

RADIO-CRAFT

HUGO GERNSBACK, Editor



Parasol Microphone!

See Page 136



TELEVISION PHONE



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Frequency Modulation

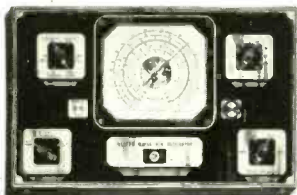


1. F.M. assigned channels 40 to 44 mc.
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— each stage aligned at exactly the same point.
3. Checking limiter and discriminator circuits.

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WESTON Model 776
direct-reading Oscillator



WESTON Model 772
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3. Because of frequency limitations of present-visual aligning equipment, current measurements down to 1 microampere offer the only means of checking I.F. alignments, cut-off point on limiter tube, and adjustment of discriminators. WESTON Model 772 Super-Sensitive Analyzer offers all ranges necessary to make these sensitive measurements; plus additional ranges for all customary voltage, current and resistance measurement needs.

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WESTON Instruments

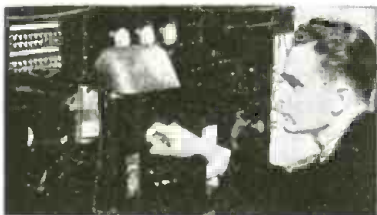


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Broadcasting Stations employ operators, installation, maintenance men and Radio Technicians in other capacities and pay well.



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.



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

I Trained These Men



Chief Operator Broadcasting Station

Before I completed all the lessons, I obtained my Radio Broadcast Operator's license and immediately joined Station WMPC where I am now Chief Operator. HOLLIS F. HAYES, 327 Madison St., Lapeer, Mich.

\$10 to \$20 a Week in Spare Time

I repaired some Radio sets when I was on my tenth lesson. I really don't see how you can give so much for such a small amount of money. I made \$100 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., Rm. 17, Denver, Colorado.



Former Truck Driver Has Own Radio Shop

Before taking your Course I earned about 17½ cents an hour as a truck driver. When I had completed 20 lessons I started service work. During the last two years I have made about \$3,000 in Radio. I now own my own shop. KARL KELLY, 409 W. Calhoun St., Magnolia, Ark.

Get my sample lesson Free. Examine it, read it—see how clear it is, how easy to understand. Find out how I train you at home in spare time to be a Radio Technician. Do it now. Mail the coupon.

Jobs Like These Go to Men Who Know Radio

Radio Broadcasting stations employ Radio Technicians as operators, maintenance men and pay well for trained men. Radio manufacturers employ testers, inspectors, 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 opportunity fields for which N. R. I. gives the required knowledge of Radio. 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 offers 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.

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any set, old or new. You get this instrument to keep as part of your N. R. I. Course.

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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 an envelope or paste on penny postcard—NOW.

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



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I want to send you a sample lesson, "Broadcast, All-Wave and Television Superhetrodyne Receiver Principles". It covers the basic interferences in superhets and how they are rectified. It brings out the importance of the preselector, mixed first-detector, local oscillator, intermediate frequency I.F. amplifier, tracking, peak and band pass adjustments, band switching and modification for adapting to Television reception. All subjects covered with special emphasis on servicing. You can get this lesson FREE. Just mail the coupon.

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National Radio Institute, Washington, D. C.

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- Spare Time Radio Repair Work
- Broadcasting Station Operator
- Loudspeaker Systems, Installations and Service
- Auto Radio Installations and Service
- Television
- 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 23FR2

RADIO-CRAFT

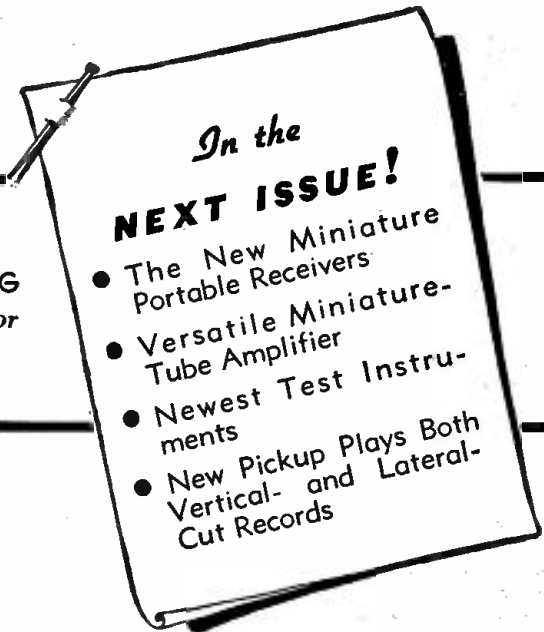
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**A REPRESENTATIVE LETTER
RE: "DO YOU WANT AN
OPERATING NOTES DEPT.?"**

Dear Editor:

In answer to your request in the July 1940 *Radio-Craft* issue, my answer is "Yes, continue the Operating Notes dept." I have saved myself considerable time by using them.

I have been a reader of your magazine ever since its beginning, and can say I have received more good out of it than all the other radio magazines combined.

So here are my first Operating Notes (reproduced elsewhere in this issue—Editor), hoping you can make use of them.

I remain, a *Radio-Craft* Booster—

Yours very truly,

THOS. R. DISSINGER,
Chicago, Illinois.

The editors of this magazine extend sincere thanks for your kind remarks, and hope that forthcoming issues will merit them in even greater degree.

Your comment that these Notes have saved you considerable time tends to prove that their publication in *Radio-Craft* is warranted; and the generous response of other readers seems to just about clinch the argument. Shoot them in, fellows; as we said in the July issue, we can't run the Operating Notes department without cooperation from Servicemen in the field, so keep us up-to-date on the characteristic faults you find.

**WANTS DISC RECORDING
ARTICLES**

Dear Editor:

The excellent article by Mr. Sam M. Harper on disc recording in the May, 1940, issue of *Radio-Craft* has stimulated me to let you know of the widespread interest in this subject, both as a hobby and as a profession, in this country, where it has been popular for many years. I note that direct (spot) recording is now capturing the public imagination in the U.S.A.

You may like to know that the British Sound Recording Association (of which I am a Founder-Member and its Technical Secretary) was formed here several years ago to organize all persons interested in sound recording, particularly direct disc recording, and it now has members and friends throughout the world. Unfortunately present conditions in Europe have upset many of our plans but we are trying to maintain communication with our members by means of publications and correspondence.

We are especially desirous of making contacts in Canada, and so if this letter should catch the attention of any Canadian enthusiast, please do not fail to write to me. Please, *Radio-Craft*, let us have in future issues a fair share of material dealing with direct disc recording.

DONALD W. ALDOUS,
"Strathdee," Studley Road,
Torquay, England.

**STUMPED ON V.-T. VOLTMETER
(Oct. '38 "R.-C.")**

Dear Editor:

I have a problem. I have made the V.-T. voltmeter described in *Radio-Craft* of Oct., 1938. It is made exactly as described. The author states that you should be able to get 250 V. on the plates of the 6Q7 and 5Z4, but all that I can get is 150 V., and I can't calibrate the instrument on account of this trouble:

I have a Thordarson transformer, type T-13R11, with 650 V. C.-T. secondary. I also

tried to adjust the 15,000-ohm filter resistor but the best I could get was 150 V. This job has cost me \$28 to make and I hate to waste all that money on it if I can't make it work. Could you please tell me what could be the trouble with it. I have checked voltage directly at the 5Z4 heaters leading to the 15,000-ohm 25-W. filter resistor, and it gives me 150 V.; and on the 6Q7 plate, 110 volts.

STAN'S RADIO SERVICE,
Camden, N. J.

This letter was forwarded to H. G. McEntee, the author, whose reply follows:

The only suggestion I can offer, in answer to your recent letter, is that you install a large electrolytic condenser from 5Z4 cathode to ground. Try 8 mf. first and see if this will raise the voltage to the required amount. If not, increase to 16 mf.

Be sure that the primary rheostat does not have considerable voltage drop when set at the supposed zero position.

No input filter condenser was used on the instrument shown, since the voltage was high enough without it.

If you need any further help, please be sure to write again.

HOWARD G. MCENTEE.

**"STREAMLINED" OPERATING
NOTES DEPT.**

Dear Editor:

Your magazine is TOPS for the Serviceman. I'd like an Operating Notes Dept. but under these lines: Notes only on popular models; brief notes, don't use full sentences like "I got a call and the complaint was this and I checked the tubes . . . and so on." Example: Philco 827—Weak and distorted—check 0.01-mf. cond. from Pl. of 75 to Grid of 41.

W. W. KOVACS,
City Radio Service,
South Norwalk, Conn.

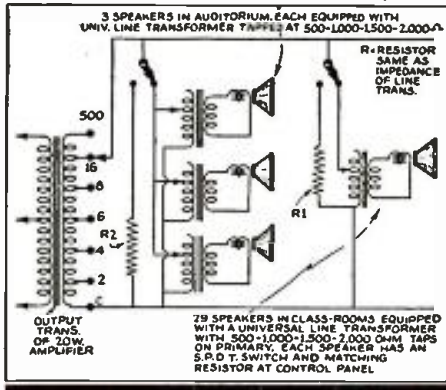
**RE: "SPEAKER MATCHING
TECHNIQUE"**

Dear Editor:

I enjoyed reading Mr. Manney's article in the June edition on "Speaker Matching Technique."

We are planning on adding additional speakers to our present set-up and wish you would tell me the proper impedance to set the output transformer and the universal line transformers on the speakers.

The future set-up will be like the sketch I am enclosing (and reproduced here—Editor). What proper taps on the output trans-



former and on the universal line transformer attached to the P.M. speakers?

DEAN C. COOK,
Nolan Intermediate School,
Detroit, Mich.

This letter was sent to the author, Mr. Manney, whose reply, which immediately

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Dept. RC-9 3224-16th St. N.W. Wash., D. C.

plan I have ever heard of in the radio industry.

If you wish, you can send me the name of the writer and I will have the Philco Distributor in his territory give him the complete information which I know will more than satisfy him.

Very truly yours,
PHILCO RADIO & TELEVISION CORPORATION,
Robert F. Herr, Manager,
Parts and Service Division.

Radio-Craft's follow-up was:
 Dear Mr. Herr,

I have your favor of the 19th, which certainly does not answer the problem.

It is a question of principle involved, and whether the copy of the letter we sent you was signed or not, seems to make little difference. As the letter stated, our reader mentioned that they are a Philco Warranty Service Station. For that reason, they certainly would know what it is all about, and their letter speaks eloquently for itself.

We feel that your letter evades the issue entirely, and for this reason we find it necessary to publish the correspondence.

You state that "This Warranty Service Station setup has put more money into the hands of servicemen than any other single plan I have ever heard of in the radio industry," yet you do not feel inclined to tell us about it.

Our last letter was sufficiently clear on the subject and we believe that we should have all the facts, which, evidently, you are not willing to give.

Sincerely yours,
RADIO-CRAFT,
Hugo Gernsback,
Editor.

(No reply has as yet been received.—
Editor)

**INTERMITTENT RECEPTION
 "TIME TABLE"!**

Dear Editor:

Here's a tabulation of the most common causes of intermittent reception. You'll probably notice that condensers were left out; that's because condensers do not have any time constant:

TIME	PROBABLE CAUSE
0-3 minutes	Tubes or poor connection in set.
3-5 minutes	Resistors, especially cathode bias resistors. Also speaker fields.
3-5 minutes (A.C.-D.C. Sets)	Series filament resistors and heavy-duty resistors.
Over 5 minutes	Power transformers and large bias resistors.

If set cuts off erratically, then it's a faulty condenser.

HAROLD R. KUNTZ,
Brooklyn, N. Y.

Ingenious, we call it. Of course, good judgment must be used in applying a tabulation such as the above, but the probabilities are in favor of the time elements Mr. Kuntz has observed in his service work. We would like to hear from other *Radio-Craft* readers in this connection.

FUTURE SERVICEMAN

Dear Editor:

Some time ago I decided to take a course in Radio, and I got one from Supreme Publications, and they tell us to get some good radio magazine and I come to buy your magazine. I look it all over, I come over

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WHERE TO FIND DATA ON SPEAKER BAFFLES

Want to know where to find extensive design data on baffles and exponential horns for use in connection with dynamic horn units and cone speakers? Well, here you are: *Proc., I.R.E.*, Oct. 1936; "Radio Engineering," by F. E. Terman (McGraw-Hill); "Motion Picture Sound Engineering," by the Research Council, Academy of Motion Picture Arts and Sciences (D. Van Nostrand); "Loudspeakers," by N. W. McLachlan (Oxford University Press); and, "Applied Acoustics," by H. F. Olson and F. Massa (P. Blakiston's).

Do You Know

how the new ultra-small-space portable radio sets are designed for maximum efficiency? Diagrams and details next month.

that article about "The ABC of Db., VU, Mu, Va, Gm, and Sm." and found that very helpful for me and I hope that you give us some more, and how about some good plans for radio volt-ohm-milliamp. tester or if possible a good tube tester?

You'll find also my money for an 8-month subscription to your magazines.

I am a future Serviceman.

ROGER LANGLOIS,
Montreal, P.Q., Can.

We'll do our best to give you articles which will help you to become a good Serviceman. Meanwhile, we suggest you pay particular attention to the books for Servicemen which have been published during the last year or two; and the recent issues of *Radio-Craft*, all of which have contained articles by and for practical Servicemen.

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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)

SECTION II—AMPLIFIERS

Voltage Amplification

Design of resistance-coupled voltage amplifiers

Commercial voltage amplifier

The Power Stage

Class A amplifiers

Class AB amplifiers

Class AB₁ amplifiers

Class AB₂ amplifiers

Class B amplifiers

When to apply class A, AB, and B amplification

Power Supplies

Half-wave rectification

Full-wave rectification

Voltage doublers

Filter Circuits

Power supply regulation, etc.

Practical Hints on Amplifier Construction

Microphonism

Placement of components

Tone compensation

Inverse feedback

Remote control methods

SECTION III—DISTRIBUTION

The Loudspeaker

Dynamic speakers

Speaker performance (frequency response, efficiency)

High-fidelity speakers

Speaker Baffles and Housings

Outdoor speaker installations

Power cone speakers

Radial (360° distribution) speaker baffles

SECTION IV—COORDINATION

Input impedance matching

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

THAT no book has yet been published which covers amplifiers and sound systems (also kindred systems) in one complete, authentic volume is almost unbelievable. Yet, it is a fact, there is no book in print which covers Public Address from A to Z. To bridge this wide-spread gap, RADIO-CRAFT will publish a complete, magnificent volume on Public Address of such magnitude—so complete and authoritative—that every man engaged in radio can have both a theoretical and practical knowledge of the function and operation of sound systems. The editorial pages are so filled with instruction and replete with illustrations that the volume fully justifies its title of 1940 AMPLIFIER HANDBOOK AND PUBLIC ADDRESS GUIDE. This great HANDBOOK on Public Address should be read and studied by those who consistently build, service and sell sound equipment.

A MATCHLESS VOLUME

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.

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RADIO-CRAFT

"RADIO'S GREATEST MAGAZINE"

RADIO WAR INVENTIONS

By the Editor — HUGO GERNSBACK

.... there does not exist in the United States an adequate Board to evaluate inventions.

IN the present rearmament of our country, Radio is bound to play a large rôle. In all branches, whether they be the War Department or the Navy (including the two Aviation Departments of both Army and Navy), radio is one of the most important adjuncts. Every type of mobile unit—on land, and sea, and air, including a part of the infantry itself—must be radio equipped now-a-days. The German war machine has shown that complete coordination between all the forces and their units is out of the question without radio.

Nor is radio used solely for communication purposes during wartime. Radio finds many applications outside of communication, such as telemechanics, facsimile, electronics, and many others too numerous to mention. The tendency in all modern armies is to make war as safe for the fighting forces as is humanly possible. The astonishing results of the German Army have shown that the percentage of their man losses, even in major attacks, was far below that in former wars. The reason for this is immediately traceable to radio, and radio alone, because quick communication and coordination between the various fighting units make it possible to work them as a huge homogeneous whole where every unit is constantly in communication with the commanding staff—no matter what the distance may be—a thing unthinkable without the instrumentality of radio.

There is, also, no question at all that as time goes on, radio will come even more into its own, and we will, during the next few years, see astonishing results mainly due to radio instrumentalities, in warfare.

America has always been ahead in radio, and it is a fact that we have more talent here than perhaps anywhere else in the world. Some of the greatest radio inventions have come from the United States—which indeed made radio possible. Beginning with the Edison Effect, discovered by Thomas A. Edison, followed by the Vacuum Tube by Dr. Lee deForest and supplemented by many modern indispensable circuits, such as the Superheterodyne of Major Edwin H. Armstrong, there have been hundreds of other radio inventions by a host of Americans. It is to be expected that in the future also, America will lead in still greater radio achievements. At the present time we are confronted by the fact that there does not exist in the United States, an adequate National Board to inspect and evaluate radio inventions, or for that matter, any other important war

inventions which could help in making America more secure.

During the World War, it is true, we had the National Advisory Council with Thomas A. Edison as its Chairman. At the present time there is no such agency where the inventor, or engineer, can take his invention for evaluation.

Frequently, important inventions come about which, if they have military value, should be kept secret for the time being, rather than be made public. But where can an inventor take such an invention today? A recent letter to *Radio-Craft* from a well-known research scientist is apropos. This scientist states as follows:

"I have had a number of inquiries from Consulting Engineers who are close friends of mine, as to the procedure of contributing any inventive co-operation for the present re-armament program. That is, where can they get a line on the work in the electronic field, which promises to yield the kind of results that would be acceptable to our Government. Various attempts here at Wright field to accomplish anything in that direction seem to disclose a lack of co-ordinated control. In other words, everybody has his own little niche in which he is interested and the amount of red tape is unbelievable to a civilian engineer. It is not uncommon to spend weeks, day after day, to walk from one department to another, so I am told, only to wind up with the result that some other Field is carrying on such and such research, or to submit a completely worked out proposition in writing, specifications, etc., to Washington, with model."

As this scientist states, we have many excellent specialists willing to devote their efforts in the right direction, anxious to avoid duplication of effort, yet there seems no effective way to make this talent available.

The growing need, therefore, is an adequate central Government body where such inventions can be evaluated properly to make them available to America. Such a body must be composed of not only experts in their particular lines, but in addition men who have imagination. All too often it has been found that experts alone cannot evaluate inventions themselves, and, frequently, such inventions have been either temporarily side-tracked or permanently shelved; instead, had they soon been perfected, they could have been of great public value.

It is to be hoped that such a national body will soon come into being, if America wishes to get the greatest benefits from its wealth of inventive genius.

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.



GOP CONVENTION TELEVISED

With the aid of an intricate setup, N.B.C. successfully televised the 5-day National Republican Convention of 1940 at Philadelphia last month. N.B.C. engineers linked together 3, sometimes 4, cameras located at widely-separated points in Convention Hall. Banks of lights had to be manipulated and focused on various personages being televised and neat "cuts" had to be made from one telly camera to another. Programs were sent over 2 experimental wire circuits and the 98-mi. stretch of coaxial cable from Philly to New York, where it was broadcast over station W2XBS's transmitter.



"PARASOL MICROPHONE"
(Cover Feature)

Pegeen Fitzgerald, WOR-Mutual's lovely commentator and fashion expert, with the "Micrasol"—a special parasol-microphone she designed herself for use at fashion shows and outdoor broadcasts. When in use the microphone is clamped to the parasol handle (see cover photo), when not in use it becomes the handle for the folded parasol.

F.M.

EXCITING news last month for farsighted radio men was the report from the General Electric Co. that frequency modulation has now crashed the aviation field in a big way. The Civil Aeronautics Authority purchased four 250-watt F.M. xmitters to control radio-range equipment in Alaska. Radio ranges are being set up by the C.A.A. near Cordova and Ralston to serve radio "beacons" to aircraft "flying the beam" over far-flung Alaskan territory. The F.M. xmitters will be used by mainland operators to remote-control the range, and the point-to-point, transmitters on the 2 islands; also over the F.M. transmitters will go weather broadcasts in voice which will be radiated from the island stations.

