.C.C. These are commercially important in that they may cut into sales of radio equipment & components. At press time the regulations were two-fold: (a) Contacts with hams outside of U.S.A. and possessions were banned; (b) the use of portable rigs was restricted to frequencies above 56 mc. except for special emergency service.

It hardly need be stressed that the greater the transmission distance and the more equipment the amateur is permitted to use, the greater will be his purchases. The fact that his contacts will be limited, for the most part, to this hemisphere means that he will be less inclined to buy the apparatus needed to construct high-power transmitters and super-sensitive receivers. Simpler, less costly, apparatus will probably serve his purpose during the emergency. Similarly he will be less likely to construct a portable post since his use of it will be limited to equipment able to reach only to the horizon. A ray of hope exists in the fact that the war may soon be over. Until then all loyal Americans will cooperate uncomplainingly.

PHILCO GOES PUBLIC

Philco stockholders have cleared the way for public participation in the ownership of the corporation's securities. (Heretofore Philco has been a privately-owned company.) As a result, par value of the outstanding common stock has been changed from $100 to $3. Each share of present common stock has been exchanged for 33 1/3 shares of new common stock. Outstanding shares of common stock now become 1,221,100 in number, plus 28,385 shares of $100 par value $5 preference stock, but no bonds, mortgages or funded indebtedness of any kind.

Present stockholders agreed to sell, through a public offering, part of their holdings of the reclassified common stock. Plans have also been made for a public offering of sufficient additional common stock to obtain funds to retire all outstanding preference stock. Upon completion of these plans, the common stock will represent the only outstanding security of Philco Corporation, and applications will be made to list this stock on the New York Stock Exchange.

NEW G.E. INSTITUTE ENTRANCE

Visitors to General Electric in Bridgeport must enter this door & pass through a reception lounge & display of appliances in order to reach factory & offices beyond. Building also houses testing lab & meeting room.

THE MUSIC GOES 'ROUND & AROUND

New "Roto Base" on RCA Little Nipper model 46X23 permits it to be turned in any direction, thus permitting the built-in loop antenna to be aimed directly at the wanted station thereby increasing signal strength.

DEMONSTRATES F.M.'S STATIC ELIMINATION

Demonstrator for G.E. F.M. sets, permits dealer to show how this transmission - reception operates free from man-made static, by playing record on wireless record player through F.M. and A.M. sets. Electric razor, well-known "static generator" is also feature of demonstration.

TIMELY TELLY TRENDS

• The N.Y. Police Dept. was given a Farnsworth television receiver when members of its police athletic league won a boxing contest locally promoted for youngsters.

• Du Mont has abandoned production on all receivers smaller than those using 14- or 20-in. C.R. tubes.

• Thomas F. Joyce, v.p. of RCA Mfg. Co. predicts that within a yr. after the F.C.C. OK's commercial telly 25,000 receivers will be sold in the N.Y. area alone. He also thinks that Americans will buy 1,000,000 telly sets within 5 yrs. (Recent check-up of sales figures in N. Y. shows weekly sales not 100 sets per wk. but 160.)

• Miss RCA Television at N.Y. World's Fair was partly selected by votes of television audience who saw dozen damsels demonstrate pulchritude & talent over the air. Typical home comment was "Ah, the high school elocution class!"

• The newly organized Television Institute of America in Hollywood, Calif., does not have a technically impressive board. Arthur A. Stern, Hollywood business man, is secretary-treasurer; Edna Williams, "prominent in the motion picture industry"; and G. H. Seward, of Hollywood Television Artists & Writers Guild, is founder-president.

• Du Mont Labs. have just issued a special bulletin covering new C.-R. tube type designations. A letter contained in the type number designates the screen: A—medium-persistence green; B—long-persistence green; C—short-persistence blue; D—medium-persistence white.

• Despite trade paper survey showing 100 television receivers sold weekly in N.Y. area correct figures are more than 50% greater.

• Shift in television channels due to FCC's commercialization of F.M. has television mfrs. worried about possible changes necessitated in television receivers in area serviced by W2XBS whose channel would be wiped out.

$'s & No.'s

$328,202 NET PROFIT for the first 3 months of 1940 is the record of Stewart-Warner Corp. Equivalent to extra earnings of 26c per share, after provision for Federal income tax and Canadian exchange. Equivalent period of 1939 produced only $146,275. Gross profits were $1,364,595.

DIVIDEND OF 87½c per share on first preferred stock and $1.25 per share on "B" preferred stock was declared by RCA. These dividends are for the period from April 1, 1940 to June 30, 1940 and were paid on July 1, 1940 to stockholders of record at the close of business June 7, 1940.

189 IS THE TOTAL number of affiliated stations of the National Broadcasting Company with the addition of KRBM, Bozeman, Mont.; and WSJS, Winston Salem, N. C. The former operates full time on 1,420 kc. with 250 watts; the latter, full time on 1,310 kc. with 250 watts.

$1,073,925 WORTH of radio receiving sets were exported in March, 1940, as compared with $730,417 worth in February, 1940, and $875,746 worth in March, 1939. The United Kingdom was biggest customer, with 60,682 sets valued at $440,182. Other major markets included Brazil, $77,059 worth; Mexico, $60,810; Union of South Africa, $56,375; and Venezuela, British India, Chile and the Philippine Islands, all of which took shipments ranging from $50,000 down to $38,000.