Hard on the heels of its announcement that F.M. had its blessings, the F.C.C. released general form No. 41741 (date: June 22), including rules governing frequency modulation stations; (and to F.M. Broadcasters, Inc., for engineers only, form No. 41851 [date: June 29]). These include: min. of 6 hrs. per day (3 daylight, ditto dark) on the air (except Sunday); at least 1½ hrs. must not duplicate other programs in same area; "to safeguard the public against monopoly, no person or group may directly or indirectly control more than 1 F.M. sta-

tion in the same area" (Radio-Craft asks: will this prevent setting-up a coast-to-coast F.M. network?) Unlike A.M. stations, F.M. stations are licensed to serve specific areas in sq. miles. Score to date: licenses issued, about 22; applications, 150.

Bell Labs. and Western Electric demonstrations of F.M. vs. A.M. reception, in a plane over LaGuardia Airport, of signals from the Labs' building in N.Y.C. last month had 2 important repercussions: (1) airline officials stated their conviction that much of the future of aeronautical communication lies in the ultra-high frequencies; W.E. officials announced intentions of the company to undertake development of ultra-H.F. equipment for aeronautical communication. . . . Speaking before the Seattle, Wash., joint meeting of the I.R.E.-A.I.E.E., General Electric's (Schenectady) technician E. E. Williams stated that because static in every form, and extreme shadow effects, constitute biggest problems with present emergency services, F.M., which is free of these faults, will be welcomed in these fields. Mr. Williams suggested F.M. for the following uses other than broadcasting: emergency service; air transport and control; relaying and program pick-up. . . . WOR's chief engineer, J. R. Poppele, complains he can't get natural static on his home F.M. receiver. So now, being unable to detect approaching thunder storms, he sometimes gets caught without an umbrella, their press dept. ingenuously remarks. . . . The column "Radio Vista" in the N.Y. Post reports that a trade magazine estimates a probable sale of 24 million F.M. units in the next 5 years.

SHORTWAVES

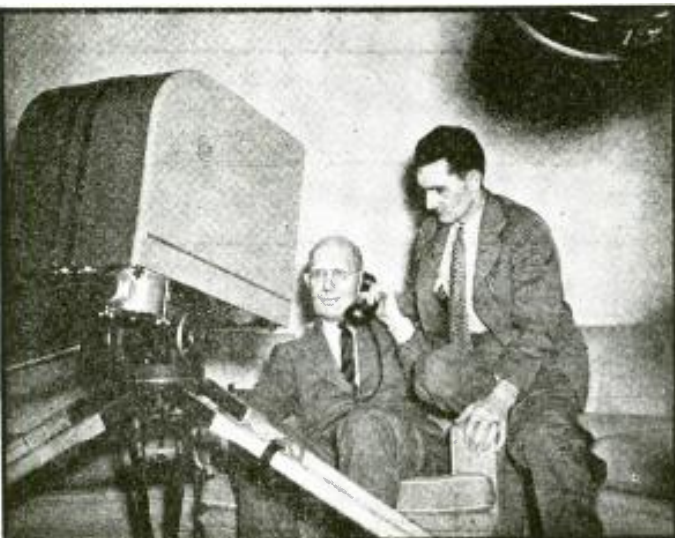
LAST month the F.C.C. clamped down on indiscriminate use of ham-radio facilities, demanded fingerprints and proof of citizenship of radio operators; commercial operators, as well, came within the scope of the questionnaire which went to "about 100,000 radio operators licensed by the Federal Communications Commission." The form requires statements under oath as to (a) citizenship, (b) nationality of immediate relatives, (c) time spent by operator or applicant abroad, (d) foreign or domestic government service, and (e) identification such as fingerprints, photographs and affidavits, all by Aug. 15.

The American Radio Relay League's managing sec'y., K. B. Warner, announces the selection of the League's "How to Become a Radio Amateur" as the organization's 3rd book to be selected by the N. Y. Chapter of the American Red Cross for translation into Braille for blind persons.

SOUND

A FEW more scares such as Orson Welles threw into us some time ago may serve either to kill or cure us of the "jitters" we then exhibited. But that we still have a hangover of this ill, superinduced by world conditions, is evident in a news item of last month, special to the *World-Telegram* from Newark, N. J. Over 500 citizens phoned to police headquarters, nervously questioning the source of "the noise in the sky." The answer: a midget-auto racetrack 7 miles away, and the wind-borne high-power output of a public address system which was picking-up the auto racing noises.

A 2-way sound system comprising loudspeakers, linked by telephone wires between her room at home and a classroom in the local school, enabled a 16-year-old Iowa girl



TELEVISION PHONE

Charles F. Kettering, General Motors vice-president, and his son Eugene are shown at the transmitter of the "television-telephone" introduced last month as part of G.M.'s display at the New York World's Fair. Mr. Kettering both hears and sees the person with whom he's talking. A coaxial cable transmits the image to a receiver connected at the other end of the telephone circuit. The spot illustration on the front cover shows Mr. Kettering's image on the receiving tube.

A recent issue of *Radio-Craft* described the "jeep control" which joins the terminal equipment.



Photo—Courtesy Long Lines—A. T. & T. Co.

COMMUNICATIONS INDUSTRY—IN PERSON

With a head-dress of vacuum tubes, a necklace of telephone dials, a bodice of teletypewriter tape, and a skirt on which telephone poles were silhouetted against a cloud background (not shown), Peggy Healy, a professional model, depicted the Communications Industry at a banquet in Washington recently. The occasion was a celebration of the 150th anniversary of the founding of the United States patent system.

to keep up with her classes during a long illness. This "DX interphone" eliminated the barrier of distance between teacher and classmates, and the remote student.

Joseph H. Kraus, Editor of *Science Observer*, last month raised an interesting question in his editorial "Why is a Stradivarius?" which radio men, particularly specialists in Electronic Music—may wish to answer. He points out that Amati, Stradivari, and other violin makers of the 17th and 18th Century, made quality instruments often imitated but never duplicated. Until recently, "Varnish" was the accepted answer, but recent experiments at Cremona have disproved this belief; removing the varnish from the old masters' instruments, and revarnishing them, failed to produce any appreciable change in the tone.

"In all these many tests human ears serve in the capacity of 'experts,'" observes Mr. Kraus, and concludes: "In this modern age when sound can be analyzed perfectly it should be possible for scientists to duplicate classical instruments of ancient vintage by recording the sounds of the perfect models and modifying modern instruments to approximate this sound. Perhaps treating the wood to a supersonic vibration will align its internal structure so that each molecule will respond properly."

ENGINEERING

"CONDUCTIVE rubber" is the newest thing out, a newspaper reported last month. In a hospital, for instance, it might be a safety measure in preventing a recurrence of such an incident as the recently-reported explosion of an anesthetic set on fire by static electricity generated as the surgeon walked across the operating-room floor.

The mobile unit recently added to the equipment of station WDAY (Fargo, North Dakota) for picking-up outside programs last month brought aid to an injured woman by making possible X-ray inspection of an injured leg. Tractors, horses and manpower helped bring the truck over almost impassable roads to supply power for the X-ray equipment. The patient's farmhouse no longer lacked electricity once the mobile unit's gas-driven generators started turning over.

James L. H. Peck's article "Weapons of the War Planes," in the May 1940 issue of *Science Digest*, recalls to mind the axiom that "there is no weapon of offense for which a defense cannot be devised." Condensed from a section of the book "Armies with Wings," one paragraph reads as follows:

"Experiments are being conducted with a tiny radio transmitter that guides bombers to their concealed objectives. A foot-square, high-frequency transmitter that may be concealed almost anywhere—in basements beneath trash piles, or in garbage cans, or on roof-tops—by saboteurs or 'inside cooperators,' sends out a signal that leads the bombers directly overhead. Operation is somewhat like following an airways beam."

TELEVISION

TITLE: "Television Places Job-Hunter." Last month WOR's J. R. Poppele (he's only chief engineer, you know), minding his own business look-listening to an N.B.C. telecast coming over his home television receiver, became impressed by the brightness of a young lady who spelled-down all the students in her class at Katharine Gibbs Business School. Sequel: the girl is now Poppele's secretary.

Television aided in a test mobilization of civilian power last month when the annual Pacific Coast American Legion Mobilization call went out over W6XAO (Hollywood). While designed primarily for disaster relief, the plan also calls for mobilizing men, who served the United States in the last World War, for national and sabotage defense, and as air warning networks.

The television camera peacefully pierced the defenses of New York Navy Yard last month and gave viewers more of an eyeful, during the launching of the 35,000-ton battleship *North Carolina*, than was obtained by most of the limited number of holders of special passes to the event whom the Navy Dept. had permitted inside the grounds.

BROADCASTING

RADIO broadcasting has had its effect on the political picture. Commenting on political broadcasts of 1924 as against those of 1940, WOR points out that whereas only an engineer and an announcer were required for the earlier set-ups, WOR-Mutual at Chicago, for example, had a staff of 25 to handle the Democratic gathering. Arrangements committees of the 2 parties now plan their sessions with an eye to radio: long demonstrations are no longer permitted; P.A. mikes placed with each state have eliminated the battles of earlier days when delegates fought to be heard from far corners of the halls.

TOURMALINE MIKE

The purpose of this Bell Telephone Labs. instrument is to measure the amount of sound entering a mike and thereby provide a standard for all microphones. The tourmaline-crystal (a thin disc about 1/4-in. in dia. and about 1/40-in. thick) develops an electric current due to the pressure of sound waves. The low output of the crystal is fed into a special, low-noise-level V-T amplifier.



EMERGENCY F.M. 2-WAY COMMUNICATION SYSTEM

One of the first applications of F.M. for emergency service was recently started by Douglas County, Neb. The sheriff's office is now in constant, interference-free communication with all mobile units patrolling different sections of the county. The entire system is 2-way, the main transmitter being a 250-W. G.E. F.M. job and each mobile transmitter being 25 W. The illustration shows a 25-W. transmitter being field-tested by G.E. engineers. Transmitter is on left, receiver at right. (See photo in cover circle.)

ABROAD

BY an odd quirk of fate, Radio last month experienced the result of its own "cry wolf." Newspapers headlined the A.P. report that thousands of French troops on the Swiss border refused to believe Marshal Petain's radio speech in which he said, "We must stop fighting," and continued to fight until forced across the border. "It's just propaganda; everybody knows the Nazis have some of our radio stations," they explained.

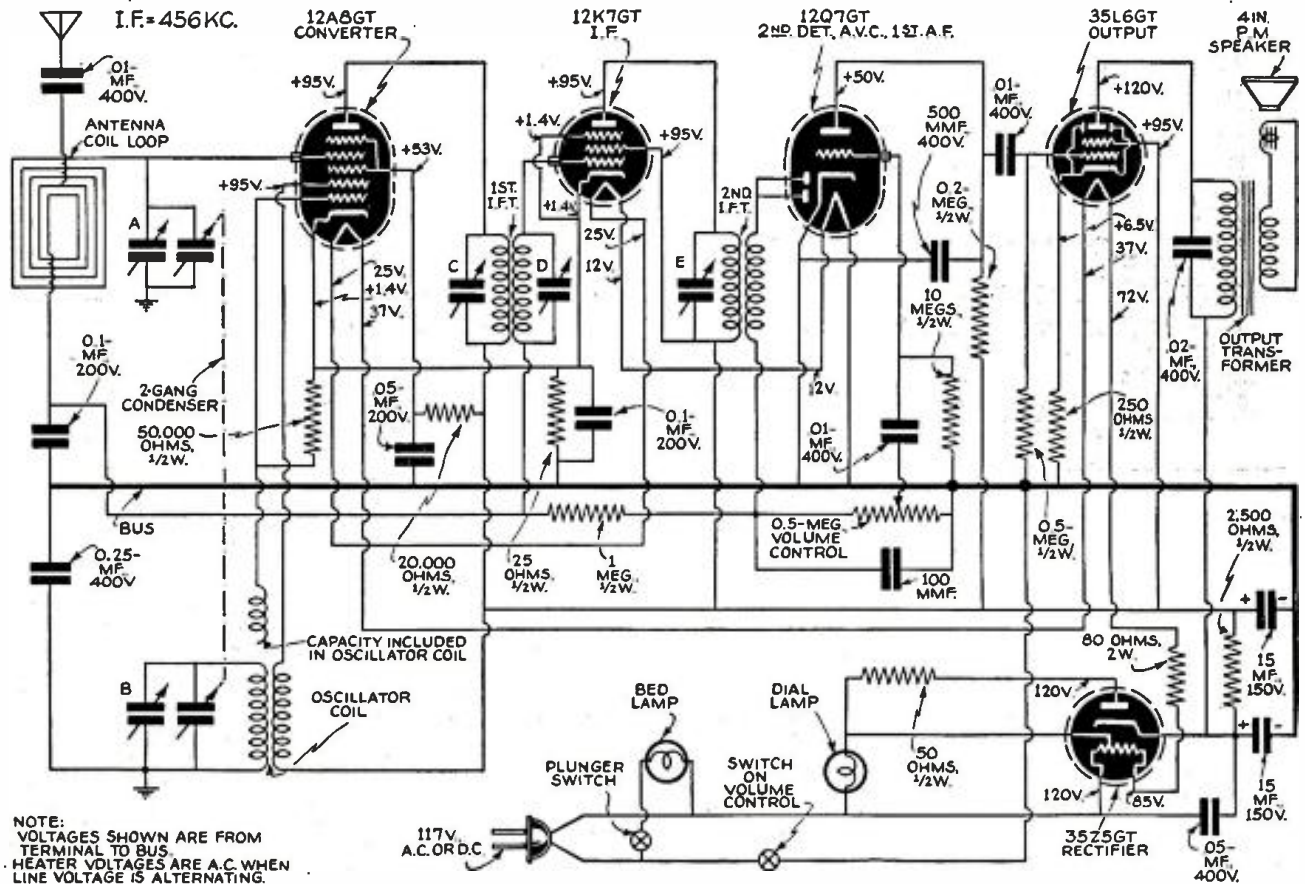
The Netherlands Legation in Washington is the source of the report, printed by the *New York Herald-Tribune*, that in the helmet of each Nazi parachutist who landed in Holland was a miniature radio set for receiving orders from German planes.

When the fight became bitterest, just before the capitulation of France, the ("presumably") British succeeded in "blacking out" German transmission (including all the American beams) all one night, starting with the Lord Haw Haw program, the *New York Daily News* reported. How? Why, by sending a continuous interfering signal on each Nazi wavelength. . . . Not since June 2 have car-radio sets been permitted to be used or owned (in England?), A.P. reported from London.

Last month WOR-Mutual released a telegram from their correspondent in France, Waverly Root, and French Army reporter Victor Luscinchi, which told of plans to continue broadcasting from Spain and Africa after German advance contingents had surrounded the last available French S.-W. xmitter.

LULLABY BEDLAMP RADIO, MODEL TSBU (Mitchell Mfg. Company)

5-Tube Superheterodyne; A.C.-D.C. Operation; Broadcast Band (535 to 1720 kc.), including Police Band; Automatic Volume Control; Built-in "Air Magnet" (Loop Antenna); 1½ Watts Power Output; Separate Reading-Lamp Switch.



Schematic diagram of the Lullaby Bedlamp Radio.

SERVICING DATA

Lack of sensitivity and poor tone quality may be due to any one or a combination of causes such as weak or defective tubes or speaker, open or grounded bias resistor, bypass condenser, etc. Never attempt to realign set until all other possible sources of trouble have been first thoroughly investigated and definitely proved not to be the cause.

NOTE: It is absolutely necessary that an accurately calibrated test oscillator with some type of output measuring device be used when aligning the receiver and that the procedure be carefully followed, otherwise the receiver will be insensitive and the dial calibration will be incorrect. The trimmers will be referred to by their function.

ALIGNMENT PROCEDURE

The alignment of this receiver requires the use of a test oscillator that will cover the frequencies of 456, 600, 1,400 and 1,720 kc., and an output meter to be connected across the primary or secondary of the output transformer. If possible, all alignments should be made with the volume control on maximum and the test oscillator output as low as possible to prevent the A.V.C. from operating and giving false readings.

The I.F. stages should be aligned properly as the first step. After the I.F. transformers have been properly adjusted and peaked, the broadcast band should be adjusted.

I.F. ALIGNMENT. With the gang condenser set at minimum, adjust the test oscillator to 456 kc. and connect the output to the grid of the 1st-detector tube (12A8GT) through a 0.05- or 0.1-mf. condenser. The ground on the test oscillator should be connected to the chassis ground. Align all 3 I.F. trimmers to peak or maximum reading on the output meter.

BROADCAST BAND ALIGNMENT. Remove chassis from cabinet and set it up on the bench. Care should be taken to have no iron or other metal near the loop. Do not make this set-up on a metal bench.

Connect the test oscillator to the antenna of the set through a 200 mmf. condenser. With the gang condenser set at minimum capacity, set the test oscillator at 1,720 kc., and adjust the oscillator (or 1,720 kc. trimmer) on gang condenser. Next—set the test oscillator at 1,400 kc., and tune in the signal on the gang condenser. Adjust the antenna trimmer (or 1,400 kc. trimmer) for maximum signal. Next set the test oscillator at 600 kc., and tune-in signal on condenser to check alignment of coils.

VOLTAGES

Voltages shown on the circuit diagram are from socket terminals to chassis base. In measuring voltages use a voltmeter having a resistance of at least 1,000 ohms/volt. Allowances should be made for variations in line voltage.

GENERAL

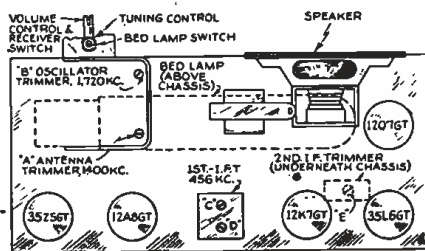
The lamp used is a show case lamp, rated at 120 volts, 25 watts, with medium screw base. (Never use a lamp larger than 25 watts.)



The Lullaby Bedlamp Radio



The Bedlamp Radio in use.



Locations of main components and trimmers.

SERVICING OSCILLATOR COILS

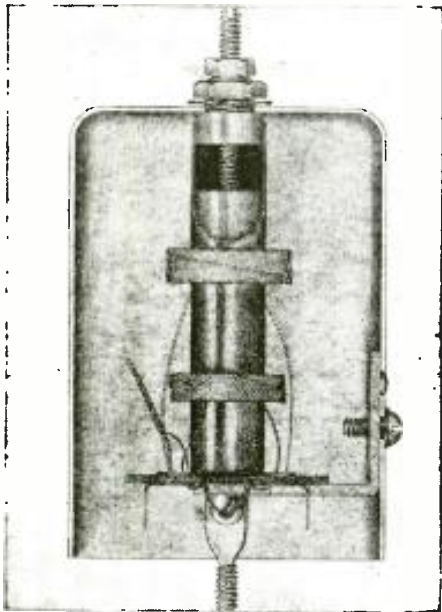


Fig. A. Cut-away view of Universal-type Adjustable-Inductance coil. Movable iron core is exposed inside coil form; adjusting screw and lock nut at top of shield can.

Valuable practical information you cannot find in books is published here for the first time by a coil specialist. Preceding this concluding article were the following: "Servicing R.F. Coils" (June issue); "Replacing I.F. Coil Windings" (July); "Replacing I.F. Transformers" (August).

L. V. SORENSEN

Rapid Résumé

A highly informative article on the operation of the local oscillator in a superheterodyne. Some of the important topics covered are:

Oscillator Failures	Excessive Feedback	Repairing Universal-wound Oscillator Coils
Oscillator Frequency Relations	Oscillator Frequency Jumps	Adjustable-Inductance Oscillator Coils
Tracking Problems	Parasitic Oscillations	Coil Matching
Reflected Capacities	Tickler Failures	
	Repairing Solenoid Oscillator Coils	

WHEN an oscillator coil fails in service, it is usually the Serviceman's inclination to look for a factory-made exact duplicate replacement coil or to return the defective part to a coil manufacturer for repair rather than to attempt to repair or replace the defective coil himself.

This is probably because he has long "been told" of the many conflicting considerations involved in the design of oscillator coils and he therefore believes it an impossible task to attempt any repair other than the installation of an exact duplicate replacement coil. In most instances such an attitude results in long delays before the set can be returned to the customer, whereas if the Serviceman is sufficiently well-informed, in many cases the defective coil can be quickly repaired or replaced with entire satisfaction from a performance standpoint and a customer's good will obtained through speedy service. It is the purpose of this article to discuss oscillator coils, their characteristics, their repair and their replacement.

OSCILLATOR FAILURES

Oscillators in superheterodyne receivers may fail to work properly for any one of a number of reasons, the most important of which are listed below:

- (1) Oscillator tube worn out or defective.
- (2) Low oscillator plate voltage resulting from abnormal current consumption by some other part of the receiver.
- (3) Abnormally low plate voltage caused by worn-out rectifier tube.
- (4) Poor contacts on range switch.
- (5) Short-circuit in the oscillator coil or associated circuit.
- (6) Open-circuit in the oscillator coil or associated circuit.

Of the above listed causes for oscillator failure, all but the last are ordinary service problems easily solved by any good Serviceman. It is the last problem, an open-circuit in the oscillator coil, that has been so difficult for many Servicemen to handle with dispatch. The solution of the problem is discussed in the following paragraphs.

OSCILLATOR FREQUENCY RELATIONS

Before attempting to describe ways and means of repairing defective oscillator coils or of making satisfactory substitutions, it would probably be wise to review some of the basic ideas connected with oscillators in Superheterodyne receivers.

The purpose of the oscillator is to beat with the incoming signal to convert it to a new frequency for the purpose of cheaply obtaining more sensitivity and selectivity than could be obtained by simple R.F. amplification.

The new frequency, normally called the *intermediate frequency* (or I.F.), can be either the sum of the signal frequency and the oscillator frequency; or it may be the difference between the two.

THE "SUM" PRINCIPLE.—Either system will work, and both systems have been used although sets working on the "Sum" principle—the oscillator frequency plus the signal frequency—are very rare since they present 2 distinct disadvantages, 1st, the I.F. is higher than the highest frequency it is desired to receive; which means that the circuits will not have the degree of selectivity available from circuits that operate at frequencies lower than the signal frequency; and the 2nd disadvantage is the difficulty of making the oscillator and the antenna circuit track together since *the tuning condensers must work in opposite directions* in order to maintain a constant sum, the *intermediate frequency*. In other words, as the signal frequency increases the oscillator frequency must decrease in order to maintain a constant sum.

THE "DIFFERENCE" PRINCIPLE.—Practically all superheterodyne receivers work on the "Difference" principle, that is, the intermediate frequency is the difference between the oscillator frequency minus the signal frequency. This does not necessarily mean, however, that the intermediate frequency must be below the frequency of the lowest signal received, although that is usually the case. Sets of the "All-Wave" type having an intermediate frequency of approximately 456 kc. and having a longwave band—150

to 375 kc. or thereabouts, are a good example of sets having an intermediate frequency above the signal frequency. Some of the more recent amateur receivers have 1,600-kc. I.F. systems. These are additional examples of sets working on the "Difference" principle, yet having intermediate frequencies above the signal frequency.

There is one more frequency arrangement sometimes used on receivers tuning to very high frequencies and that arrangement has the oscillator frequency below the signal frequency. The principal reason for the oscillator being operated below the signal frequency is that the oscillator then does not have to tune to as high a frequency as when it operates on the "high side" of the signal, and since there frequently is difficulty in getting an oscillator to function properly at the extremely high frequencies, especially in multi-band sets, operating the oscillator below the signal frequency gives some help in the problem of maintaining proper oscillation. The number of sets employing this procedure, however, are comparatively few.

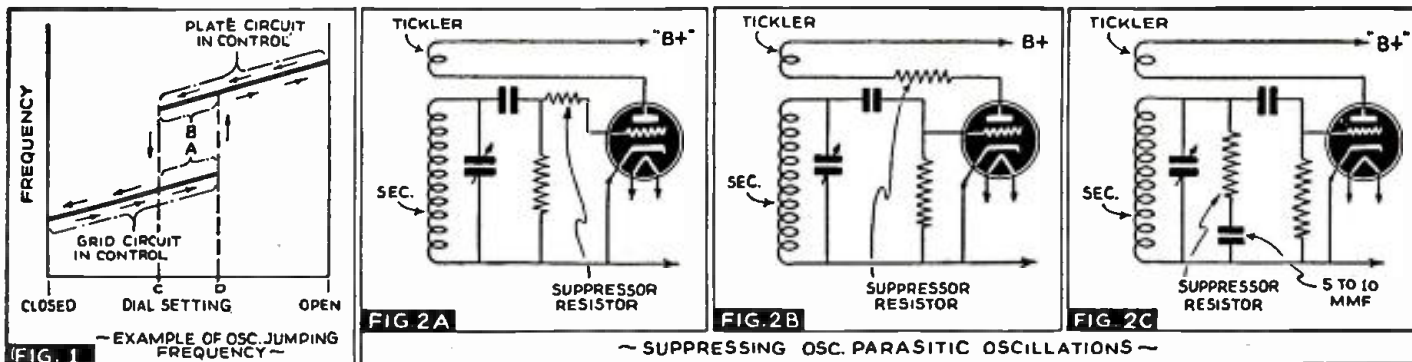
TRACKING

When 2 identical inductances are tuned by 2 identical sections of a gang condenser, both circuits are simultaneously tuned to the same frequency. These circuits are said to "track" together. Such is the goal for which engineers strive in the design of T.R.F. (tuned radio frequency) receivers.

In a superheterodyne receiver, the problem is a little more complicated. There, the problem is to make 2 different values of inductances simultaneously tune to 2 frequencies having a fixed difference, the intermediate frequency.

Examining the most common arrangement of circuits, the oscillator frequency higher than the signal frequency, and selecting for an example a broadcast receiver tuning from 550 kc. to 1,650 kc. and having an intermediate frequency of 456 kc., it can be seen that the oscillator must operate from 1,006 kc. to 2,106 kc.

The antenna frequency ratio is 1,650 kc. ÷ 550 kc., or 3 which requires a capacity



ratio of 9 to 1 since frequency ratio is proportional to the square of capacity ratio. The oscillator frequency range is only $2,106 \text{ kc.} \div 1,006 \text{ kc.}$, which equals 2.09, and requires a capacity ratio of only 4.37 to 1. This reduced capacity ratio can be obtained in any one of the following ways:

- (1) Increase the fixed capacity in the circuit by the use of a high-capacity trimmer condenser.
- (2) Decrease the maximum capacity by the use of a condenser in series with the tuning condenser.
- (3) Combination of 1 and 2, decreasing the maximum by means of the series (padding) condenser and increasing the minimum circuit capacity.
- (4) Use fewer plates in the oscillator section of the gang condenser to reduce the maximum capacity.
- (5) Use plates of special shape in the oscillator section of the tuning condenser.

Actually, in practice, method No. 5 (specially-shaped oscillator plates), is used on most single-band sets of modern design, while method No. 3 (combined series and shunt condensers) is used on some single-band sets (usually of older design) and on dual-band or multi-wave receivers.

PADDING CONDENSER.—If method No. 1, high minimum capacity, No. 2, low maximum capacity, or No. 4, reduced number of plates of the same shape as the antenna tuning condenser plates, is used, the circuits will be "in-track" over 2 narrow regions on the tuning curve, one near each end, but the "tracking" would not be good at other points.

Method No. 3, combined series and shunt condensers, and method No. 5, specially-shaped plates in the oscillator tuning condenser, can give excellent tracking over the entire tuning range when the coils are properly designed.

SHAPED-PLATE OSCILLATOR CONDENSER.—Condensers having specially-shaped oscillator plates are frequently called "cut-plate" condensers or "tracking-section" condensers. A moment's thought should bring forth the realization that a "cut-plate" condenser can be correctly shaped for *only 1 frequency range* and 1 intermediate frequency (or any other set of frequencies, maximum, minimum and intermediate frequency that bears a fixed relation to the original figures). For example, if a given gang condenser tracks perfectly from 550 to 1,650 kc. with an intermediate frequency of 450 kc., it will also cover the range 1,100 to 3,300 kc. perfectly when using an I.F. of 900 kc. In this example all values were multiplied by 2. They could, of course, be divided by 2 giving perfect tracking from 275 kc. to 825 kc. with an I.F. of 225 kc., or any other multiplier or divisor could be used.

When one type of gang condenser is used in different sets to cover slightly different frequency ranges with the same in-

termediate frequency, or used to cover identical tuning ranges with different intermediate frequencies, the "tracking" under the ideal conditions (for which the plate shapes were worked out) can be perfect; while, for any other condition the set can be expected to run slightly out-of-track at several points, usually 3—the middle and the 2 extremes—while being perfectly tracked in the 2 places between. The maximum amount of mistracking, however, is usually small in any well-designed set.

It also follows from the above discussion that sets using intermediate frequencies that differ materially from each other and that use "cut-plate" gang condensers must use oscillator plates of different shape for one intermediate frequency than for another. There are, accordingly, "cut-plate" gang condensers for the broadcast band of sets with 175-kc., 252-kc., 370-kc. and 456-kc. I.F. systems.

THE TICKLER COIL.—Having considered, at some length, the frequency requirements of oscillators in superheterodyne receivers, it now remains to look into the operating characteristics of oscillators.

The vast majority of oscillator circuits consist of a tuned secondary to which is coupled a low-impedance winding commonly called the "tickler," whose duty it is to feed back from the plate circuit enough energy into the grid circuit to make the tube circuit oscillate strongly and continuously.

REFLECTED CAPACITY

It is unfortunately true that in feeding voltage from the plate circuit back into the grid circuit, the tickler also reflects capacity and resistance from the plate circuit into the grid circuit. The amount of capacity reflected depends upon, among other things, the tube, the ratio of tickler inductance to secondary inductance, and the degree of coupling.

In shortwave oscillator coils there frequently is considerable trouble during the initial design to make the circuit oscillate with sufficient strength at the low-frequency end without at the same time reflecting so much capacity across the secondary that the oscillator fails to reach as high a frequency as desired. When the design has been worked out satisfactorily from an electrical standpoint but with a coil construction that has not been chosen for maximum uniformity in production, there sometimes is enough variation in the characteristics of the coil due to the position of the tickler (on shortwave coils especially) to prevent the circuit from reaching its proper top frequency in the case that the coupling is unusually tight, or to permit oscillation to stop at the low-frequency end of the tuning range if the coupling is too loose. Sets with either of these defects seldom get out of the factory of a reputable manufacturer, but these tendencies are pointed out so that any Service-

man replacing the tickler on a shortwave coil will have a proper appreciation of the importance of the position of the tickler and will govern himself accordingly.

EXCESSIVE FEEDBACK

Sometimes during the initial design of shortwave oscillator circuits with tubes of low mutual conductance or with tuned circuits of poor quality, a large number of tickler turns may be used to obtain satisfactory oscillator strength at the low-frequency end of the tuning range. Then when the condenser is turned toward the high-frequency end of the scale, either of 2 undesirable results may occur: (1) the oscillator frequency may jump suddenly to some frequency much higher than it should be; or (2) the oscillator may start to work at a number of frequencies spaced close together giving rise to multiple responses from a single signal.

OSCILLATOR JUMPS FREQUENCY

In the case of the oscillator jumping frequency, Fig. 1 is representative of what occurs. Starting with the gang closed, and following the arrows in the diagram, the frequency of the oscillator is seen to increase smoothly for a considerable portion of the condenser rotation, then suddenly oscillation jumps to a much higher frequency. As the condenser is turned further in the same direction, the frequency increases further, as might be expected. On the return trip, increasing capacity, the frequency will be found to decrease smoothly to a point considerably past the setting at which the first jump in frequency occurred, and then suddenly the frequency will jump down to its proper value.

Frequencies in the range marked A can only be reached when the gang condenser starts from a position to the left of point C and frequencies in the region B can only be obtained when the condenser starts from a position to the right of D. The diagram has been clearly marked showing the region in which the grid circuit controls the frequency, and the region in which the plate circuit assumes control of the frequency.

There are several remedies to such a fault which, in all probability, no Serviceman will be called upon to repair unless the set is built by an experimenter, but they are listed here for the sake of the knowledge they impart:

- (1) Decrease the number of tickler turns.
- (2) If the oscillator gets too weak or stops at the low-frequency end of the tuning range before the jump in frequency is completely removed, connect a carbon resistor between the plate of the tube and the tickler. The value will have to be determined by experiment. It may be 10, 25, 50 or 100 ohms. It is hardly likely that the value would have to go higher.

- (3) Make the oscillator coil enough more efficient that fewer tickler turns will give satisfactory strength of oscillation at the low-frequency end of the tuning range.

PARASITIC R.F. AND A.F. OSCILLATIONS (INCLUDING WHISTLES)

When the set suddenly breaks into multiple responses or multiple tweets and whistles near the high-frequency end of the tuning range, the oscillator is said to be "parasitic."

This trouble is usually remedied by reducing the number of tickler turns, if that can be done and yet maintain adequate oscillator strength at the low-frequency end of the tuning range, or carbon oscillation-suppressor resistors may be added in accordance with Figs. 2A, 2B or 2C. The values are not critical but should not be much larger than just enough for the job after testing a group of tubes while the set is operated at high line voltage. The high line voltage test condition is recommended because parasitic oscillation is usually aggravated by high voltage.

TICKLER FAILURES

Returning to a consideration previously brought out in the 3 preceding articles of this series, it is usually the winding at positive potential, in this case the tickler, that fails spontaneously in the presence of moisture and direct current. If one winding must fail it is, indeed, fortunate that the one which fails is manufactured to broad tolerances of inductances while the secondary, which determines tracking and dial calibration, and consequently is held to close tolerance, is undamaged.

On some broadcast and practically all shortwave oscillator coils the secondary is wound in a single layer while the tickler is wound in another single layer adjacent to, or over, or between the turns of the secondary. It should, therefore, be a simple matter to remove the defective tickler without disturbing the secondary and to replace it with a new winding.

REPAIRING SOLENOID OSCILLATOR COILS

The first step in replacing a defective tickler winding is to carefully make a diagram of the connections from the coil to the remainder of the receiver, and another sketch of the position of the winding, its winding direction, the lugs to which each end of the winding is connected and then to count the number of turns in it.

Should the winding direction be omitted or the terminals become confused, there is a universal rule for connecting oscillator coils that is always correct, whereas no such universal rule can be given for R.F. or Antenna coils. The rule is as follows:

If one starts at the grid end of the secondary and follows around the turns of the secondary and then proceeds to the tickler in the same direction, one enters the tickler at the low-potential end and ends at the plate.

The position and number of turns in the tickler is of great importance. Measurements should be made to the nearest 64th of an inch before the old tickler is removed, and then the new one of the same number of turns should be installed in as nearly the same place as possible. Sometimes when the tickler is removed the marks from the cement or wax holding the tickler are a convenient guide to the location of the new tickler.

As pointed out in the preceding discussion of oscillator characteristics, the location of the tickler is important because if it is too far away from the center of the secondary

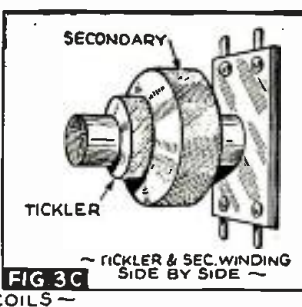
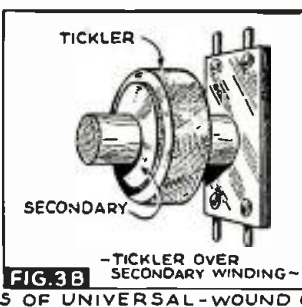
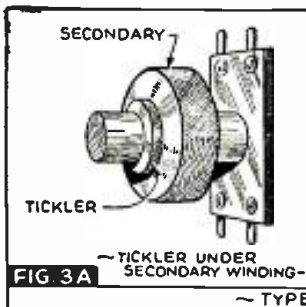


FIG 3A ~TICKLER UNDER SECONDARY WINDING~ FIG 3B ~TICKLER OVER SECONDARY WINDING~ FIG 3C ~TICKLER & SEC. WINDING SIDE BY SIDE~
~ TYPES OF UNIVERSAL-WOUND COILS ~

coil the oscillator may fail to work at the low-frequency end of the tuning range, especially when operating at low line voltage, or if the tickler is too close to the center of the secondary, it may not be possible to reach the proper top frequency even with the trimmer condenser wide open.

When the tickler repair is finished the coil should be reinstalled in the set and then a complete alignment given to the receiver. If the repair has been properly made the trimmer and padder condensers should require only the most minor adjustments.

REPAIRING UNIVERSAL-WOUND OSCILLATOR COILS

Universal-wound oscillator coils are of 2 major types—(1) the completely universal-wound type in which both windings are the universal type; and, (2) the combination type in which the tickler is wound as a single-layer solenoid covered by a layer of insulating material with the secondary universal-wound on top of it.

The completely universal-wound type is divided into 3 general types: (1) tickler under the secondary, shown in Fig. 3A; (2) tickler over the secondary, shown in Fig. 3B; (3) side-by-side construction shown in Fig. 3C.

Universal-wound oscillator coils present so much more difficult a repair problem than single-layer solenoid coils that their repair usually can be justified only by some very powerful argument. It is usually much more economical to install a new coil, either adjusting it to the proper inductance on some sort of a coil matching device, pulling off turns until the proper inductance is reached, or by employing a Universal adjustable-inductance oscillator coil which can be adjusted either on a coil matching device or in the set. It is possible, however, to make satisfactory repairs on certain types of coils if the tickler does not have too many turns, was wound where it was possible to work on the tickler, and if the Serviceman has sufficient patience.

TICKLER COIL UNDER SECONDARY.—A coil having its tickler wound under the secondary is a very difficult type of coil on which to attempt to replace the tickler, but in extremely urgent cases it can be done although involving some experiment to determine the proper number of tickler turns. With too-many turns, the oscillation may become parasitic, and with too-few it will fail to oscillate at the high-capacity end of the tuning condenser. (With the tickler wound backwards or connected backwards the circuit will not oscillate at any setting of the tuning condenser. See rule above for proper polarity of connections to produce oscillation.)

A reasonable procedure in repairing a broadcast oscillator coil with tickler under the secondary is to wind about 30 turns of No. 36 D.C.C. wire (or some other wire of approximately the same size with reasonable insulation such as S.S.E., D.S.E. or D.S.C.) in the form of a doughnut just large enough to slip on the coil form, tie it with thread in several places to hold it

together, and place this on the oscillator coil form close to the original winding holding it in place with wax or cement. The coil leads should then be connected to the lugs which terminated the original tickler winding (making sure of the winding direction and connection according to the rule previously set down), and the coil placed in the receiver for test.

If the set plays, and the oscillator can be trimmed to calibrate properly at 1,400 kc., and if it does not stop working with the gang condenser closed at low line voltage (about 105 volts on a nominal 110-volt line), and if it does not break into parasitic oscillations at the full-open position of the gang condenser, the repair can be considered a success.

If the circuit fails to oscillate at the low-frequency end of the dial, more tickler turns are needed. If the circuit becomes parasitic at the high-frequency end, fewer tickler turns are needed and adjustments on the number of tickler turns should be made accordingly until satisfactory results are obtained. Note that in all cases the bunched tickler should be as close to the secondary as possible.

TICKLER COIL OVER SECONDARY.—In the event that the tickler is wound over the secondary or beside the secondary as in Figs. 3B and 3C, the experimental work to determine the proper number of tickler turns need not be performed since it is very simple to remove the defective winding without disturbing the secondary, count the number of turns, and random wind a new coil to take the place of the defective one.

UNIVERSAL ADJUSTABLE - INDUCTANCE OSCILLATOR COIL

It has been pointed out in preceding articles of this series that where acceptable factory-made replacement coils are available at reasonable prices, it is usually an economy to use these replacement parts in preference to attempting a repair. Oscillator coil failures are no exception.