$2,567,042 WORTH OF PENSIONS was paid out by General Electric during 1939. On December 31, 1939, 3,410 pensioners were on the rolls with an average age of 69.3 years, an average continuous service of 29.3 years, and an average annual pension of $756.00.

$2,945,244 is the consolidated earned surplus of Zenith Radio Corp. for the yr. ended April 30, 1940. Its net profit for the yr. ended April 30, 1940 after depreciation, taxes and prior yr. adjustments was $738,083. The co.'s cash & cash resources, according to its annual report just released, is $1,775,265 including $500,000 in U. S. government treasury bills.

FCC THREATENS NETWORKS

The FCC (which does not stand for Fifth Column Cohorts), having slipped the dagger between the shoulderblades of television, is now whetting its knife for the networks.

A Commission triumvirate held that contracts signed between major nets and their outlets were unfair to the latter, in that they tie the outlet exclusively to one net, refuse to let it sell time for less than the network rate, and are for excessively long periods.

The 3-man committee, however, failed to charge that men with guns and whips compelled the outlets to sign the contracts.

Personal

LOUIS A. McNABB is dir. of the new electronics div. of *Bell & Howell*. This leading movie camera co. is planning entry into the sound equipment & television fields.

GEORGE W. RUSSELL, *Sentinel Radio* sales mgr., reports situation in South indicates this will be banner yr.

PHILIP D. REED was reelected chairman of the *G.E.* board & CHARLES E. WILSON pres. All other officers were also reelected.

WALTER R. JONES, *Hygrade Sylvania* commercial eng., is back from a radio service lecture tour in the Central South & reports especially lively interest in oscillator circuits and battery receivers as far as Servicemen are concerned.

P. A. TILLEY (no relation to Eustace) has been appointed ass't mgr. of *G.E.'s* radio & television dept. with hq. in Bridgeport, Conn.

CHARLIE GOLENPAUL has celebrated his 10th yr. with *Aerovox*. Prior to that he was with Clarostat.

Changes in the *FCC* include TELFORD TAYLOR succeeding W. J. Dempsey as gen. counsel, & JOS. L. RAUH, JR., succeeding W. C. Koplovitz as ass't gen. counsel.

LAURENS HAMMOND, the big electronic organ man, received a 1940 medal award from the Franklin Institute of the State of Pa. "in consideration of the inventive skill displayed in the development of the Hammond organ."

STEPHEN NESTER, sales mgr. of *Recoton Corp.* won the Advertising Club's silver medal in the Selling & Advertising essay competition.

ALLAN R. ROYALE succeeds Clifford J. Hunt as sales rep. in the Phila., Balto. and D.C. districts. Hunt has become mgr. of the co.'s distributor div.

JACK CLUNE, *Nat'l Union's* office mgr., has graduated with a B.S. degree from Fordham U. He took the course in his spare time.

GUY FLAIG has been made mgr. of the *Crosley Distrib. Corp.* of Cincinnati. Mr. Flaig has been a distrib. & mfrs.' rep. in Cinci for 15 yrs.

L. MARTIN KRAUTTER for 4 yrs. copy chief of the Cramer-Krasselt Adv. Agy. has been made adv. & sales promotion mgr. of the *Crosley Corp.* In the same co. WILLIAM M. SHIPLEY has been made mgr. of account sales.

ANTHONY G. SCHIFINO who formerly operated the Rochester Radio Supply Co. has taken charge of sound system engineering at *Stromberg-Carlson*.

AN EDITORIAL
By Artie Dee

The Consolidated Edison Co., as you know from seeing the figures on the sales derived on some of their deals, are no dopes. *Radio-Craft* received additional proof thereof a couple weeks after moving to its new address. It also received an idea which should help you make money.

A letter signed by the v.p. of Consolidated Edison says: "Now that you have had time to 'size up' your new place, perhaps you have found things that need attention . . ." and goes on to say that maybe we could use better lighting, a new ventilating system, etc. An enclosed postcard invites us to have a representative call to give us free advice on our lighting, air conditioning, etc.

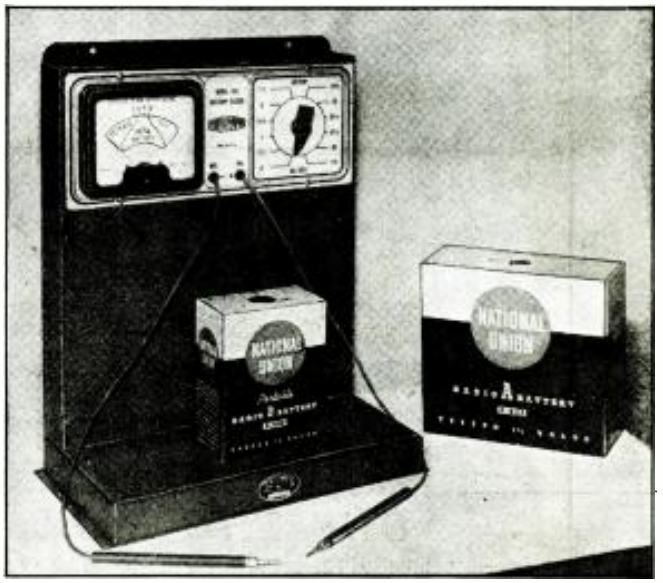
You know when moving day is in your town. You know the leading rental agencies and moving companies. Have you been to see them?