Where an oscillator tickler has corroded open, leaving the secondary intact, the Universal Replacement Coil is a great convenience, but in the unusual case where the secondary is open, giving no clue to the proper value of inductance to use, the Uni-

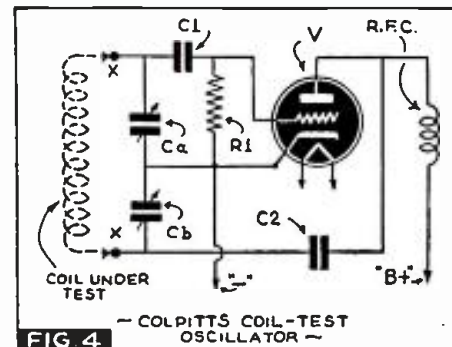


FIG 4 ~ COLPITTS COIL-TEST OSCILLATOR ~

Suggested component values: C1, 100 mmf.; C2, grid excitation condenser, about 0.002-mf.; gridleak, R1, 50,000 ohms.

versal Adjustable-Inductance Oscillator Coil is practically a necessity. A coil of this type is shown in the heading illustration of this article. With its adjustable-inductance feature, the coil can be quickly adjusted in the receiver to match the dial calibration.

In the failure of an oscillator secondary, the greatest aid to rapid repair is an undisturbed setting of the oscillator trimming and padding condenser, especially the latter.

TRIMMERS AND PADDERS UNDISTURBED; SERVICE-OSCILLATOR ALIGNMENT.—If this adjustment has not been disturbed and the adjustable-inductance oscillator coil has been installed, the set should be connected to a signal generator or service oscillator in the normal manner with the service oscillator frequency set at 600 kc. and then the adjustment screw on the oscillator rotated slowly while the gang condenser is rocked as if padding, watching for maximum response. When maximum response is obtained at 600 kc., the generator and set should be set to 1,400 kc. and the oscillator trimmed to calibrate properly. The 600 kc. point should be readjusted, if necessary using the inductance adjuster—not the padding condenser, and the trimming at 1,400 kc. touched-up.

TRIMMERS AND PADDERS DISTURBED; TRIAL-AND-ERROR ALIGNMENT.—In the event that the secondary of the original coil has been damaged, and the padding condenser has been thrown out of adjustment, it becomes necessary to track the oscillator coil to the dial calibration by the trial-and-error method. The simplest procedure is to align the set at 600 kc. and 1,400 kc. and then check to see how far the set runs "out-of-track" at the middle. The oscillator inductance is then changed and the set aligned at both ends and checked in the middle again. This process of adjusting, trimming, padding, and checking is continued until proper tracking over the entire tuning range results.

The procedure is as follows: Set the inductance adjuster at some point, tune the

generator to 600 kc. and adjust the receiver dial to indicate the same frequency, then adjust the padding condenser until the set responds to the signal. Then tune generator and set to 1,400 kc. and trim the oscillator to respond at that frequency. Shift to 1,000 kc. and check the point on the dial at which the signal is heard. Shift the oscillator inductance adjuster 1 turn and repeat the process. If the dial calibration at 1,000 kc. becomes more nearly correct, proceed with the above-outlined plan until the accuracy is good at 1,000 kc. and the sensitivity is also good over most of the tuning range.

If the calibration at 1,000 kc. gets worse, it is obvious that the first shift in inductance was in the wrong direction and subsequent shifts should be in the opposite direction until good alignment and calibration is obtained. It must be remembered, of course, that there is some variation from exact accuracy in practically all commercial sets, and therefore complete agreement with the indicated frequencies on the dial is not to be expected.

If the set is of the cut-plate type employing no padding condenser the problem is much simpler; simply use the oscillator inductance adjuster as if it were a padding condenser and adjust for maximum response at 600 kc., then trim at 1,400 kc.; repeat the process once more and the job is finished.

COIL-MATCHING DEVICE

Probably the simplest possible coil-matching device is a *Colpitts oscillator* such as shown in Fig. 4 used in combination with a receiving set and a signal from a broadcast (or shortwave) station. The tube, V, can be almost any triode, and the voltage about 90. The choke, R.F.C., shown in the schematic is not critical as to constants but should have reasonably low distributed capacity and reasonably high inductance. (A Meissner No. 19-2330, 30-millihy. choke or equivalent is recommended.)

The tuning condenser may be any high-

capacity gang condenser. If possible, it should be a 4-gang condenser with the 2 gangs at one end connected together (in shunt) and the 2 at the opposite end also connected in parallel. This arrangement is recommended because in the circuit shown, the 2 tuning condensers, Ca, Cb, in series across the coil under test, only equal a single section as normally used in the set.

With this device, the good secondary of the defective coil (shown dotted) is connected to the points marked X, the set tuned to a station of appropriate frequency and the test oscillator tuned to zero beat with the station, and the dial setting noted. (Remember that a broadcast oscillator for a set with 456 kc. I.F. normally tunes from about 1,000 to 2,000 kc. and shortwave oscillators correspondingly tune higher than the dial calibrations by an amount equal to the I.F.)

The new coil is now substituted for the old one, the test rig tuned for zero beat, and the dial setting noted. If the tuning capacity for zero beat is higher than when the original coil was connected, the new coil is too low in inductance and turns must be added until the desired inductance is obtained, or a new coil of higher inductance must be obtained so that it may be pulled down to the correct inductance. When turns have been pulled off until the inductance is only a fraction of a turn too high (or too low), the last adjustment can often be conveniently made by radially pressing in on the periphery of the coil which spreads the turns slightly and decreases the inductance a few per cent (or by squeezing the coil in the axial direction which will raise the inductance a little).

This article has been prepared from data supplied by courtesy of Meissner Manufacturing Co.

NOTE: In the first article, "Servicing R.F. Coils," Fig. 7B should be 7C, and vice versa.

OPERATING NOTES

Trouble in . . .

. . . WURLITZER COIN-PHONOGRAPH

One afternoon recently, a friend who operates a sandwich and beer counter, stopped in to report his nickelodeon had ceased operations amid a great racket.

A quick check-up showed the amplifier OK and localized the trouble in the speaker. Examination of the speaker disclosed a sliver of steel lodged in the gap between the center pole-piece and the voice coil form. Held there by the magnetic force, the vibration of the cone had caused the metal sliver to saw a 3/16-in. hole in the coil form and finally to cut the wire.

The machine was one of the older model Wurlitzers using 2-30s, 3-45s and a 5Z3, the speaker field being in the bias circuit of the output 45s.

He had obtained the machine from a bootleg dealer, so had no distributor to call on. The speaker being a special job (it looked like it might be a Jensen) there were no replacement cones listed in the catalogs and the nearest possible source for a duplicate speaker was 100 miles away. So I took the speaker to the shop and loosening the spider pushed the cone as far out as possible without loosening the outside edge, with the aid of a magnifying glass and a pair of long tweezers, unwrapped the cut wire on the voice coil (luckily it was the last turn) and resol-

dered it to the lead wire. There was no room to patch the form so a thin coating of speaker cement was applied to the edges of the hole, and when dry, sanded smooth again.

This is not offered as a recommended repair for damaged speakers but as a means of meeting an emergency.

E. H. DISNEY,
Lowry City, Mo.

. . . AUTO-RADIO AND MIDGET SETS

There is a troublesome defect that has been encountered in some auto-radio and midget-type receivers. Certain bypass and trimmer condensers grounded to the chassis by means of rivets or bolts cause erratic circuit behavior. *Standard ohmmeters detect no trouble.* Cleaning and tightening, or better still, soldering the connections eliminates the headaches. The only explanation is that a molecular-thick layer of oxidized metal causes troublesome rectification effects, especially where oscillator trimmers are involved.

Similar trouble was found with cold-solder connections and dry, corroded tuning condenser assemblies. That is, similar in that ordinary ohmmeter rigs were useless. (Resoldering of all connections and oiling of condenser bearing and contact parts, of course, is the cure.)

As a result of these headaches, a special, very-low-range ohmmeter such as is used in power engineering work was purchased.

This proved to be a godsend where such occasional cases cropped up.

TED POWELL,
Maspeth, L. I.

. . . PHILCO MYSTERY CONTROL

The complaint was lack of reception at times when using Mystery Control; also, the Mystery Control would select the wrong station.

The complaint sounded complicated but the cure is very simple. Remove the cover from the Mystery Control relays located on top of the chassis. Inside are located 2 relays. One is a holding relay and the other a quick-release relay. (You can identify the holding relay by the copper slug on one end.) This relay has a small adjusting screw and a locking nut located in the top of the armature. Loosen the locking nut and turn the screw in about 1/4-turn. Tighten locking nut. Turn set on and check operation.

This holding relay in this case did not release at all at times thus keeping the automatic silencing switch closed. Due to holding too long it also upset operation of the station selector switch.

R. B. OLSON,
Rockford, Ill.

. . . PHILCO 39

Complaint was made on several Philco model 39 sets, of a loud "whizzing noise" during strong winds. These sets were sup-

plied with vertical whip antennas which were pointed at the top. By soldering a small ball removed from a curtain rod to the top of these antennas, the noise was completely eliminated.

Here in Texas when we have wind, we have sand or dust with it. This sets up corona action that feeds off (discharges from) the point of the antenna into the air. By putting a ball on top, the electricity is carried to the ground through a resistor made into the lightning arrestor. Some Chevrolet cars have this same trouble and can be cured the same way.

PERRY CLARK,
Wichita Falls, Tex.

.... MAJESTIC 3C80

Intermittent reception, squeals, and howls in this set, may be due to a bad 6Q7G socket, and is usually caused by bad prong contacts. Replace with a better grade socket, such as an Amphenol socket (which I found to be satisfactory).

.... A.K. 82

Complaint: volume fades out completely after turning set on for about 15 seconds. Remedy: change the 670-ohm bleeder resistor, between volume control and ground, to 1,000 ohms.

JACOB M. WASSER,
Souderton, Pa.

.... G.E. E155

Set lacked volume on distance, but seemed to operate all right on locals. This trouble was cured by replacing a shorted 0.05-mf. condenser in the grid circuit of the 1st I.F. transformer. (This condenser is marked T. C. No. 40 on diagram.)

Also check the 10 mf., 25 V. bias condenser in the 6F6 driver stage as this loses its capacity.

.... SPARTON 1068-78

Complaint: very noisy reception at times. The trouble was found to be in the I.F. coil marked No. 14442-3. By taking this coil out and resoldering all the wires to the coil terminals, then reassembling and rebalancing, the radio set operated OK.

.... ZENITH 12S-265

Set dead, and no screen-grid voltage on the 6K7G and 6L7G tubes. Replaced an open 11,000-ohm section in the Candohm resistor and the radio set was OK.

.... ZENITH 6S-152 (Chassis 5634)

The complaint was fading. I removed the set to the shop and checked it thoroughly. The set would operate all right in the shop, but when I took it to the customer's home it started to fade right away. Upon checking the customer's line voltage I found it to be unusually high.

When the radio set was taken to the shop again, and the line voltage stepped-up to the same voltage as at the customer's home, the receiver started to fade.

What actually happened was that the high voltage broke down the insulation between the high-voltage side of the Candohm resistor and the chassis, and this was not noticeable by visual inspection.

.... CROSLEY 6625 (SET USING 685 POWER TUBE)

Complaint: set lacks volume. I found all the plate voltages low. This was caused by a leaky 0.05-mf. coupling condenser from the type 76 tube to the grid of the 6B5.

.... WARD AIRLINE O. D. M. (10-TUBE SET)

If the complaint is: "set inoperative," check the 0.7-mf. condenser connected to

the last I.F. transformer, and bypassing the plate circuit of the 6K7 tube.

.... SPARTON 26-26

A complaint that the tone was poor, and that volume could not be reduced, was cured by replacing a shorted 0.2-mf. condenser connected in the grid circuit of the R.F. 35 tube. This condenser is mounted inside the copper R.F.-coil can.

.... PHILCO 60

Inoperation of this model Philco set was caused by a leaky 0.5-mf. condenser (No. 20 on diagram). This condenser bypasses the condenser plate resistor and is connected between two 70,000-ohm resistors.

.... GRUNOW 8B SETS

In the case of an inoperative set, check for a shorted 0.002-mf. condenser (No. 28717 in factory diagram) connected to the plate of the type 42 tube. For replacement use a 600-V. condenser.

Another complaint in this model Grunow receiver was that volume could not be reduced. This was caused by the 15-mf. condenser, which connects to the type 85 tube cathode, becoming open-circuited.

THOS. R. DISSINGER,
Chicago, Ill.

.... GLORITONE 99

When this receiver does not operate at the low-frequency end of the dial, look for a defective 3,000-ohm resistor or a 0.01-mf. condenser in the cathode circuit of the 1st-detector—oscillator circuit.

.... RCA 44

Should it ever be necessary to replace the plate detector choke, the one under the detector tube, make sure the small bolts do not protrude through so far as to make contact with the cathode prong. Otherwise this makes a direct ground and reduces the volume.

.... ZENITH 870

If it is impossible to get signals below 700 kc., yet they come in OK above, check for shorted or leaky 0.01-mf. 400-volt condenser in the oscillator plate circuit.

.... GRUNOW SUPER TELEDIAL (ANY MODEL)

When this set cuts-off and the trouble cannot be located, slip off the dial and check the reeds on the station stop. Careful inspection of the reeds and moving them with an insulated prod will show up the trouble as defective mica spacers. Replace with new ones.

.... SONORA A-11 SETS

When this small A.C.-D.C. set hums do not always suspect the filter as defective. This round or tubular filter is of the plug-in type and mounted on a regular octal base. The prongs on the socket often lose tension and soldering is the best permanent remedy.

Another type of recurrent fault in the Sonora A-11 is an intermittent noise and cutting-off of signals when tuning this set between 90 and 130 on the dial. The trouble is not in the tuning condenser but is caused by the plates (rotor) of the condenser rubbing against the tube shield of the 6D6 tube. To remedy, slip a small piece of mica under the tube base on the side next to the condenser so that the tube will tilt just enough to clear the metal plates of the condenser.

MARION L. RHODES,
Knightstown, Ind.



In high frequency work, electrolytic condensers are very satisfactory. Yes?.... No?....

Are standard glass tubes and metal tubes interchangeable? Yes?.... No?....

Are electron emissions due indirectly to impact by electrons or ions known as Secondary Emissions? Yes?.... No?....

Does shielding help to keep inter-electrode capacities at a minimum? Yes?.... No?....

Are the filaments of 1.4 volt battery tubes heated directly? Yes?.... No?....

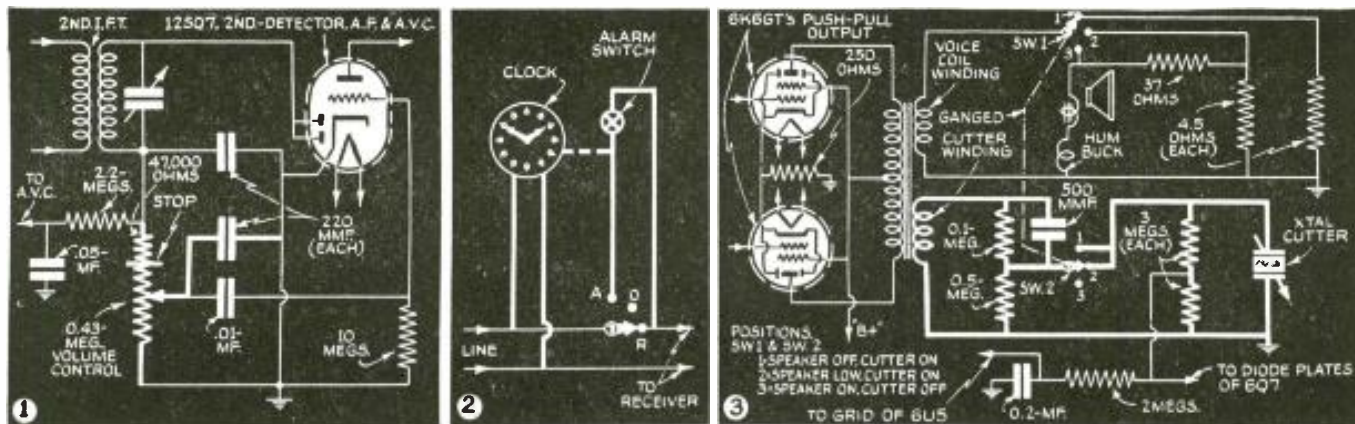
Does Sylvania produce as many as 17 different types of panel lamps? Yes?.... No?....

In converter tubes is low frequency drift desirable? Yes?.... No?....

IF YOU aren't positive of the answers to these and thousands of other questions about radio tubes and their application, the latest edition of the Sylvania Technical Manual has all the answers in useful, handy form. 272 pages of information including operating conditions, characteristics and circuit applications on 374 types of tubes. Write to Hygrade Sylvania Corp., Dept. RC90, Emporium, Pa., enclosing 35c for your copy of this great book today.

SYLVANIA

SET-TESTED RADIO TUBES



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. 36



(FIG. 1.) I.F. FILTER INCLUDED IN VOLUME CONTROL WITH STOP

RCA MODELS 45X111, 45X112, AND 45X113.—Elimination of a separate resistance unit and simplification of the circuit is achieved by making the I.F. filter resistance a part of the volume control.

The volume control for this purpose, as illustrated in Fig. 1, is similar in general to the antenna-bias type having a small minimum bias section beyond a stop. This one, however, is of high-resistance value with the usual left-hand taper. Its total value is ½-meg. but only 453,000 ohms (0.453-meg.) of this is actually used as the volume control, the other 47,000 ohms placed in series beyond a stop in the resistance coverage always remains in the circuit as the resistance element of the I.F. filter.

The output filter condenser of the I.F. filter is attached at the volume control slider so that when at maximum volume setting the filter acts exactly as the normal filter using a separate resistor. As the volume is decreased, however, resistance of the volume control is added to the I.F. filter making it even more effective than before. This method of connection also avoids an extra tap in the volume control resistance.

(FIG. 2.) AUTOMATIC SWITCH USES RADIO SET AS ALARM

KADETTE MODEL L-40.—The power switch of this receiver has 3 positions, namely, "off," "radio," and "alarm." The "off" and "radio" positions correspond to off-on positions in the usual way. In the alarm position, however, there is another line switch in series with the receiver line, operated by an electric clock.

The alarm consists of the radio receiver being placed in operation at a predetermined time within 10 hours of the time that it is set, with the volume control being preset to a local station for any desired volume. The receiver remains in operation 1½ hours unless turned off. One application of such an "automatic on" circuit is in awakening a person by turning on the radio set at any predetermined time.

(FIG. 3.) SEPARATE RECORD CUTTER SECONDARY ON RECORDER COMBINATION

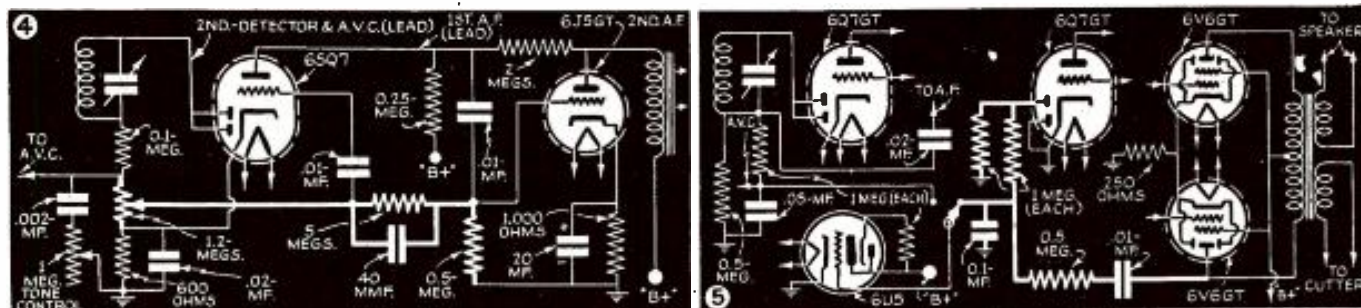
LAFAYETTE MODEL S53.—An additional output winding on the output transformer provides a higher impedance and higher voltage to properly drive a crystal cutter.

The ordinary voice coil of the usual receiver is not satisfactory even unloaded to drive a crystal cutter. For this purpose a medium high impedance winding (approximately 1,000 ohms) is placed on the transformer to drive the record cutter. Connection and values for the output and cutter circuits are shown in Fig. 3.

Since the cutter makes use of negligible power in comparison with the speaker, provision is made in the switching circuits to provide a load on the transformer approximately equal to that of the speaker whether or not the speaker is in actual use when the cutter is operating. The speaker may be switched off, or on very low output, when the record cutter is in use. The cutter circuit consists of an output resistance network and rectifier to show an indication of the output by a "tuning eye" or visual-indicator tube.

(FIG. 4.) INCREASED AUDIO BIAS FOR LARGE SIGNALS WITH DEGENERATION

TRUETONE MODEL D978.—A method of providing for larger signals by means of an increased grid range whereby a positive grid voltage is prevented and the negative grid range produces no distortion percentage increase is used in this circuit.



From the circuit in Fig. 4, it may be seen that the volume control carries the rectified I.F. D.C. component. From its slider through a 5-meg. resistor to the 2nd A.F. grid there is provided a D.C. circuit. Values of the 2nd A.F. grid network resistances show that the grid will obtain about 9% of the negative voltage on the volume control at the point where the slider rests. With a maximum D.C. across the volume control of 25 to 30 volts, the 2nd grid may be biased up to 2.25 or 2.7 volts negative in addition to its normally applied bias at maximum signal volume. While this added bias does not force the negative grid swings far enough to cause undue distortion, the normal bias is preferred for average volume reception.

Another important effect of this connection is that degeneration is introduced, which increases with the volume level. Degeneration may reach a factor of nearly 7% at maximum volume setting, with virtually no degeneration at minimum volume setting. This is provided by the division of the signal voltage on the 2nd A.F. grid by the 5-meg. resistor and the total A.C. impedance at the volume control slider contact. Degeneration, of course, has the effect of reducing volume and corresponds in A.F. circuits roughly in action with A.V.C. in high-frequency circuits.

(FIG. 5.) RECORDER OUTPUT INDICATED FROM POWER AMPLIFIER PLATE CIRCUIT

HOWARD MODEL 568R.—As the output voltage to the record cutter or speaker is proportional to the plate signal voltage at the output tube, this voltage may be used to indicate the proper voltage level for the record cutter. Moreover, the same "eye tube" (6U5) may be used for both tuning indication and record cutter level by means of a switch.

The circuit showing method of switching the 6U5 grid is shown in Fig. 5. The output signal at the output plate is attenuated by means of a resistance network before rectification so that it may fall within the range of the 6U5 grid voltage. Considerably less than maximum power output is needed for recording purposes.

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An item in *The New Yorker* mentions a radio-equipped, balloon-tired baby carriage which may be seen on nice days in the vicinity of the 80s, on the Park side of 5th Ave. (N.Y.C.) Is it the nurse or the baby who prefers the fare usually heard—WQXR's hi-fi offerings?

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0.1 TO 3000 D.C. VOLTS—covered by six overlapping ranges of 0/6/30/150/300/600/3000, 1000 ohms per volt standard sensitivity. Accuracy $\pm 2\%$ on all ranges except 3000 volt which is $\pm 3\%$.
0.1 VOLT TO 3000 A.C. VOLTS—covered by six overlapping ranges of 0/6/30/150/300/600/3000. Accuracy $\pm 3\%$. This guaranteed circuit is fully compensated for temperature variations so you are assured that you can use it in winter or summer with equal accuracy.
0.1 VOLT TO 3000 OUTPUT VOLTS—covered by

six overlapping ranges of 0/6/30/150/300/600/3000. No external condenser necessary. May be used with any signal generator for receiver alignment.
0.1 TO 600 MILLIAMPERES—covered by five overlapping ranges of 0/6/30/150/300/600. Uses wire wound shunts calibrated to $\pm 2\%$.
1 OHM TO 20 MEGOHMS—covered by five carefully selected ranges of 0/2000/20,000/200,000 ohms and 0/2 meg. /20 meg. Low range has center scale resistance of 25 ohms.
-10 TO +44 D.B.—covered by ranges of -10/+4/+18/+34/+38/+44 calibrated to read D.B. directly on any 500 ohm line. Simple conversion chart is supplied so that readings may be taken on any line of known impedance.
0.005 TO 20 MICROFARADS—covered by three ranges of 0/2/2/20 mfd. Capacity values read directly on meter scale.
 Model 547 incorporates a large 7" illuminated meter which allows accurate reading with minimum eye strain. Call at your parts jobbers and it will take you only a minute to see the difference between the Model 547 and other types of multimeters.
 The Model 547 is also available in a beautiful Oak carrying case, as illustrated. \$38.50 cash or \$4.00 cash and 9 monthly payments of \$4.02.



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PHILCO MODEL 39-116 (Code 121) "MYSTERY CONTROL" SUPERHET.

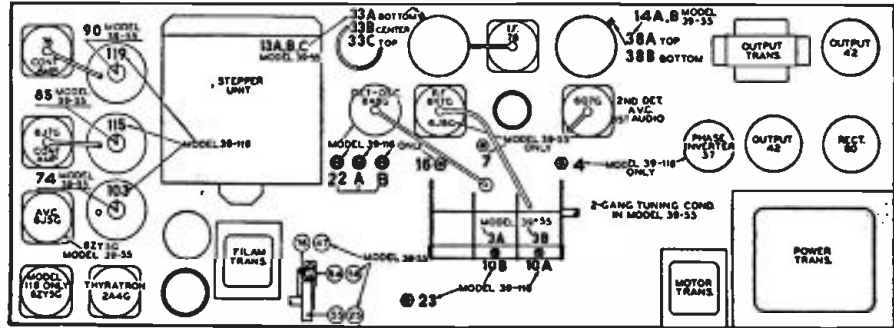
A 14-Tube Broadcast and Shortwave Set (Range, 540-1,720 kc., 1.7-5.8 mc., and 5.8-18 mc.); Remote Tuning, Volume and Off-On Control via "Mystery Control"; Audio Output, 10 Watts; A.V.C.; Continuously-Variable Tone Control; Negative Feedback.

See Data Sheet No. 285 for schematic circuit.

Keep the aerial lead-in away from the horizontal inductor coil located in the bottom of the cabinet. Run the aerial lead-in directly to the "Ant" terminal post on the back of the receiver; do not coil up excess and drop it in back of cabinet.

ALIGNMENT PROCEDURE

Connect an output meter to the plate terminals of the type 42 tubes and adjust for the 0 to 30 V. A.C. scale. Now adjust the compensators (see table below); their locations are in diagram at right. Adjust strength of signal generator to keep output meter needle on-scale.



Locations of compensators.

NOTES: (These pertain to the tabulation below.)

NOTE A. Connect the "Dummy Antenna" (condensers) in series with the signal generator output lead (high side). Use the specified capacities.

NOTE B. Dial Calibration: In order to track the receiver dial with the tuning condensers, proceed as follows: With the tuning condenser closed (max. capacity), set the dial pointer on the extreme left index line at the low-frequency end of the broadcast scale.

NOTE C. See data on Control Frequency Amplifier adjustments.

SIGNAL GENERATOR			RECR.†	
Opera- tion	Dummy Antenna (Note A) Kc.	Dial Settings Kc. (*Mc.)	Adjust Compensators	
1	0.1-mf.	470	580	38A, 38B
2	0.1-mf.	470	580	33C, 33A 33B, 38B
3	150 mmf.	1550	1550	22, 10B 10A
4	150 mmf.	580	580	23
5	150 mmf.	1550	1550	22
6	400 ohms	5.0*	5.0*	22A
7	400 ohms	18.0*	18.0*	22B, 16, 4

†Receiver control settings, operations 1 to 5, incl. Range Switch on Broadcast: 6, on Short Wave; 7, on Police.

Output connections to receiver: operation 1, 78 grid; 2, 6A8 grid; 3 to 7, incl., antenna and ground. Special instructions: operation 1, turn out 33B full; operation 2, note B; operation 4, roll gang; operation 7, see Note C, above table. Set Volume Control at Max. for all operations.

ADJUSTING CONTROL FREQUENCY AMPLIFIER

The Mystery Control receivers are shipped with 5 different control frequencies which range from 350 to 400 kc. These are identified by code numbers appearing on the serial number ticket and on the rear of the chassis, as follows: Code 5, 355 kc.; Code 6, 367 kc.; Code 7, 375 kc.; Code 8, 383 kc.; Code 9, 395 kc.

The purpose of the different control frequencies is to prevent interaction between 2 Mystery Control receivers which are on the same floor or are exceptionally close together. When several Mystery Control receivers are to be located close together, use different control frequencies, 20 kc. apart, to avoid interaction between the receivers.

If 3 receivers are to be operated at the same time and are closely situated, it will be advisable to adjust the control frequency of the 1st set to 355 kc., the 2nd set to 375 kc. and the 3rd to 395 kc.

When realigning or changing the control frequency of the Mystery Control circuit, a signal generator with a coil of wire (about 4 or 5 turns—12 ins. in dia.) attached to the output terminals is required. The leads between the coil of wire

and signal generator should be sufficiently long to permit the coil to be placed near the large secondary inductor in the bottom of the receiver cabinet.

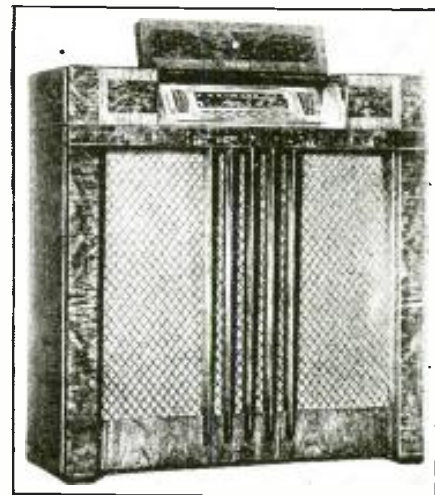
With this apparatus, the Control Frequency is adjusted as follows:

(1) With the temporary coil of wire in the center of (or near) the secondary inductor, the control frequency to which the Mystery Control Amplifier is tuned can be determined by tuning the signal generator between 350 and 400 kc. When the signal generator is tuned to the control frequency, the Thyratron (2A4G) tube will glow (blue haze). If this frequency is to be used, leave the signal generator indicator at this point or turn the indicator to any other frequency desired between 350 and 400 kc.

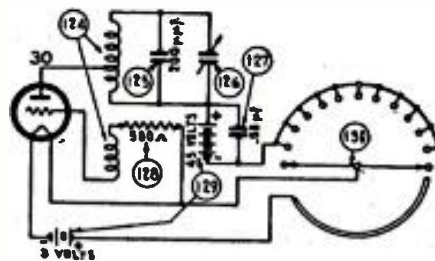
(2) When the control frequency is selected, turn the sensitivity control (117) located on the left rear of the chassis—towards the position marked "extreme." Using the 2A4G Thyratron tube as a resonance indicator, adjust padders (103), (115), (119) for maximum signal (indicated by the brilliance of the 2A4G's glow). As the padders are adjusted, gradually turn the sensitivity control to the "near" position or reduce the output from the signal generator. When the padders are correctly adjusted to maximum, the Thyratron will glow with the sensitivity control (117) at the "near" position and with a very weak signal from the signal generator.

(3) Next, adjust the padding condenser (121; cardboard encased, in one corner of the sec. inductor) on the secondary inductor located in the bottom of the receiver. Carefully adjust for maximum glow in the 2A4G tube with weakest signal from signal generator. Also, have the sensitivity control as close as possible to the "near" position. Extreme care should be used in adjusting the padder to the exact point of resonance, as the secondary inductor is a very sharply-tuned circuit. After adjusting the circuit, remove the signal generator and loop from the receiver.

(4) The Mystery Control unit is now adjusted as follows:



Philco 39-116, Code 121, 14-tube superhet.



Circuit of Mystery Control unit.

A.—Dial any one of the stations indicated on the remote unit by pulling the selector to the "Stop" position. Then, as the dial is released at the "Stop," press the "Stop" down and hold it in this position.

B.—Holding the "Stop" in this position, bring the Mystery Control unit close to the receiver. Using the padding wrench, tune the padding screw (126) located on the bottom of the unit until the 2A4G Thyratron in the receiver glows at full brilliance.

Now, turn the sensitivity control on the receiver towards the "near" position until a point is reached where the 2A4G tube almost stops glowing. Then, readjust the padder (126) of the unit again for maximum brilliance in the 2A4G tube. The Mystery Control unit should now be adjusted to the same frequency as the control frequency in the receiver.

SERVICING F.M. RECEIVERS

The author presents his conclusions as to why a wobbled oscillator and a cathode-ray oscilloscope are not essential in servicing frequency modulation receivers; and how comparatively standard servicing instruments may be used to test and align F.M. sets.

E. T. HIGGONS



Illustrated here are representative, Weston precision instruments suitable for efficient testing and alignment of frequency modulation receivers. They are identified as follows: A, model 776 oscillator; B, model 787 high-frequency oscillator; C, model 669 V.-T. voltmeter.

DURING the next year thousands of people throughout the country are going to avail themselves of the many benefits of frequency-modulated transmission by purchasing new receivers. Those F.M. receivers will have to be installed and maintained by qualified Servicemen. This will definitely mean increased business and profit to all actively engaged in the radio field.

Most Servicemen already realize that their present test equipment will not adequately take care of the requirements of F.M., but there is much confusion and difference of opinion regarding the equipment which will be required. Most of this confusion is due to the fact that few people have had any actual experience with F.M. receivers in order to really know the requirements.

The majority of the present worries have been based upon the problems arising from the wide band of transmissions. Experience will soon show that the band-width is the least of the worries, although it does enter into the picture somewhat. The biggest problem is to get test equipment which will function at all at 40 to 50 megacycles!

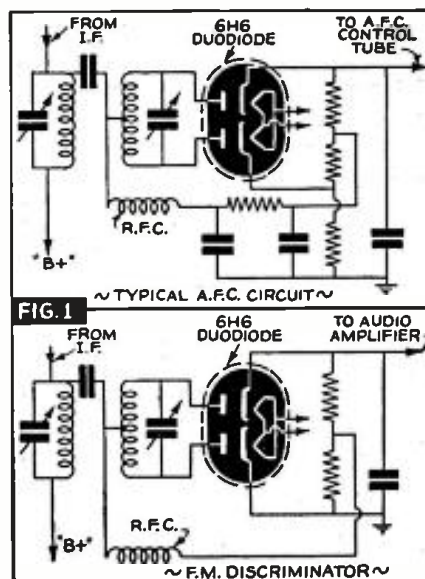
In order to simplify an understanding of the major factors in servicing F.M. radio receivers and adapters the following description is divided into 5 sections identified as follows: (A) I.F. alignment; (B) discriminator adjustments; (C) R.F., detector and oscillator adjustments; (D) locating receiver troubles; and, (E) testing tubes.

TEST UNIT NO. 1:

I.F. SERVICE OSCILLATOR

A.—In aligning F.M. receivers there is no way of controlling the band-width. That has been left entirely to the manufacturer.

The Serviceman cannot possibly change the coupling between the coils on intermediate frequency transformers and expect any degree of success. In actual practice all I.F. adjustments are made for peak performance at the intermediate frequency which usually lies between 1 and 5 megacycles, depending upon the individual manufacturer. The transformers cannot be stagger-tuned in an attempt to broaden the band-pass characteristics. Any attempt in that direction will result in all kinds of distortion. The most important point in connection with the I.F.



alignment is that all adjustments be made at exactly the same frequency. This requires, therefore, a service oscillator which is free from drift at 1 to 5 megacycles. There is one such oscillator available, designed with a negative feed-back circuit which is referred to as *automatic amplitude control*. This results in remarkable stability at the required frequencies.

TEST UNIT NO. 2:

U.-H.F. SERVICE OSCILLATOR

B.—The only other circuit in F.M. receivers which is particularly annoying to the Servicemen at present is the discriminator circuit. However, if we analyze this portion of the receiver very carefully it will soon be seen that this is exactly the same as similar circuits which were used for automatic frequency control in A.M. receivers. See Fig. 1. The adjustment of these circuits is exactly the same as shown.

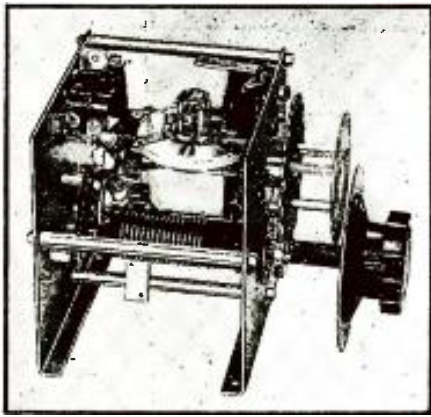
C.—The last adjustment required in the new type of equipment is that of the R.F., detector and oscillator circuit. These adjustments must be carried out using a service oscillator which is capable of accurate tuning at between 40 and 50 megacycles. Such equipment is extremely rare at the present. Any attempt to use harmonics of lower frequencies will be very annoying and confusing. Furthermore, it will be impossible to check the band-width characteristics of the receiver as is often desired. An oscillator using inductive tuning capable of operation from 30 to 150 megacycles is particularly suitable as its tuning characteristics at F.M. frequencies is better than anything else now available. On this unit one division of the dial at 40 megacycles represents only 40 kilocycles, making it convenient to tune through the desired band of 100 to 150 kilocycles.

At the present stage of affairs there has been an expression on the part of some people of the desire for a service oscillator, capable of being 100-kc. F.M. wobbled; to be used in conjunction with an oscilloscope. If such equipment were available it would serve to very little advantage as all adjustments would still have to be made for peak response. The oscilloscope would function as nothing more than a visual type of voltmeter. The various I.F. transformers could not be adjusted any more accurately or quickly with such a setup.

TEST UNIT NO. 3:

V.-T. VOLTMETER

D.—In locating the troubles in F.M. receivers, it will once again be necessary to resort to fundamental test equipment such as 20,000 ohms/volt analyzers, vacuum-tube voltmeters, etc. Due to the frequency of operation the many types of so-called signal tracers will be of doubtful assistance as they have all been designed for operation at the present A.M. broadcast frequencies. The most logical instrument for localizing receiver troubles in F.M. equipment will be a vacuum-tube voltmeter capable of measuring the A.C. signal voltages at from 1 to 50



Chassis of the Weston model 787 oscillator tuner, assembled.

megacycles. There are a few such voltmeters which have been available for some time.

E.—The testing of tubes in F.M. equipment will present quite a problem, as many tubes capable of satisfactory operation at the lower frequencies will fail completely at the F.M. frequencies. Tubes such as the 1852 and 1853 must be used in order to obtain sufficient gain at high frequencies. Those tubes have very small elements closely spaced, and are much more susceptible to leakage and shorts than the other, more common types. Experience has also proven that no commercial tube tester will satisfactorily indicate the quality of a tube which is to be used as an oscillator at 50 megacycles.

Because of the fact that very little work has previously been done at these higher frequencies, it is perfectly safe to prophesy many new and radically different types of tubes during the coming few years. The tube checker picture, therefore, is the only uncertainty in the consideration of suitable test equipment for F.M.

It is hoped that in the excitement and rush resulting from the widening of activity in F.M. the Serviceman will keep his head in the selection of equipment. Do not be too anxious to jump at the purchase of equipment which is represented to be a cure-all.

Above all do not let any one give you the idea that there is anything tricky or complex about F.M. receivers. When it comes

WHY DIDN'T SOMEONE TELL JEREMIAH SMUDGE ABOUT ATOMS?

UP until yesterday, Jeremiah Smudge was a radio serviceman. Now he's working for the WPA.

The trouble is that Jeremiah is a wee bit old-fashioned.