They can give you information as to persons who have moved into new quarters. These persons are natural customers for antenna installations, if nothing more. They are potential customers for alteration of receivers from A.C. to D.C., or D.C. to A.C. They are also possibilities for sales of new and better radio equipment. (Old furniture always looks at its worst in a new home.) Talk-up office interphones!

A postcard—a letter—a personal visit from you or your salesman may mean more than an initial sale. It may mean establishing a contact for long and profitable service connections. A logical method is to send out a letter specifically aimed at the new resident. You may be able to sell an annual service contract in conjunction with a special-rate installation fee. You will certainly be able to let him know of a good reliable Serviceman in his neighborhood, ready to dash to the rescue when his set goes sour.

Stop saying that business has gone to Sheol. Even if it has—go after business.

NEW DEAL ON TEST INSTRUMENTS



National Union, now putting out branded "A" and "B" batts, offers a deal on counter-model Triumph Mfg. Co. battery tester. Dealer can use it to demonstrate condition of old & new batteries.

Servicemen are invited to enter Allen B. Du Mont Labs.' "Cathode-Ray Tube Application Contest" which runs for a yr. beginning June 1, 1940. Get the dope straight from Du Mont. . . . 5 new models in the G.E. line include an auto-radio & 4 portables. . . . Stewart-Warner has introduced a special de luxe line. . . . Harold Davis, Inc., Miss. parts house, will run its post-graduate radio course in Jackson, Miss., July 15-27.

G.E. has built & equipped an Institute of Electrical Living in Bridgeport, Conn. . . . Stromberg-Carlson is marketing a complete kit for repairing damaged or worn "flock" (whatever that is) on radio-phonographs. . . . Nat'l Union has become exclusive U.S. sales agent for sound systems made by Erwood Sound Equipment Co. . . . DeJur-Amsco Corp. is now putting out a complete line of ammeters, milliammeters, microammeters & voltmeters in 2, 3, & 4 in. sizes, round and square cases. Aims particularly at mfrs.

Farnsworth Tel. & Radio Corp. held its 2nd annual internat'l sales conference at the Edgewater Beach Hotel in Chi.; about 300 reps. from U.S. & S.A. saw the new line. . . . G.E.'s new wireless record player is non-directional; there is also a new wired job. . . . Same co. now tests apparatus by giving it thorough shaking. . . . Stromberg-Carlson believes that F.M. "will revitalize the entire industry."

Flash! Place no faith in rumors that NBC will abandon television if forced to make costly changes in W2XBS transmitter. Fact is that so many RCA television receivers have been sold on time, with payment deferred over 18-mo. period, that co. must continue to supply programs in order to insure payoff.

Sales Helps and Deals

WILLARD STORAGE BATTERY CO. has run off a series of 27 electrical transcriptions featuring air and screen stars for local radio station use. A commercial provides for local dealer tie-in.

Punchboards are being used to push the sale of *KENT* A.C.-D.C. portables.

PHILCO'S 4-in. square aerial demonstrator generates terrific static causing terrible reception until "super loop" in receiver is adjusted. Co.'s parts sales mgr. says demonstration is more convincing than star salesman's best spiel.

Cut prices up to 90% on surplus stock of guaranteed genuine parts & new P.D. ice-cube tray are 2 *PHILCO* deal offers.

WQXR, hi-fi station in N.Y., sells complete printed programs for $1 per yr. and has a nice sideline from including ads in the booklet and stuffers in the envelope.

CORRECTION

Your Trade Digest editor has been informed that the Trymo Copycraft & Supply Company is a company separate and distinct from Trymo Radio Co., Inc., and does not supersede it, as our write-up on page 764 of the June 1940 issue inferred. Both companies are in the field doing business—Sorry.

Changes & New Addresses

Where to Reach Old and New Companies

UNITED CINEPHONE CORP. has moved its offices & plant to Torrington, Conn., taking over more space.

RADEX CORP. is in new & larger quarters at 1733 N. Milwaukee Ave., Chicago, Ill.

ALFRED CROSSLEY, 549 W. Randolph St., Chicago, Ill., will give sales engineering service on Allen B. Du Mont cathode-ray equipment in that territory.

NATIONAL RECORDING SUPPLY CO. is a new firm at 1065 N. Vine St., Hollywood, Calif., acting as exclusive local sales reps. for Universal Microphone Co.'s products. Glenn Wallichs & F. H. Brown, well-known in that area, are associated in the enterprise.

CALLITE TUNGSTEN CORP. is the new name of the old Eisler Electric Corp. The co. is situated in Union City, N. J.

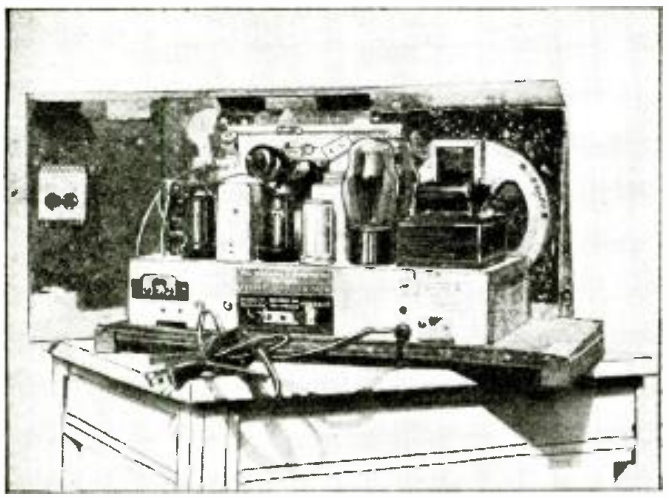
THE MAY CO. in Cleveland & the RUDOLPH WURLITZER CO. in Buffalo have been made exclusive outlets for Ansley Dynaphones in their respective cities.