He drives a Model T Ford on which everything makes a noise but the horn, uses a mustache cup and still thinks the Philadelphia Athletics have a chance for the American League pennant. He runs—we mean *ran*—his service business just about the same way. Take condenser replacements for instance:

Jeremiah spent weeks and lost half a dozen good customers waiting for exact duplicate replacements to arrive.

No one ever told him that he could get a couple of Sprague Atoms (midget tubular dries) from his jobber, strap 'em together and make up almost any "duplicate" he'd ever heard of—in smaller size and actually at less cost.

Plenty of times Jeremiah lost his temper trying to fit an old-style condenser into a midget set—then lost the customer, too, when the repair bill ran almost as much as the set was worth.

No one ever told him that Sprague Atoms are no bigger than his little finger, reliable as the North Star, and cost but a fraction of the price of larger types.

Jeremiah wore out eight tires and the seats of six pairs of pants riding down to the jobber to buy a condenser every time he needed one.

No one ever told him he could save money buying Atoms in handy kits—and that a

kit or two would enable him to handle 80% of all dry electrolytic replacements—in less time than it took him to crank his fliwer.

Jeremiah did go modern—once. He tried a midget condenser of some other make. It exploded like a firecracker, scared Jeremiah so badly he swallowed his chewing tobacco, then decided once and for all he'd never try any more new-fangled ideas.

No one ever told him that Sprague Atoms are positively guaranteed against blow-ups, and have been ever since they were introduced.

Last but not least, Jeremiah was always complaining about price-cutting competition. He even wrote his Congressman about it. However, the Congressman didn't tell him that maybe these fellows weren't cutting repair prices at all—

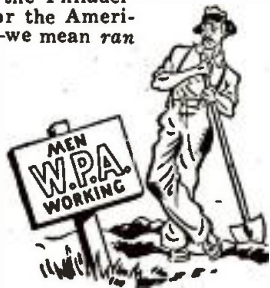
that they were probably using Atoms and other parts which enable them to do good work for less money and still make a nice profit doing it.

Get the idea?

Of course you do! The fact is Sprague Atoms are just as far ahead of old-style condensers as those sleek, speedy automobiles of today are ahead of Jeremiah's Model T.

Use Atoms universally—regardless of the size of the unit they replace. They'll save you time—money—space. They're made in all capacities—all voltages—and many popular dual combinations. Catalog free.

Sprague Products Company
North Adams, Massachusetts



right down to reality the circuits and component parts which are used are no different than those already familiar to everyone. The real issue is the operating frequency of 40 megacycles, and the only problem is to get equipment which is designed carefully and accurately enough to reliably operate at that frequency of 50 megacycles. Fifty megacycles is no place for 5 & 10c store parts, and poor design.

RIGS UP P.A. CAR

Dear Editor:

ENCLOSED you will find a snapshot (reproduced here—Ed.) of my effort to get things going in the Public Address business in connection with my electrical work. Although it is against the law here to drive around the city with the speakers in operation, I quite often drive around the parks and put on a musical program, or a baseball match brought in by the car-radio set. I have a gas generator in the trunk to operate the complete system, which at the present time is just a 25-watt manufactured job. The speakers are 10-in., 15-watt P.M. units.

MAX MARTIN,
Ottawa, Ontario, Can.

Concluding his letter, Mr. Martin mentions that he expects to put to good use in future civic elections the well-earned power amplifier he won as 5th prize in Radio-Craft's Public Address Contest.

SORRY!

Due to unforeseen circumstances, several articles scheduled for this issue of Radio-Craft will appear in the next issue, instead. We refer to "Modern Microphone Technique," "Interference and the Ground," "A Model Service Shop," and "Analyzing the Electronic Violin."



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READRITE METER WORKS, Bluffton, Ohio

Which Antenna? —

OUTDOOR, LOOP or LIGHTLINE — for Least Noise?

Comparative factors in the selection and use of tuned loops, of ordinary outdoor antennas, and of noise-reducing outdoor antenna systems are graphically analyzed with respect to their ability to afford noise-free radio reception.

JULIUS G. ACEVES

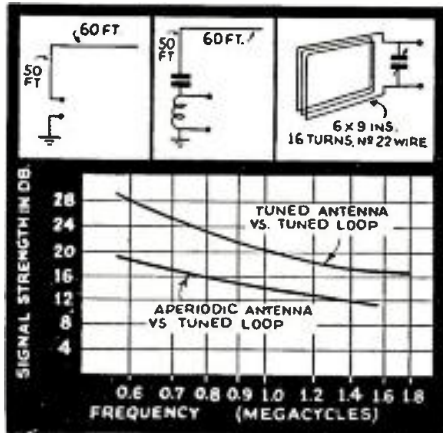


Fig. 1. Signal strength of tuned and untuned antennas compared with a tuned loop.

Do you know that a good noise-reducing outdoor antenna can step up the noise - signal energy ratio of average radio reception by something like 1,000 times? This is no mere advertising claim, no loose talk, no wishful thinking; it's just plain engineering fact, of which radio Servicemen should take greater advantage.

Or to put it another way, if you were listening to a nice philharmonic orchestra program, you could soften the background noise from an annoying *forte* down to a mere *piano*, for \$10 or less retail, by means of a good Noise-Reducing Antenna System.

Of course these advantages have little significance for the owner of a midget receiver costing \$10 or less. Such facts are economically out of step with bargain-basement radio reception. But when it comes to a quality console or table-model receiver whose owner is not scared off by the mention of a few dollars extra to attain superlative results, the noise-reducing antenna can at least be granted a fair trial.

COMPARATIVE EFFICIENCIES

The main point is to be sure you are dealing with a genuine noise-reducing antenna system. That's the catch. Frankly speaking,

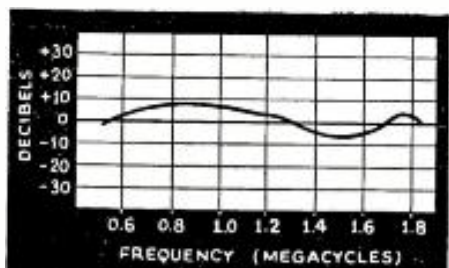


Fig. 2. Comparison of relative signal strength received from a noise-reducing system vs. conventional antenna of same dimensions.

there have been too many "phonies" in this noise-reducing antenna game. However, a short engineering analysis of this situation will reveal more to the average technical reader than would pages of generalizations; so let us look further into this matter of loop, outdoor and noise-reducing antennas.

The graph of Fig. 1 shows a typical instance of relative signal levels from a tuned loop vs. ordinary outdoor antenna of the tuned and untuned types. Figure 2 shows the relative signal levels from a noise-reducing outdoor antenna (an outdoor antenna, equipped with noise-reducing units) vs. an ordinary outdoor antenna (that is, the same antenna without the noise-reducing units and with an open download).

From these graphs the superiority of the antenna over the loop for signal strength alone is established in these particular examples by inspection of Fig. 1. The superiority of the signal strength of the antenna equipped with noise-reducing units and transmission line over the conventional type, of the same dimensions, is apparent from Fig. 2.

The signal-level difference, A, the noise-level difference, B, and combined effect—signal-to-noise logarithmic ratio, C, for a certain antenna kit on the market, as compared to an open-type antenna-and-downlead of the same dimensions, are illustrated in Fig. 3.

Thus there is no substitute for the noise-reducing outdoor antenna, where performance rather than price of installation and convenience, is the prime consideration. To be sure, the loop and the built-in or light-line antenna are fully justified in the portable receiver or the midget taken from room to room, or used in a temporary location such as school dormitory, hospital, hotel, summer resort—fully justified from the standpoints of convenience and cost. No one is going to spend a few extra dollars for an antenna installation, when the set doesn't cost much more.

But with better and still better programs on the air, and with the rising competition of ultra-high-frequency reception to show up the shortcomings of our present-type reception, Servicemen should capitalize the fact that the owner of a quality receiver is interested in doing what must be done to work that receiver to the utmost in tone, volume, and distance, which means the minimizing of interference and background noises.

LOOP ANTENNAS

There's nothing new about loops as signal interceptors. Call them by any fancy name you will, they are still loops. Using Faraday shields certainly cuts down electrostatic pick-up and concentrates on electromagnetic, which can be made quite directional. If the set is used in a location where there is very little interference, the loop may be

orientated against the noise source so as to reduce it to a minimum without materially affecting the signal, if it does not come from the same direction. If the signal comes from a nearby broadcast station or with plenty of strength, loop reception can be quite ideal. But if the field strength of the desired program is weak, and if the set is surrounded by interference or man-made static usually encountered in city apartments from a multitude of sparking appliances in and out of the building, the loop is simply seeped in interference and cannot provide satisfactory reception.

The signal pick-up with a straight wire antenna, even indoors, is better than that with a loop. However, if this interceptor too is seeped in a zone of interference, and if the field strength of the desired station is weak, then this interceptor too is unsatisfactory.

NOISE-REDUCTION IN BRIEF

The purpose of a noise-reducing system is simple enough. It serves to preserve or increase the signal strength, and reduce all interference. This is done by (1) elevating the aerial high above the zone of interference, so as to obtain maximum signal strength with a minimum of parasitic noises; and (2) by conveying the intercepted signals through special circuits and a transmission line which neutralize any interference picked-up down to the receiver, or injected into this system from power line connections. The genuine noise-reducing antenna system does just that.

So much for the technical side which may well be passed on to Mr. John Q. Public who is becoming still more interested in really good radio reception from his set whether old or new. But there is the business side as well to be considered.

To the jobber, dealer, Serviceman, the noise-reducing outdoor antenna is an important source of income.

This article has been prepared from data supplied by courtesy of Amy, Aceves & King, Inc.

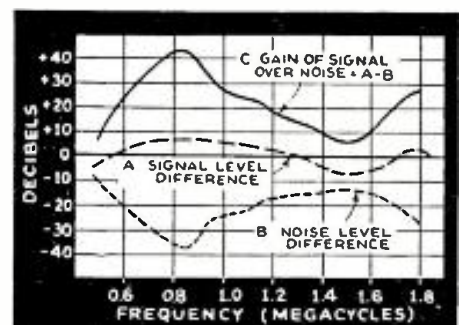
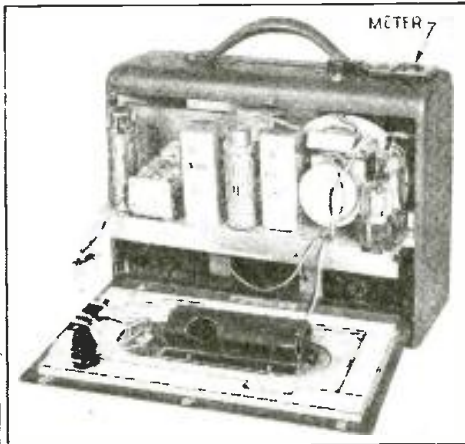


Fig. 3. Comparison of performance of a noise-reducing system with conventional antenna of same dimensions.



Exterior and interior views of the Sprague model IL-1 Interference Locator. The built-in loop antenna, mounted on back cover as shown in photo at right, may be supplemented by a rod antenna (see diagram, below).

One of the newest additions to the growing list of test instruments for Servicemen is the Interference Locator here illustrated and described. It makes short work of tracking noise to its lair; applying corrective measures is then the concluding, profitable step.

LATEST INTERFERENCE LOCATOR

SERVICE calls where the complaint is "noisy reception" may be made profitable for the Serviceman if he is equipped with the knowledge and facilities which can enable him to locate and correct the most obstreperous interference conditions in minimum time. If, however, only cut and try methods are used, then necessarily such calls must be anything but profitable.

When your tests show that the noise source is not in the customer's home, and the use of a noise-reducing antenna unit proves inadequate, then the defective device must be isolated by means of an "interference locator."

A portable receiver especially designed, with the necessary auxiliary antenna, and output measuring devices may be employed. A portable superheterodyne is preferred. The receiver must be well shielded.

PROFESSIONAL "NOISE LOCATOR"

The Sprague Interference Locator is ideally constructed for this service. This Locator consists of a specially-designed, highly-sensitive superheterodyne R.F. amplifier, and an A.F. amplifier, combined with loudspeaker, and headphone output, 2 spe-

cial antenna systems, a highly directional loop, and a telescoping pole antenna. Output meter and calibrated volume control are included for checking interference levels. The battery supply is self-contained and gives 150 hours of continuous service. This Locator tunes over the frequency range of 500 to 1,600 kc.

The gain control is calibrated to give reference settings for comparison of volume levels. Operation of the Locator while tracing interference or during reception of strong radio signals, does not require the full output of the Locator amplifiers. The output can be easily reduced by switching the Economizer Switch to its LOW position. This materially increases the life of the batteries.

The loudspeaker is for double checking of the interference noise and for the reception of radio signals.

The output meter allows a quantitative measure of the interference level and gives a visual indication of interference reduction as various corrective means are applied to the noise source. Headphones may be used in audibly noisy locations where mechanical noises mask the loudspeaker output.

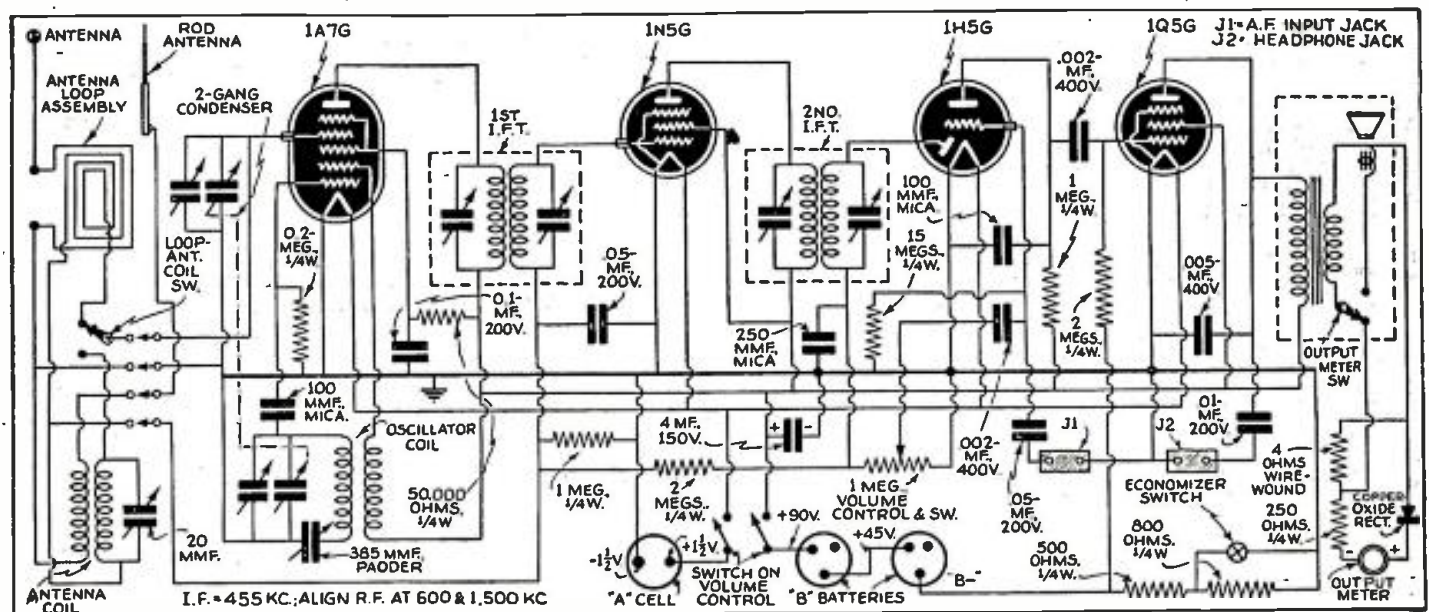
In some cases electrical devices which cause radio-frequency interference set up a very strong audio-frequency interference field for a very short distance immediately surrounding their location. This is sometimes true of faults in line insulators, pole hardware, etc. An A.F. pick-up means is of great value in these cases as it allows sharp isolation of a particular interfering device among a closely associated group of apparatus; for example, a particular pole or insulator on a powerline to which R.F. interference has been traced.

The A.F. input jacks are provided for connection of a search coil and extension leads for use in this type of work.

A loop-pole antenna selective switch (L.P.A.) allows the highly-directional internal loop, or the non-directional telescoping pole antenna mounted on the end of the case, to be used at will.

DIRECTIONAL INTERFERENCE-TRACING METHOD

In checking interference being received by a radio set, it is sometimes desired to determine whether the noise is being caused by faulty antenna or ground connections, or to determine definitely whether the noise



Both R.F. and A.F. interference can be picked-up with the Interference Locator diagrammed above. A battery "economizer" switch considerably extends battery life in areas of high signal intensity.

DYNAMIC DEMONSTRATOR

RCA Test Equipment Licks Service Problems Faster — More Profitably

Over 335 million RCA Radio Tubes have been purchased by radio users. In tubes, as in parts and test equipment, it pays to go RCA ALL THE WAY.



See exhibit of all RCA services including Television at RCA Building, New York World's Fair—and Golden Gate Exposition, San Francisco.

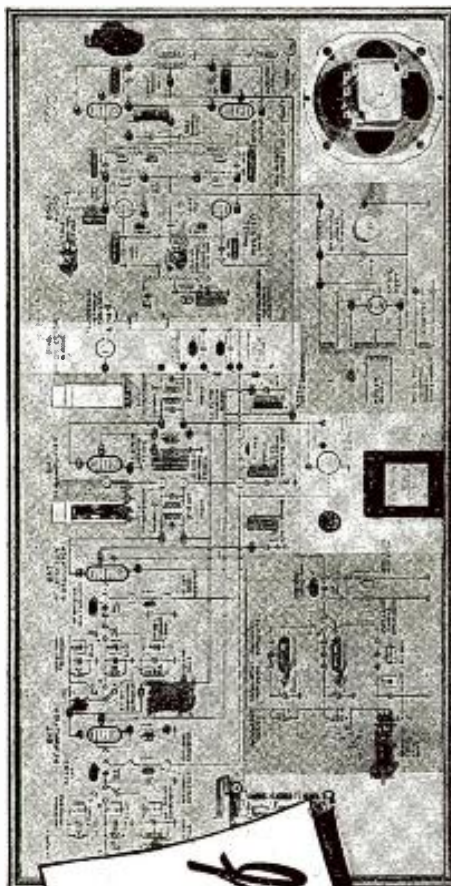
Test Equipment

RCA Manufacturing Co., Inc., Camden, N. J.
A Service of the Radio Corporation of America

Are you in doubt about which test equipment—and which testing methods—are best? See the RCA Dynamic Demonstrator!

It's a radio set turned "inside-out"—designed so you can readily duplicate any type of circuit defect. All the parts of a typical modern super-heterodyne are shown, together with their wiring scheme.

See the Dynamic Demonstrator at your RCA Distributor's....ask for on-the-circuit proof of the superiority of RCA Test Equipment.



is being received by the antenna-ground system. This can easily be checked by connecting the antenna and ground to the "A-G" terminals on the back of the Locator and listening to the instrument's output. When these connections are used, the unit's antenna switch should be placed in the POLE ANTENNA position, and the pole antenna completely collapsed.

The directional loop antenna is used to obtain the direction of arrival of radio signals. When the locator is rotated, a position of maximum signal intensity is obtained, and in this position the direction of arrival of the signal is along a fine line, drawn lengthwise through the handle on the top of the locator. Walking backward and forward with the Locator along this line will indicate exactly where the signal is coming from. The direction of arrival of signals can also be taken at

points spaced about 200 feet apart, and the direction lines followed to their intersection, which will give the approximate location of the signal source.

"HOT-COLD" INTERFERENCE-TRACING METHOD

The pole antenna is used principally in the "hot and cold" method of tracing interference; for example: If interference is being received on the Locator on the 3rd floor of a building, switch the pole antenna in the circuit and tilt the Locator to bring the pole antenna into a horizontal position. If the interference level increases, it is almost certain that the source of interference is below the 3rd floor; perhaps in the basement. If the interference does not increase on tilting, then the source is on the same level or above, or else is coming from outside the building, altogether.