THE BENJAMIN T. CRUMP CO. of Richmond, Va., and the CHARLES S. MARTIN DISTRIB. CO. of Atlanta (with a branch at Athens, Ga.) have been appointed Farnsworth distribs.

PARMETAL PRODUCTS CORP. has moved to 32-62 49 St., Long Island City, N. Y., affording greatly expanded facilities.

C. G. PYLE, gen. sales mgr. of lamp operations for Hygrade Sylvania has moved his hq. from Chi. to N.Y.C.

THIS SET WAS NOT G.W.T.W.



When a tornado struck Albany, Ga., Will Anderson's house collapsed and the set, pictured at left, flew away together with most of his furniture. The set was recovered and returned to the Morrow-Cook Furniture Store for repairs. Accidentally plugged in before work started, it operated perfectly and thus won fame.

OFF THE PRESS

FOLDER. Cornell-Dubilier Elec. Corp., South Plainfield, N. J. Complete listing of condensers for power factor correction of the new fluorescent lamps. Includes circuit and data on calculations of line current for the standard lamp.

PAMPHLET. Sprague Specialties Co., North Adams, Mass. 8 pages. Specifications and technical descriptions of coaxial tuning units.

CATALOG. Presto Recording Corp., New York, N. Y. 52 pages. Complete line of recording equipment, amplifiers, pre-amplifiers, radio tuners, needles, and other accessories.

CATALOG. Atlas Sound Corp., Brooklyn, N. Y. 8 pages. Describes complete line of sound projectors, exponential horns, trumpet units, speakers, baffles, microphone stands and connectors.

FOLDER. Ideal Commutator Dresser Co., Sycamore, Ill. 4 pages. Describes all types of hand- and machine-operated wire strippers, DX cable cutters and other electrical accessories.

FOLDER. RCA Mfg. Co., Aviation Radio Section, Camden, N. J. Gives complete physical and technical description of model AVR-20 Aircraft Communication Receiver.

BOOKLET. Hygrade - Sylvania Corp., Salem, Mass. 18 pages. Describes in detail the advantages of the new fluorescent lamps and lists a variety of models and reflectors.

CATALOG. Kenyon Transformer Co., Inc., New York, N. Y. 24 pages. Lists complete line of transformers, replacements, filter units, new plug-in type transformers. Contains a variety of "Ken-o-graf" 's.

CATALOG. General Rotary Antenna Co., Coral Gables, Fla. 8 pages. Lists rotary beam antenna equipment and accessories.

FOLDER. J.F.D. Mfg. Co., Brooklyn, N. Y. Lists a variety of frequency modulation and television antennas, including brackets and accessories.

FOLDER. Triplett Elec. Instrument Co., Bluffton, Ohio. Describes complete line of portable and panel-mounting meters.

CATALOG. Radio Wire Television, Inc., New York, N. Y. 120 pages. Everything in radio, public address, amateur radio equipment, portable, parts, etc.

CATALOG. Crowe Name Plate & Mfg. Co., Chicago, Ill. Complete listing of remote control units and matching plates for all auto radios,

CATALOG. Terminal Radio Corp., New York, N. Y. 12 pages. Lists complete line of public address equipment, microphones, speakers, phono pickups, phono motors, radio tuners, recorders, etc.

CATALOG. National Carbon Co., Inc., New York, N. Y. 8 pages. Lists complete line of drycells and batteries for portables and other applications. Features the new "Mini-Max" "B" batteries for longer life.

RADIO BUILDERS' HANDBOOK. Allied Radio Corp., Chicago, Ill. 36 pages. Contains complete constructional data, plans and parts lists for building a variety of receivers, transmitters, amplifiers, photocell equipment, etc. Send 10c to Allied Radio for it.

CATALOG. Burton Rogers Co., Boston, Mass. 8 pages. Describes a complete line of portable and panel-mounting meters, sold under the trade-name "Hoyt."

VOLUME CONTROL GUIDE. International Resistance Co., Philadelphia, Pa. 48 pages. Gives a complete listing of volume control replacements for all commercial receivers, besides listing the various types of controls available, including the various tapers, etc.

SHEET. Ideal Commutator Dresser Co., Sycamore, Ill. Describes new instant-heating soldering tool operating from transformer on 110-V. line. A similar tool is described for heating metal conduits where joints are soldered.

NEW TUBE BOOSTS HAM BIZ

"Ikey", the baby iconoscope just made available by RCA, should prove to be the heart of a flock of sales to the hams who always like to be the chaps who put the "van" in advance. Designed for amateur experimental use, the new television pick-up tube can be used for ham transmission of indoor or outdoor pick-ups. It has the advantage of operating on voltages available from most xmtr power supplies, and requiring but a cheap lens. Other components will be required with it to build sweep circuits and video amplifier to hook into the UHF rig.

$alesman $am $ays:—

Data issued by U. S. Gov't. Far more detailed information is available from the Bureau of Foreign & Domestic Commerce, Washington, D. C. Publications to request are: World Radio Markets *covering countries wanted* & The Electrical & Radio World Trade News.

URUGUAY—About 150,000 sets in use by 2,000,000 population, 1/3 of which reside in the capital, Montevideo. The annual market has been about 20,000 receivers, but growing restrictions of import caused by exchange control, seem to be gradually cutting down this figure. Both socket power and battery receivers are in demand. Most of the receivers sold are of the 5- to 6-tube table model type, with all-band reception, and selling at moderate prices. The electric supply is 220 volts, 50 cycles, A.C. There are no demands for phonograph combinations or television receivers. Portable sets are not selling well because of the difficulty of securing suitable dry batteries.

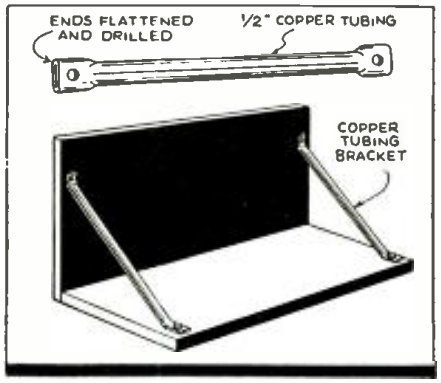
SWITZERLAND. 500,250 sets in use by population of 4,000,000. The annual market is estimated at 40,000 domestic and 9,300 imported receivers. The War has boomed the radio market, which will probably remain good if Switzerland is able to remain neutral. Over 99% of the sets sold are of the A.C. variety, A.C.-D.C. sets without a special transformer are prohibited. Five-tube receivers are most popular—these should be preferably of the all-wave variety.

U.S.S.R. 450,000 sets in use by population of 165,000,000. The purchase of many items, including radio sets, is very restricted. The Soviet government has emphasized the development of central receiver systems. Outlets are estimated to number 5,500,000 as compared with 450,000 individual receiving sets.

"PREFERRED TYPES"

The above title applies to both the RCA Victor tubes and the personable person presented with them. The display in 10 colors is 42 ins. high & 25 ins. wide, designed for promotion via window or wall.

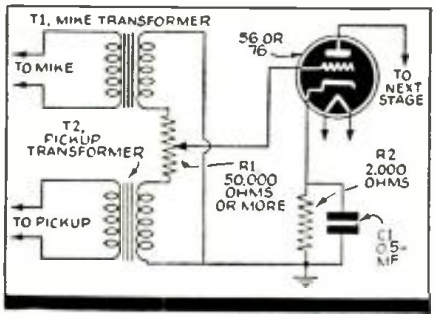
HOME-MADE PANEL BRACKET



● FOR supporting panels I found that brackets made from ½-in. copper tubing were light, strong and inexpensive. The tubing is flattened with a hammer for an inch or so at each end, and then drilled and bent as shown.

DAVID BIRNBAUM,
Brookline, Mass.

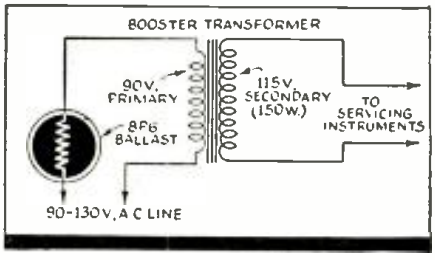
2-CHANNEL MIXER



● I WANTED a mixing system for 2 channels but did not want to go to the expense of buying attenuators. I have designed a mixer (see diagram) that will mix 2 channels without requiring the usual expensive attenuators. The system works quite well and yet is inexpensive. The value of the potentiometer will depend a great deal on the transformers used. With a little experimenting the correct value to suit individual cases can be found. It should be at least 0.1-meg.; in most cases it will have to be more.

WINNIE NEAL,
Huntsville, Ala.

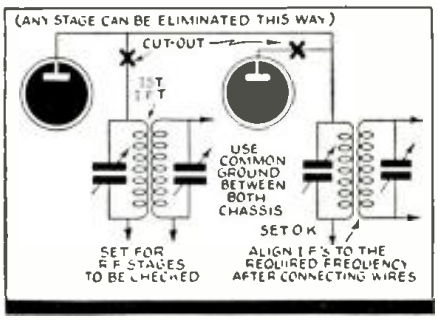
STEADIES LINE VOLTAGE FOR TEST INSTRUMENTS, ETC.



● I HAD trouble with my test instruments on account of the line voltage fluctuating from 90 to 120 volts. A Thordarson Booster Transformer type T-6107, and a ballast resistor from an old Majestic 8P6 power pack, did the trick. This idea may be of value to others who may be experiencing the same trouble.

AUBREY V. SCHROEDER,
Loyalton, Calif.

STAGE ANALYZING WITHOUT A STAGE ANALYSIS TESTER!

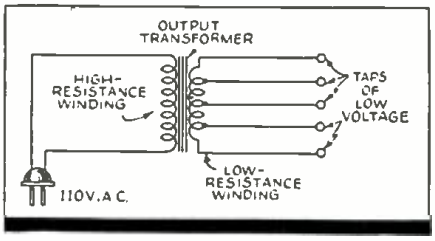


● IT IS sometimes very difficult to check a set if one has not a channel tester or some similar instrument. I have been using the following trick for a long time.