SERVICING QUESTIONS & ANSWERS

LONG WARMING-UP PERIOD

(168) Lawrence Mitling, Watson, Minn.
(Q.) I have a Sentinel battery radio receiver model 39B which puzzles me. The complaint is that considerable time elapses from the time the set is turned on until it operates normally. The time required is 1 minute during the day while at night 2 to 3 minutes are required. The radio set works OK from then on. The set has been that way for a year's time. Tubes, all of which test OK, are as follows: 1—1C6, 2—30's, 2—34's, and 1—19.

(A.) You state that considerable time elapses before your Sentinel battery receiver operates normally, but no mention is made of the manner in which the receiver behaves during this period. However, we believe one of the type 34 tubes has developed a poor weld, resulting in the condition described. Check operation with a new pair of type 34 tubes.

screen-grid tubes (G24) and 1 variable-mu screen-grid power detector tube (G24), together with 2—G-45 power amplifier tubes in push-pull and 1—G-80 rectifier.

Trouble is experienced with the volume. This set will play satisfactorily for about 5 minutes and then suddenly increase in volume. After resetting the volume control, it will continue to play all right for another few minutes and then drop in volume until it is barely audible.

All tubes have been checked and found OK. Voltages appear OK. Have tried changing volume control but to no avail.

Would appreciate your opinion as to what the trouble is, and the proper procedure for locating same.

(A.) The symptoms of fading and weak reception are commonly caused by open-circuiting or leaky 0.04-mf., 1st R.F., 2nd R.F. and detector secondary-return bypass condensers. Replace these units with others having moisture-proof (impregnated) qualities, and possessing good internal contact.

Leaky screen-grid and cathode bypass condensers may also produce a similar condition. We suggest a check by substitution.

WANTS ALIGNMENT DATA

(169) G. A. Dey, London, Ont., Canada.
(Q.) Will you please advise the correct procedure for aligning a Chevrolet auto-radio set No. 985252. I have no data re schematic diagram, I.F., or otherwise and would appreciate as much information as possible. Would also like your opinion as to whether a whip antenna about 36 ins. long should be good enough for this radio.

(A.) The intermediate frequency employed in the Chevrolet auto-radio receiver No. 985252 is 262 kc. Align the I.F. transformers to this frequency for maximum output using a signal generator coupled to the control-grid of the 6A7 through a 0.01-mf. condenser. Keep the receiver volume control full and use as little generator signal as possible. Set the receiver dial to 1,400 kc. and adjust the R.F., 1st-detector, and oscillator trimmers for maximum output.

The whip antenna mentioned is satisfactory.

SET SMOKES!

(171) Steve Semelsberger, Hastings, Pa.
(Q.) I have a Grunow model 1191 for repair. This set is inoperative. Smoke comes from it in a few seconds after being turned on. Several resistors get too hot. The set had been operated with the ground wire on Ant. post. Could you give any clue to the possible trouble?

(A.) As you gave no symptoms other than non-operation, smoke from the set, and hot resistors, it is rather difficult to advise as to the exact trouble.

Suggest you check the bypass condenser on the R.F. plus supply marked No. 28726 and the electrolytic condenser marked No. 36721.

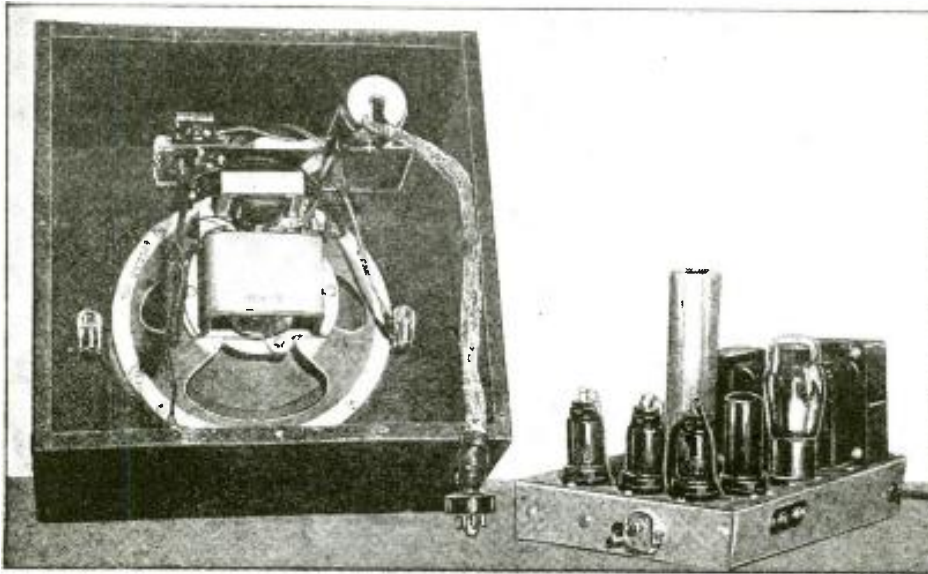
The bypass unit No. 29135 on the screen-grid supply may also be shorted. Check the screen-grid series resistor which should be approximately 14,000 ohms.

Check bypass units on A.V.C. circuit for shorts which would lower bias and cause tube to draw more current. This also applies to the A.F. tubes, the output (6F6) tubes in particular. The high-frequency bypass condensers on the plates of 6F6 tubes sometimes break down.

UNSTABLE VOLUME

(170) R. G. Hammond, Sunnyside, L. I., N. Y.

(Q.) The writer has a model 130A Majestic radio set employing 3 variable-mu



▲ Above, front view of the Practical Signal Tracer.

◀ The rear view (left) of Mr. Freedman's test instrument shows the simplicity of its construction. Buzzer is on top shelf, at left of "eye" tube.

How to Make a Simplified

PRACTICAL SIGNAL TRACER

An instructor of radio in one of New York City's vocational high schools tells how to make and use a test instrument he has devised to rapidly solve daily problems in radio trouble-shooting. Resistance-capacity coupled semi-aperiodic R.F. and A.F. amplifiers entirely eliminate tuning and alignment problems! A buzzer provides receiver test signals; the tester's "eye" tube or the equipment under test (ordinarily via its own loudspeaker) provides the indication.

MONROE M. FREEDMAN

What it does:

This instrument checks:

Antennas
Signal Strength of Stations
Radio-Frequency Coils and Circuits
Oscillator Coils and Circuits
Intermediate-Frequency Coils and Circuits
A.V.C. and A.F.C. Circuits
Oscillator Drift
Bypass Condensers
Shorted Trimmers
Opens and Shorts R.F. Circuits
Oscillator Voltage
Internal Noise
R.F. Distortion
R.F. Oscillation
Detector Stages

Resistance-, Impedance-, Transformer- and Direct-Coupled Audio-Frequency Amplifiers.
Bass-Compensation Circuits
Phase-Inverter Circuits
Inverse Feedback Circuits
Audio-Frequency Coupling Condensers
Audio-Frequency Volume and Tone Controls
Push-Pull Circuits
Bypass Condensers
Input and Output A.F. Transformers
Opens and Shorts in A.F. Circuits
A.F. Distortion
A.F. Oscillation
Intercommunicators
P.A. Systems

Sound Recorders
Phonograph Circuits
Earphone Circuits

Power Supply Analysis
Hum
Noisy Voltage Dividers
Vibrator Hash
Open or Shorted Condensers

Miscellaneous Uses

Checking Tubes
Checking High- and Low-Impedance Pickups and Microphones
As Output Indicator
As Simple V.-T.Vm. (using "eye" tube)

SIGNAL tracing with this writer was developed out of necessity. As an instructor of radio in one of the New York City vocational high schools, a daily problem had arisen in "trouble-shooting" various types of A.C.-D.C., A.C., tuned-radio-frequency and superheterodyne receivers, and public address systems, that were being constructed in our radio course.

Just imagine the problem of trouble-shooting dozens of "supers." within the short duration of a couple of school periods. Think of the various mistakes, that could be made by youngsters varying in age between 14 and 17 in wiring automatic volume control, oscillator, mixer, phase-inverter and intermediate frequency circuits, with parts obtained on the "bargain counter" at New

York's several large radio supply companies.

This led to the development of the simplified Practical Signal Tracer described below. This signal tracer has *no tuning controls, no multitude of probes, no system of constantly observing "tuning eyes" for each and every test, no need for adjustment of numerous controls* on each probing; and, best of all, may be constructed from odds and ends that any radio mechanic probably has kicking around.

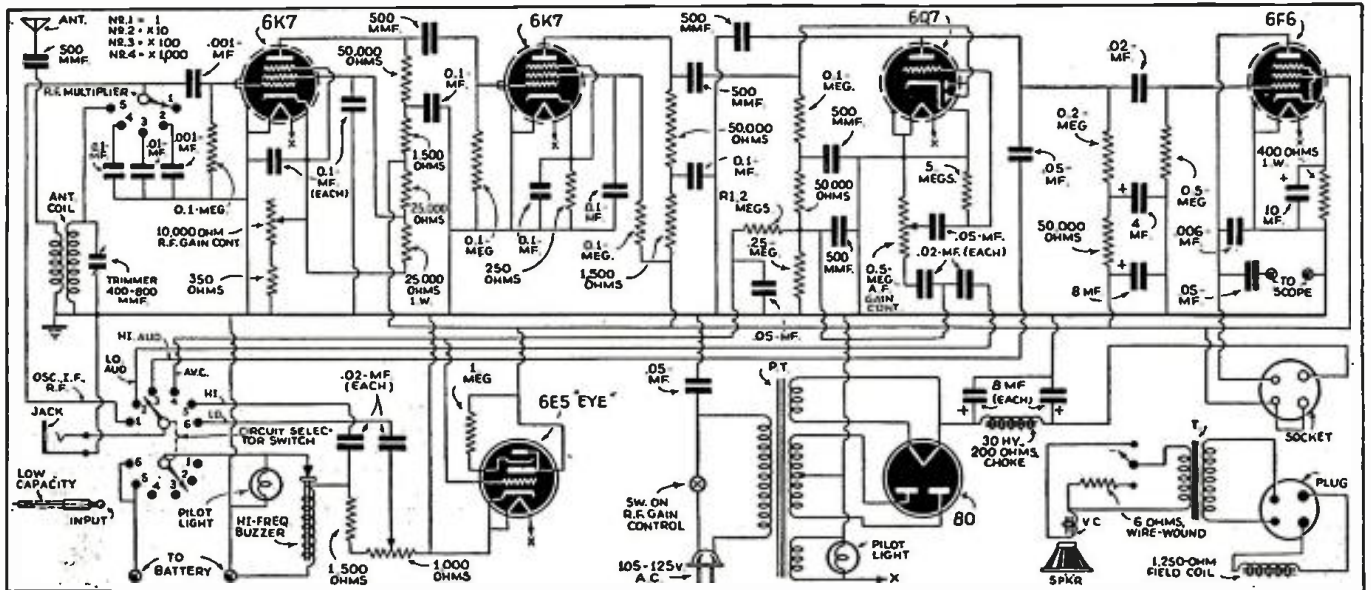
SIGNAL TRACING SYSTEMS

As we know, receiver analysis started with the simple circuit disturbance test and has gone through (a) voltage, (b) current; and (c) resistance analyses, (d) signal sub-

stitution with a signal generator, (e) signal tracing, and finally (f) dynamic analysis.

Without doubt, each one of these methods is not the only method to be used in the trouble-shooting of radio receivers. Each method of analysis has its outstanding advantages as well as its disadvantages. The radio man who can apply to advantage those phases of each one of these methods of analysis in receiver trouble shooting is the man who will do an accurate and good job in a minimum of time!

It has been found that with the signal tracer described below the Serviceman needs only, in addition, a good volt-ohmmeter and a signal generator (which he probably already owns).



Schematic circuit of the Simplified Practical Signal Tracer. Note the use of resistance-capacity coupled R.F. and A.F. stages. This low-cost design affords exceptional simplicity of construction and operation. The use of crystal microphone cable is the "secret" of the success of the low-capacity probes.

CIRCUIT ANALYSIS.

By observing the schematic diagram of the Practical-Signal Tracer it can be seen that it consists of a simple untuned resistance-capacity coupled radio-frequency amplifier, as well as a resistance-capacity coupled audio-frequency amplifier, with appropriate switching arrangements for application of the test probe to any part of the receiver under analysis.

The test probe used is made up of very-low-capacity crystal microphone cable. The lower the capacity, the less detuning will occur. Coaxial cable is highly recommended for this particular purpose, especially when used in radio-frequency, oscillator and intermediate-frequency circuits. Audio circuits are not critical.

Summing up, this instrument has 3 outstanding advantages:

- (1) It is *exceptionally inexpensive*;
- (2) It is *very simple* since only 1 probe is necessary and involves a minimum of dial twisting (1 position for Radio Frequency, Oscillator or Intermediate Frequency, and 2 positions for Audio); and,
- (3) It is a definite *time saver* in locating trouble since it is not necessary to "observe" the gain or loss per stage. You merely "hear" the gain per stage!

FUNDAMENTALS OF SIGNAL TRACING

Every receiver consists of 3 fundamental divisions. (1) The *radio-frequency amplifier*; (2) the *audio-frequency amplifier*; and, (3) the *power supply*.

With this signal tracer, regardless of the type of R.F. amplifier utilized, when the probe is placed anywhere in the R.F. circuit the signal, whether it be a broadcast or signal-generator modulated frequency, will be heard from the loudspeaker of the signal tracer. Similarly, when the probe is placed in the A.F. circuit of a receiver under analysis, an audio signal if it exists will be heard from the speaker of the signal tracer.

With this equipment it is possible to follow a signal straight from the antenna, going from grid to plate, from tube to tube, right up to the speaker voice coil; and secondly, we can feed a signal into the receiver starting at the speaker voice coil and going backwards stage by stage, from plate to grid, right back to the antenna. In either of these methods, *where the signal stops, the point of difficulty is isolated.*

By bonding the signal tracer chassis to

the chassis of the receiver under analysis we have both devices at ground potential. It should be noted that whenever a chassis is "above ground," i.e., when semi-fixed biased circuits are employed, the bonding of the signal tracer should be made to the center-tap of the high-voltage winding. In A.C.-D.C. midgets it is advisable to connect or bond the signal tracer to the variable condenser rotor.

SPEAKER-TO-ANTENNA SIGNAL TRACING

Buzzer Signal-Generator.—Observe a device included in this signal tracing making use of a high-frequency buzzer. This buzzer generates a high-frequency signal so broad in nature that it consists of both R.F. and A.F. signals. By applying this signal from the buzzer in the A.F. amplifier, whether it be on the plate of the output tube or the plate of the 2nd-detector, this signal should be heard in the speaker of the receiver under analysis. The signal strength depends upon the number of tubes that amplify it.

It readily follows that in tracing trouble in the A.F. end of the receiver, it is merely necessary to apply the highest output voltage from this high-frequency buzzer to the plate or plates of the output tubes, and then, work backwards from plate to grid through the entire A.F. system. The moment the signal does not come through the speaker of the set under analysis, the trouble is isolated. It is then merely a job of making the voltage and resistance measurements at this point to definitely locate the trouble.

Similarly, in trouble shooting the R.F. end of the receiver it is merely necessary to apply the output of this buzzer from plate to grid of the various R.F. tubes, working from the detector back to the antenna.

Buzzer-Signal Attenuator.—However, it will be immediately noticed that in working with the output of this high-frequency buzzer on the various points in the receiver, that as we go backward from speaker to antenna this signal will be amplified by the various tubes between the points of insertion and the speaker of the receiver under analysis. It will then be seen that, as the buzzer signal gets louder and louder, there should be included a method by which the output signal from the buzzer may be attenuated. Such a system is included in this device whereby a control is introduced by proper switching arrangement so that the output from the buzzer can be regulated as

desired. This attenuated signal will be found most convenient when applied into the R.F. stages because of the tremendous amplification produced by the A.F. and R.F. amplifiers between the probe and speaker.

By shutting off the speaker in the signal tracer by means of the single-pole double-throw switch provided so that the buzzer will not be heard from the signal tracer, and by rotating the Circuit Selector switch (which consists of a 6-circuit double-contact switch) to position No. 5, we can readily have at our disposal a high-output "broad" signal which may be applied anywhere between the speaker and the antenna.

If a low-voltage attenuated signal is desired from the same source it is merely necessary to switch the Circuit Selector to the No. 6 position. This signal may then be reduced in intensity by the 1,000-ohm Attenuator Control in the output circuit of this high-frequency buzzer.

ANTENNA-TO-SPEAKER SIGNAL TRACING

It is relatively simple to follow a signal (broadcast or signal generator) from the antenna through the speaker in a receiver with this signal tracer by checking either the R.F. or the A.F. portions of the receiver.

By turning the Circuit Selector switch and the R.F. Multiplier switch to the No. 1 position, our signal tracer is now adjusted to pick up *any* modulated R.F. signal which can be heard from the speaker of our tracing equipment. Of course the R.F. and A.F. gain controls should be set at maximum at the start. With the signal tracer adjusted, as mentioned above, it is only necessary to apply the probe anywhere between the antenna and the diodes of the detector in order to trace the signal within the receiver.

Checking Antenna.—By applying the probe to the antenna, a signal or signals, since the amplifier is untuned, should be picked up. This, incidentally, is a method by which the efficiency of the antenna may be checked.

If the antenna is grounded, no signal will be heard. If the antenna has any degree of leakage, a weak signal will be heard. If the antenna is satisfactory, a loud signal should be heard. In other words, the efficacy of the antenna system can easily be checked.

Checking R.F., I.F. and Mixer Circuits.—By placing the probe on the control-grid of the R.F. amplifier, we should be able to tune-in any signal by simply rotating the

variable condenser gang in the receiver being tested. By placing the probe on the plate of this R.F. amplifier, we should hear a definite gain through this stage.

We may now proceed to the grid of the mixer stage. There should be a transfer of energy between the plate of the R.F. stage and the signal-input grid of the mixer stage. If no transfer of energy occurs, the difficulty is, without doubt, in the secondary circuit of the R.F. coil. If the signal appears at the mixer signal-input grid we now shift our probe to the mixer plate. At this point we should get additional amplification.

We next proceed to the control-grid of the I.F. stage. The signal should appear at this point. We then go on to the I.F. plate, and then to the diodes of the 2nd-detector.

At this point it will be found that the gain within the receiver, if all circuits are functioning properly, should be very high. To reduce this gain to a comfortable level, we need merely adjust the R.F. Multiplier switch to a satisfactory point of operation.

From the foregoing, it is merely a mechanical method of diagnosing the R.F. amplifier of the receiver. It is only necessary to apply the probe from grid to plate, starting at the antenna and ending at the diodes. If the signal does not appear at any of these points, the difficulty should be located with the use of a simple volt-ohmmeter.

USING THE "EYE" TUBE

Checking Oscillator.—To check whether the oscillator is functioning, it is only necessary to apply the probe adjusted in the No. 1 R.F. position, as indicated above, to the oscillator-grid of the pentagrid converter (mixer) or the oscillator tube. If the "eye" of the 6E5 in the signal tracer closes, it is a definite indication that the oscillator is functioning. If the 6E5 eye does not close, the oscillator is not functioning and it is merely necessary at this point to check the oscillator circuit and locate the cause.

Efficiency.—By applying the probe which is set for the No. 1 or R.F. position to the oscillator-grid of the pentagrid converter or oscillator tube, and by rotating the variable condenser tuning the oscillator coil, we can easily check the efficacy of the oscillator circuit.

If the 6E5 eye closes, this is a definite indication that the oscillator is functioning. By adjusting the R.F. gain control to the point where the eye just closes, and then rotating the variable condenser across the band of the receiver, it may easily be noted as to how efficiently the oscillator is functioning on the different portions of the band. The degree to which an oscillator is functioning on shortwave bands, when tracing "dead spots," can easily be determined in this manner.

Checking A.V.C. Circuits.—In order to check the automatic volume control circuit, we set the Circuit Selector switch to the No. 4 position and apply the probe anywhere on the A.V.C. bus. Then, by merely rotating the variable condenser of the receiver under analysis, we can easily determine whether the automatic volume control is functioning; or check the A.V.C. voltage to each grid by watching the 6E5 in the signal tracer. It should act like a normal tuning indicator.