To check I.F. stages I remove the 1st-detector tube and solder a wire (as short as possible) to the plate of the 1st-detector tube socket; the other end is soldered to the plate of a radio set which is quite OK. Now remove the 1st I.F. primary lead from the socket, connect a common ground to both the chassis, and turn them "on." By using this kink one can easily find out many faults which cannot be traced out so very easily such as defective I.F. transformers, crackles, intermittent reception, fading, etc.

R. J. ANTIA,
Mirzapur,
Ahmedabad, India.

OUTPUT TRANSFORMER AS FILAMENT TRANSFORMER



● SOMETIMES experimenters find a need for small filament transformers. These are hard to find in the ordinary junk box. An old universal output transformer, however, will do the job nicely. The transformer need not be of the "universal" type but it is preferred as the taps of the low-voltage winding will give you outputs ranging from 2 to 10 volts; and approximately 1 ampere.

To use the output transformer as a filament transformer the 110-V. A.C. line is connected to the high-resistance winding. The filament voltage will be taken from the "low" winding which is more commonly called the voice coil winding. The transformer connected this way can also be used for ringing doorbells and buzzers.

GEORGE PLATCO,
Brockway, Pa.

"WEATHER 6" GIRLS GET "TUTOR" RECORDS

An innovation in training girls to handle the job of recording on steel-tape, in making recordings for the Bell Telephone Co.'s Weather Forecast service, is the use of phonograph records which demonstrate the perfect way to give a weather forecast bulletin, showing-up all the subtle problems in its delivery. This will enable the girls to listen over and over again, and study each point as much as they like. The recordings were made at the Bell Labs. by some of the weather service girls.

•BOOK REVIEWS•

RADIO AT ULTRA-HIGH FREQUENCIES (1940). Published by RCA Institutes Technical Press. Heavy paper cover, 6 x 9 ins., profusely illustrated, 456 pgs.

Frequency Modulation—today's No. 1 topic—is extensively discussed in the newest publication of RCA Institutes Technical Press. In "Radio at Ultra-High Frequencies" technical papers by RCA engineers also present the newest information on the propagation, relaying, measurement and reception of signals on frequencies above 30 megacycles.

The book is divided into 2 sections as follows: PAPERS PUBLISHED IN FULL: Part I—Ultra-high frequencies below 300 mc.; Part II—Ultra-high frequencies above 300 mc. PAPERS PUBLISHED IN SUMMARY FORM: Part I—Ultra-high frequencies below 300 mc.; Part II—Ultra-high frequencies above 300 mc.

We could go to great lengths in reviewing this book, pointing out in detail the important articles it contains on television, frequency and phase modulation, new transmitting and receiving tubes and the various other subjects of interest to short-wave specialists, but we would still fall short of conveying the importance of this book. We can only say it is a "must" for every advanced radio technician. Note that there is no price set on the volume and no copies are to be sold. Its sole distribution will be as a premium with the 3rd year of a new or old subscription to RCA Review (quarterly).

NEW CONSTRUCTION BLUEPRINT SERIES. Construction Pattern Series, Folders Nos. 1 to 7, incl. Published by Technifax. Price, 50c each.

This series of construction patterns is a set of blueprints that show how to make various types of metal locators or so-called treasure finders. The Patterns are complete with construction details. List of Parts and a 22 x 34 in. blueprint schematic diagram and construction working plan. The different Patterns are identified as follows: No. 1—"Radioflector Pilot"; No. 2—"Harmonic Frequency Locator"; No. 3—"Beat-Note Indicator"; No. 4—"Radio-Balance Surveyor"; No. 5—"Variable Inductance Monitor"; No. 6—"Hughes Inductance-Balance Explorer"; No. 7—"Radiodyne Prospector".

FREQUENCY MODULATION. by John F. Rider (1940). Published by John F. Rider Publisher, Inc. Size, 5½ x 8½ ins., cloth cover. profusely illustrated. Price, $1.00.

Servicemen throughout the country are evincing exceptional interest in frequency modulation. For this reason, "FM—An Introduction to Frequency Modulation" should receive wide acceptance if only because it is the first published description in detail of frequency modulation as seen through the eyes of the Serviceman. This reviewer predicts Rider's newest book will be a sell-out.

The chapters cover: Frequency Modulation; What Happens at the Transmitter and Receiver; Transmission of F.M.; F.M. Receiving Antennas; and, Servicing F.M. Receivers.

For the theorist there is appended an amazingly extensive bibliography which should meet the needs of anyone who wishes additional information not strictly related to servicing.

CENTRAL SOUND SYSTEMS FOR SCHOOLS (1940). Published by Committee on Scientific Aids to Learning. Size, 6 x 9 ins., paper cover, illustrated, 69 pgs.

Here is a practical manual dealing with the installation of sound equipment in schools which the Serviceman and sound technician will find useful. Sound systems and components are described in sufficient detail as to enable sound men to readily apply the information to practically all makes of apparatus. Write for this publication on your company letterhead.

Table of Contents: The Functions of Central Sound Systems in Schools; Facilities Provided by Central Sound Systems; Technical Characteristics of Sound Systems; Sample Specifications for a School Sound System.

THINGS A BOY CAN DO WITH CHEMISTRY. by Alfred Morgan (1940). Published by D. Appleton-Century Co., Inc. Size 5½ x 8½ ins., cloth cover, profusely illustrated, 288 pgs. Price, $2.50.

Radio and electronic experimenters will be particularly interested in at least 4 of the chapters in this book, viz.: The Two Great Divisions of Chemistry, Atoms and Molecules, Chemical Shorthand—The Tools of the Chemist; Metals, Alloys, Iron and Steel; Experiments with Metals; Electrochemistry.

Mr. Morgan is an old hand at making descriptions of things technical easy to read.

Index to advertisers

(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

THE NEW MODEL 1230

SIGNAL GENERATOR

WITH 5 STEPS OF SINE-WAVE AUDIO

SPECIFICATIONS:

1. Combination R.F. and A.F. Signal Generator. R.F.—100 K.C. to 90 Megacycles. A.F.—200 to 7500 cycles: Sine-Wave.—WITH OUTPUT OF OVER 1 VOLT. All direct reading, all by front panel switch manipulation.
2. R.F. and A.F. output independently obtainable, alone or with A.F. (any frequency) modulating R.F.
3. Latest design full-range attenuator used for controlling either the pure or modulated R.F.
4. Accuracy is within 1% on I.F. and broadcast bands; 2% on higher frequencies.
5. Giant dial etched directly on front panel, using a new mechanically perfected drive for perfect vernier control.
6. Operates on 90 to 130 V. A.C. or D.C. (any frequency).

The Model 1230 comes complete with tubes, shielded cables, molded carrying handle and instructions. Size 14"x6"x11". Shipping weight 15 pounds. Only **$12.85**

THE NEW MODEL 1280

SET-TESTER

Combines Models 1240 and 1250

A complete testing laboratory in one unit, the Model 1280 combines the Models 1250 Multitester and 1240 Tube Tester. (See specifications of each below.)

- ★ Instantaneous Snap Switches Reduce Actual Testing Time to Absolute Minimum.
- ★ Spare Socket and Filament Voltages Up to 120 Volts, Make the Model 1280 Obsolescence Proof.
- ★ Latest Design 4½ D'Arsonval Type Meter.
- ★ Works on 90 to 125 Volts 60 Cycles A.C.

Even those servicemen who through past purchases know they can always get SUPER-VALUES from Superior, will be amazed and delighted when they read the specifications of this all-purpose instrument and then note the unbelievably low price. The Model 1280 features a 4½" D'Arsonval type meter for easy reading of the various scales, and in line with our new policy of stressing appearance as well as serviceability in our new 1200 line of test equipment, our Model 1280 utilizes an aluminum etched panel, designed for beauty as well as ruggedness. The primary function of an instrument is, of course, to make measurements accurately and when designing test equipment this is our first thought. However, we also appreciate the important part the appearance of an instrument plays in the impression a serviceman makes on his customers, especially on home calls. We have, therefore, paid special attention to the outward design of all of our new instruments. For instance, the panel of this Model 1280 is made of heavy-gauge aluminum and etched by a radically new process which results in a beautiful, confidence inspiring appearance.

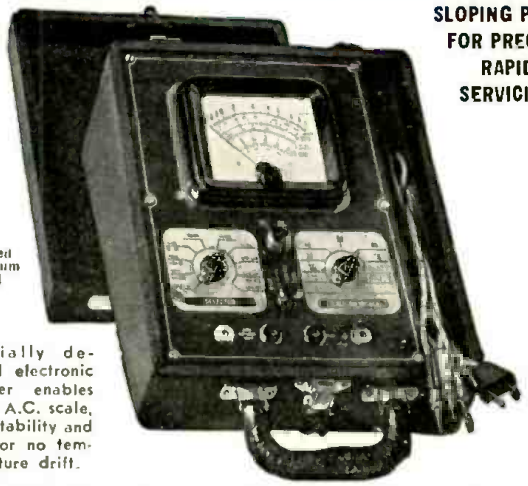
Model 1280 comes complete with test leads, tabular data and instructions. Shipping weight 18 pounds. Size 13" x 11" x 6½". Our net price .. **$19.95**

Portable cover $1.00 additional

THE NEW MODEL 1250

MULTITESTER

SLOPING PANEL FOR PRECISE RAPID SERVICING



Etched aluminum panel

Specially designed electronic rectifier enables linear A.C. scale, high stability and little or no temperature drift.

Here is an opportunity to acquire a Multi-Service, Precision Engineered Instrument, for less than you would have to pay for an ordinary Volt-Ohm Milliammeter. Besides making the usual volt, resistance and current measurements (both A.C. and D.C.) this unit accurately measures the CAPACITIES of mica, paper and electrolytic condensers, INDUCTANCE of coils, chokes and transformers, DECIBEL gain or loss, of power amplifiers and public address systems, WATTS output of amplifiers, receivers, etc.

SPECIFICATIONS

Complete A.C. and D.C. Voltage and Current Ranges	High and Low Capacity Scales .0005 to 1 mfd. and .05 to 50 mfd.
D.C. Voltage:—0-15, 0-150, 0-750 volts	3 Decibel Ranges
A.C. Voltage:—0-15, 0-150, 0-750 volts	– 10 to +19, – 10 to +38, – 10 to +53
D.C. Current:—0-1, 0-15, 0-150, 0-750 ma.	
A.C. Current:—0-15, 0-150, 0-750 ma.	Inductance: 1 to 700 Henries
2 Resistance Ranges 0-500 ohms, 500-5 megohms	Watts: Based on 6 mw. at 0 D.B. in 500 ohms .006000 to 600 Watts

Model 1250 works on 90-120 volts 60 cycles A.C. Comes complete with test leads, tabular charts and instructions. Shipping weight 9 lbs. Size 9½" x 11" x 6½". Our net price **$11.85**

Portable cover $1.00 additional

THE NEW MODEL 1240

TUBE TESTER

Instantaneous snap switches reduce actual testing time to absolute minimum.

•

Tests all tubes 1.4 to 117 volts.

•

Sockets for all tubes — No adapters.

•

Superior is proud to offer the newest and most practical tube tester ever designed. Unbelievably low in price—unbelievably high in performance.

- ★ Tests all tubes, 1.4 to 117 volts, including 1, 3, 6, 7, 7L, octals, loctals, Rantam Jr., Peanut, single ended, floating filament, Mercury Vapor Rectifiers, the new S series. In fact every tube designed to date.
- ★ Spare socket included on front panel for any future tubes.
- ★ Tests by the well-established emission method for tube quality, directly read on the GOOD ? BAD scale of the meter.
- ★ Jewel protected neon.
- ★ Tests shorts and leakages up to 2 megohms in all tubes.
- ★ Tests leakages and shorts in all elements AGAINST all elements in all tubes.
- ★ Tests BOTH plates in rectifiers.
- ★ Tests individual sections such as diodes, triodes, pentodes, etc., in multi-purpose tubes.
- ★ Latest type voltage regulator.
- ★ Features an attractive etched aluminum panel.
- ★ Works on 90 to 125 volts 60 cycles A.C.

Model 1240 comes complete with instructions and tabular data for every known type of receiving tube. Shipping weight 12 pounds. Size 6" x 7½" x 10¾". Our Net Price..... **$11.85**

Portable cover $1.00 additional

SUPERIOR INSTRUMENTS CO.

136 LIBERTY ST., DEPT. RC8
NEW YORK, N. Y.

4 times the proof that its RCP Test Equipment FOR BIG VALUE AT LOW COST!

TUBE TESTER-SET ANALYZER Model 801M

WHERE COULD YOU BUY these two essential instruments individually, and get the same high quality—at the same low price? And RCP has added, at no extra cost, miniature tube testing and self-contained battery power supply (for ohmmeter range below 1 megohm)—new features built on the basic advantages owners have long enjoyed in Combination Model 801. Here's the biggest test instrument value low price ever bought! Model 801 has every worthwhile modern feature . . . and it opens a whole new era in test equipment profit. Extra-money-making features like these make RCP Combination Model 801 something to see your nearest jobber about TODAY—

- Meter is fused—line is double fused
- Tests all new and old tubes . . . all ballast tubes
- Noise test . . . meter reversing switch
- AC voltage measurements have linear scales to coincide with DC
- DC voltmeter 0/10/50/500/1000 ohms per volt
- New miniature tube tests
- Four range AC voltmeter 0/10/50/500/1000
- DC milliammeter 0/1/10/100/1000. DC Ammeter 0/10
- Ohmmeter 0/500/5000/1,000,000/10,000,000—built-in power supply.
- D.B. Meter—8—15/15 to 29/29 to 49/32 to 55 decibels

RCP MODEL 801 **$27.95**

Famous DYNOPTIMUM TUBE TESTER

MODEL 308

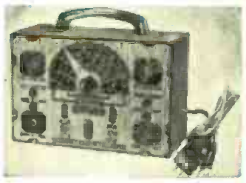
Tests all new miniature tubes . . . all ballast tubes. Noise and hum test for tubes showing otherwise good. Sensitive neon tests for shorts and leaks. Spare socket for future tube developments. Checks pilot lights, headlights, miniature lights. Rapid, accurate. Individual check of sections of rectifiers and multi-purpose tubes. It's Tomorrow's Tube Checker today! . . . amazingly versatile, handsomely finished, sensationally low-priced!

Counter Type Model 308 **$16.95**

Combination Portable—Counter Type Model 308P **$18.95**

SIGNAL GENERATOR

MODEL 702



An even finer performing test instrument than RCP's famous former Signal Generator, and it costs 30% less! All latest improvements in circuit and mechanical design. Extremely wide all-wave coverage continuously variable from 95 Kilocycles to 100 Megacycles. Output modulated at will, 30% modulation at 400 cycles, sine wave from self-contained independent 400 cycle circuit. Attenuation in approximate microvolt calibration by means of five step ladder attenuators. Highly attractive appearance. **$22.95**

AC-DC MULTITESTER

MODEL 445

It's in a class with testers selling at twice the price! Actually, it is the equivalent of 25 different instruments. D'Arsonval meter accurate within 2%. DC voltmeter 0/5/50/250/500/2500. DC Ammeter 0/10. AC voltmeter 0/10/100/500/1000. Three range ohmmeter 0/500/100,000/1 Meg. Meter sensitivity 1 Milliampere or 1000 ohms per volt. Selector switch operated, complete with batteries. **$9.95**

SEE YOUR JOBBER OR if he cannot supply you with the RCP Test Instrument you desire, write to us direct (penny postcard) for new catalog describing the complete RCP BIG VALUE—Low Cost Test Equipment Line.

RADIO CITY

PRODUCTS CO. INC.

88 PARK PLACE, N. Y. C.