Level Indicator.—The 6E5 in the signal tracer may be used as an output indicator by merely applying the probe to the diodes in the receiver being aligned. By adjusting various trimmers, maximum deflection in the 6E5 indicates maximum signal. The eye may be adjusted by the R.F. Gain control.

TROUBLE SHOOTING

Checking Distortion or Oscillation (in the R.F. Amplifier).—In order to check for dis-

tortion or oscillation in the R.F. amplifier, it is only necessary to apply the probe from grid to plate between the antenna and the diodes and the detector. The point where the distortion or oscillation is heard is the stage to be analyzed.

It is possible to check distortion in the R.F. amplifier with the use of an oscilloscope by applying the vertical plates of the 'scope to the terminals provided on the Signal Tracer. It is then merely necessary to feed a 400-cycle modulated R.F. wave from any standard signal generator into the antenna and ground of the receiver under analysis. By placing the probe between the antenna terminal going from grid to plate to the detector diodes, we may observe any distortion or flattening of the sine wave generated by the signal generator. The point where the distortion occurs is the point to be analyzed.

Checking for Noise or Hum (in the R.F. Amplifier).—From the above we can readily see that it is just as easy to check the R.F. section of the receiver for noise or hum by the simple method of probing from grid to plate between the antenna terminal and the detector diodes. A broadcast or signal generator signal may be used.

Checking Tubes (in the R.F. Amplifier).—In so probing we at the same time are able to check the various tubes. There should be a definite gain between the grid input and the plate output of these R.F. amplifier tubes. If no gain is obtained between the grid and the plate it is suggested that the tube be checked as well as the voltages to its terminals.

Checking the Entire A.F. Amplifier.—By setting the R.F. Multiplier to the No. 5 position and the Circuit Selector switch to the No. 3 position, and attaching the antenna to the signal tracer, it is possible to have this Practical Signal Tracer operate as a radio receiver.

The station received with an ordinary antenna coil and a trimmer condenser shunting its secondary, with a trimmer condenser having a capacity between 400 and 800 mmf., should be a low-frequency broadcast station. It will be found that WMCA (570 kc.) or WEAJ (660 kc.) operating at the lowest-frequency-end of the broadcast band in the vicinity of New York City will be received with the greatest gain. It is due to the fact that the resistance-capacity coupled R.F. system used in this signal tracer peaks within the lower frequencies. It is now possible to use this broadcast signal emanating from our signal tracer to check any A.F. amplifier.

By applying the probe to the grid of the output tube or tubes (we may cut off the speaker in our signal tracer by flipping the single-pole double-throw switch), it is possible to feed this audio signal through the output tubes and speaker of the audio end of the receiver under analysis. We may now move the probe back to the plate of the previous audio voltage amplifier tube and then to the grid of the same tube and note whether any A.F. amplification has taken place.

It may be necessary to attenuate (reduce) the signal input, by decreasing the audio gain within the signal tracer, otherwise distortion will result. By this method we can inject an actual broadcast audio signal anywhere within the A.F. amplifier of the receiver under test and check the A.F. amplifier as to its operation.

Checking the A.F.-Circuit Volume Control; Coupling Condensers.—By injecting the broadcast audio signal, as outlined above, into the arm of the A.F. volume control in the receiver under analysis and rotating the arm of this control, we may check it for noise as well as its operation.

NEW Combination Tester



New Lever Switching

Combining simplicity of operation with absolute flexibility, Triplett's new lever switching permits individual control for each tube element—yet test procedure is simple and quick. The switch setting shown above will permit tests of 45 commonly used different type tubes without change of position of the levers. Many tubes require only two lever switch settings—more than half, only three settings.

Model 1183 is truly a Non-Obsolescent Tube Tester, combined with a Volt-Ohm-Milliammeter and Free Point Tester . . . three fundamental testers that you can use for many years. Volt-Ohm-Milliammeter Ranges: 0-10-50-250-500-1000 AC and DC Volts; DC at 10,000 Ohms per volt; AC at 2,000 Ohms per Volt. DC Milliamperes 0-1-10-50-250; Resistance 0-500 low ohms; 0-150,000 Ohms; 0-1.5 and 0-15 Megohms. Complete Free Point Tester with sockets for all tubes, including new Midgets. Tube Tester has new lever type switch. Speedex Roll Chart, removable from panel as separate unit. Dealer Net Price **\$49.84**

MODEL 1200-F

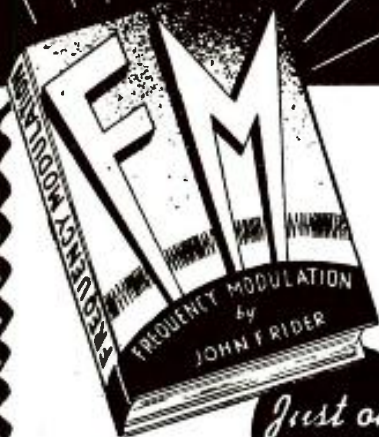
This New Automatic Volt-Ohm-Milliammeter is Push-Button Operated—with 19 AC-DC Ranges; 25,000 Ohms per Volt DC, 1000 Ohms per Volt AC. Only one button need be pressed for any range and test setting. RED * DOT Lifetime Guaranteed Instrument . . . Furnished in attractive metal case with rich brown suede enamel finish . . . Dealer Net Price **\$27.84**



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Solar Condenser QUICK-CHECK

Spots "bad ones" while set is operating

Quick as a wink

Write for Bulletin QC

SOLAR MFG. CORP. Bayonne, N. J.

Again, by injecting the broadcast audio signal on either side of the coupling condenser we may check the condition of the coupling condensers.

Checking Phase-Inverter, Push-Pull and Inverse-Feedback Circuits. — By switching the Circuit Selector switch to the No. 2 position or low-audio-input position, we may now check for audio signal at any point beyond the detector and up to the voice coil.

Since in push-pull circuits where it is necessary to have equal voltages on the grids of the output push-pull tubes, and since it is the purpose of the phase inverter and associated circuits to produce audio voltage on the grid of its associated push-pull tube that is equal yet 180 degrees out of phase with the voltage on the other push-pull tube, it is only necessary to apply the probe to the grids of the push-pull output tubes and note whether the gain is equal to each one of these points. If it is not, it is only necessary to move the probe backward from grid to plate to grid, and isolate the point of difficulty.

In checking inverse-feedback or degenerative circuits it is merely necessary to move the probe from the output or the point from which the signal is fed back to the previous grid or cathode circuits and note whether degenerative action is taking place.

Checking Tubes (in the A.F. Amplifier).— In checking these tubes we need only remember that we are dealing with an audio-frequency component. It is merely necessary to place the probe between the grid input and plate output of any of the tubes acting as A.F. amplifiers. There should be a definite gain between the grid and the plate. If no gain or insufficient gain is obtained it is suggested that the voltages should be checked at the tube's terminals. If these voltages are satisfactory, then it is only necessary to replace the tube.

Checking for Noise, Motorboating, or Hum in the A.F. Amplifier.—With the probes set in the low-audio-input position or No. 2 on the Selector Circuit switch, it is quite simple to check for noise or hum by merely probing from grid to plate in the audio amplifier.

Checking an Inoperative A.F. Amplifier.— This is quite simple to diagnose because it is only necessary to apply the probe from the point where the A.F. signal originates, in the detector, and follow-through from grid to plate right up to the voice coil. Where the signal stops, that is the point of difficulty. Where the audio signal is too high merely switch Circuit Selector to No. 3. This action merely switches 1 audio stage out of the circuit.

CHECKING AUDIO COMPONENTS AND POWER SUPPLIES

Checking High-Impedance Phono Pickups and Microphones.—To check these devices it is merely necessary to apply the probe to one side of the pickup or microphone, whereas the other sides are connected or bonded to the chassis.

Checking Low-Impedance Phono Pickups and Microphones.—These devices are checked in the same manner as the high-impedance type mentioned above, except for the fact that a matching transformer is necessary between each one of these low-impedance devices and the probe of the audio system of the Practical Signal Tracer.

Checking Power Supplies for Hum or Noise.—When tracing noise or hum in power supplies it is necessary to set the probe into the low-audio-input position or No. 2 on the Circuit Selector switch. By applying the probe from the rectifier filament to the various points in the filter circuit, i.e., to the various choke connections between the

rectifier filament and the last filter condenser, one can easily detect the point where the hum is not reduced by the actual parts in the filter circuit. Shorted turns in filter chokes, and open condensers in filter circuits, are located very rapidly and easily.

CHECKING PUBLIC ADDRESS SYSTEMS

By feeding a 400-cycle audio-frequency wave from any standard signal generator into the input of a public address system, it is only necessary to probe from grid to plate from the input position right up to the voice coils of the output speakers.

However, at certain points it will be found that the signal tracer will overload when the probe is in the low-audio-input position. This condition of overloading depends upon the number of voltage amplifiers between the input of the 400-cycle signal and the voice coils of the speaker. At those points where the audio-frequency voltage is very great, it is only necessary to switch the Circuit Selector switch to the No. 3 position, where the Practical Signal Tracer makes use of only 1 audio-frequency stage instead of the 2 stages when the switch is in the No. 2 position.

FOR THE EXPERIMENTER . . .

. . . Who Would Like to Make Gain Per Stage Measurements.—This can be done by connecting an output meter or the vertical plates of the oscilloscope across the 2 terminals provided at the points marked "scope". It is only necessary to feed a modulated signal from your signal generator into the antenna circuit of the receiver being tested. The signal from the generator should be kept at a minimum point so that overloading does not occur. It is now merely a mechanical job of applying the probe from grid to plate through the R.F. and A.F. amplifier and noting the output readings. These output readings can easily be converted to gain per stage data.

. . . Who Wants More Selectivity.—The individual who really feels that a single tuned stage preceding 2 untuned stages lacks the selectivity and variety of stations desired, can easily substitute a superheterodyne or tuned-radio-frequency tuner in front of these untuned stages. However, this will definitely add more switching arrangements and attendant tedious dial calibration.

. . . Who Would Like to Feed an R.F. Signal into a Receiver.—This may be done with ease by the addition of another switch contact which may be tapped from the diodes in the 6Q7. In this manner we would have an R.F. signal available which can be sent through an inoperative R.F. amplifier.

. . . Who Would Like a Vacuum-Tube Voltmeter.—With a source of voltages available, but with the additional expense of a 0-1 ma. milliammeter, some resistors, a tube and switching components, a V.-T.Vm. may easily be incorporated.

As may be noted, this instrument was designed for portable use. It was built into a metal speaker cabinet. For those who would find this instrument more useful on the test bench, it may be constructed on an aluminum panel and arranged for rack mounting.

List of Parts

RESISTORS

- One I.R.C., 6 ohms, wire-wound;
- One I.R.C., 400 ohms, 1 watt;
- One I.R.C., 250 ohms, ½-watt;
- One I.R.C., 350 ohms, ½-watt;
- Three I.R.C., 1,500 ohms, ½-watt;
- Two I.R.C., 25,000 ohms, ½-watt;
- One I.R.C., 0.2-meg., ½-watt;
- Four I.R.C., 50,000 ohms, ½-watt;
- One I.R.C., 0.25-meg., ½-watt;

One I.R.C., 5 megs., ½-watt;
 One I.R.C., 2 megs., ½-watt;
 Four I.R.C., 0.1-meg., ½-watt;
 One I.R.C., 0.5-meg., ½-watt;
 One I.R.C., 10,000 ohms, bias control (R.F. gain) and switch;
 One I.R.C., 0.5-meg., audio volume control.

CONDENSERS

Six Sprague, 500 mmf., mica;
 Five Sprague, .1-mf., 600 W.V.;
 One Sprague, 0.1-mf., 200 W.V.;
 Two Sprague, 0.001-mf., 200 W.V.;
 One Sprague, 0.01-mf., 200 W.V.;
 Five Sprague, 0.05-mf., 600 W.V.;
 One Sprague, 0.006-mf., 600 W.V.;
 Three 8-mf., electrolytic, 450 W.V.;
 One Sprague, 4-mf., electrolytic, 450 W.V.;
 One 10 mf., electrolytic, 50 W.V.

SWITCHES

One Yaxley S.P.D.T. toggle switch;
 One Yaxley single-circuit 5-contact (R.F. multiplier)
 One Yaxley double-circuit 6-contact (circuit selector).

MISCELLANEOUS

One Meissner antenna coil;
 Four Amphenol octal sockets;
 Two Amphenol 4-prong sockets;

One Amphenol 4-prong speaker plug;
 One Amphenol "tuning eye" socket assembly;
 One 8-in. dynamic speaker, pentode output transformer with 1,250-ohm field;
 One Thordarson 30-hy. filter choke, 200 ohms;
 One Trimmer condenser, 400 to 800 mmf.;
 Two Yaxley pilot light sockets with jeweled reflector;
 One power transformer, 115-V. pri.; secondaries: 6.3 V., 2A.; 700 V., center-tapped; 5 V., center-tapped;
 Two type 6K7 tubes;
 One type 6Q7 tube;
 One type 6F6 tube;
 One type 80 tube;
 One Signal high-frequency buzzer;
 One 1.5-V. cell (for buzzer);
 Test prod (see text);
 Cable, must be crystal-mike type;
 One metal-shell type of plug;
 One midget open-circuit jack;
 Three nameplates: (1) INPUT; (2) GAIN CONTROL;
 One Parmetal cabinet, 12 x 12 x 7 ins. deep;
 One Amphenol "eye" assembly;
 One chassis (to fit cabinet);
 Three tip-jacks (insulated).

Radio Aids to Better Welding

The following items are published by courtesy of the General Electric Co.

Motor Control.—A new system of automatic field control, in a new line of synchronous-motor controllers, features a slip-cycle impedance relay controlling both the application and removal of field excitation. In applying field, the relay acts on the cyclic variation in motor impedance; in removing field, it acts on the abrupt change in impedance phase-angle on pullout. This new field-control system illustrates 2 of a wide variety of new applications of condensers in industrial control devices and circuits.

Weld Recorder.—Particularly advantageous for spot welding on aircraft, railway equipment, and other structures where faulty welding would be disastrous, is a weld recorder, which is a combined recording instrument, warning device, and lockout control.

When a variation of the electrical input is outside preset allowable limits for successful spot welding, a bell gives a continuous audible signal, and the weld-initiating circuit is opened automatically, and subsequent welding is prevented until a push-button is pressed. Simultaneously it records on a paper chart the variations of electrical input to the primary for each weld, compared with the predetermined normal, and indicates visually the per cent variation.

Weld Sequence Timer.—For air-operated spot welders there was produced a line of sequence timers, in which a direct-

reading calibrated dial permits adjustment of time for each of the timing intervals. In operation, the solenoid valve of the timer is energized to create full pressure of the electrodes on the work. After a time delay, called the "squeeze" period, power is applied for a predetermined "weld" period, and then during a "hold" period the metal is allowed to "freeze" before the electrodes are lifted. There is then an "off" period before the panel repeats. Timers to provide for interrupted spot welding (repeated applications of current to the weld) were also introduced.

Welder Electronic Timers.—A combination electronic control for resistance welders was made precisely synchronous in operation and suitable for mounting all available sizes of water-cooled ignitron tubes. It is a complete electronic timing circuit, suitable for spot, interrupted spot, and seam welding. Independent calibrated dials permit selection of the precise timing required for each current flow and each "off" interval, and there is a dial to permit selection of the total number of current impulses for interrupted spot welding.

Power-Factor Correction.—Series condensers were introduced for power-factor correction of resistance welding machines. Among advantages resulting from their use are reductions in power demand, line regulation interference between welders, light flicker, disturbance on feeders, and power cost by lowering peak demands. They also permit use of larger or more welders on existing feeders.

Radio as "Dove of Peace"

WE quote from David Sarnoff's (Pres., RCA) bid for peace in a troubled world, "Communications in a Changing World," delivered at the University of Virginia (Charlottesville, Va.) last month:

"... It remains true that only through communications can there be that meeting of minds which must be obtained if world opinion is to establish and maintain peace. "War has obscured but not destroyed this

truth. Those who are trying to remake the world in the image of barbarism understand it clearly enough. They fear to expose their peoples to the interchange of intelligence, so they forbid them, under pain of imprisonment or death, to listen to anything other than the false propaganda of their own controlled broadcasting." With unity of purpose, he concluded, our communication facilities will help preserve the free institutions of America.

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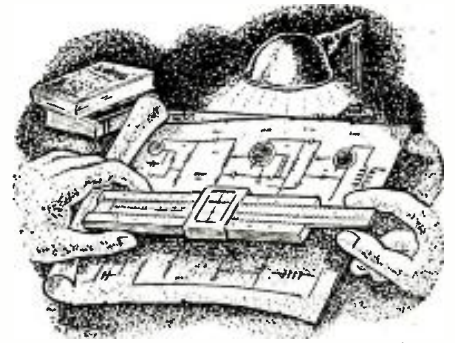
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This department is being conducted for the benefit of RADIO-CRAFT subscribers. All design, engineering, or theoretical questions relative to P.A. installations, sound equipment, audio amplifier design, etc., will be answered in this section. (Note: 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. 9

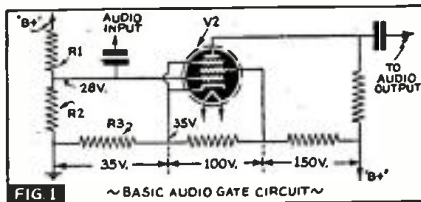


FIG 1 ~ BASIC AUDIO GATE CIRCUIT ~

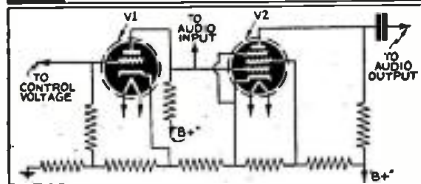


FIG 2 ~ BASIC AUDIO GATE CIRCUIT WITH CONTROL TUBE ~

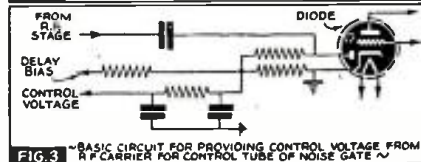


FIG 3 ~ BASIC CIRCUIT FOR PROVIDING CONTROL VOLTAGE FROM R.F. CARRIER FOR CONTROL TUBE OF NOISE GATE ~

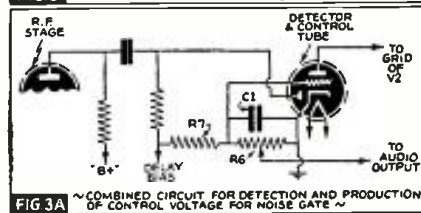


FIG 3A ~ COMBINED CIRCUIT FOR DETECTION AND PRODUCTION OF CONTROL VOLTAGE FOR NOISE GATE ~

AUDIO NOISE-GATE

The Question . . .

We recently built a resistance-coupled superheterodyne for reception of police signals on 8.43 meters. While it is receiving signals, it is quiet, but when the carrier is off the air, then the characteristic oscillatory rush is very loud and annoying. My customer uses it for standby reception, and as such, it is unbearable after a short time.

In your experience in the field of sound, could you suggest an audio noise-gate or blocked audio stage for this receiver which would render it quiet when in the standby position? We are aware that such circuits are critical as to input signal strength, audio quality, etc. Audio quality is not a factor here, and the sensitivity of the set is an unknown quantity. We can say that the audio whack of the set leaves something to be desired, however.

The idea is to leave the set alive to the signal, before the detector, and kill only the audible portion until the carrier comes on the air to open it up to the speaker. Most circuits which have come to our atten-

tion, employ some interlocking with A.V.C. in the set, but this job is not so equipped.

EDWIN A. WOLF,
Wolf Radio Service Laboratory,
West Roxbury, Mass.

The Answer . . .

An audio noise-gate can be developed to fit any type of R.F. receiver, if a few basic principles are followed. As you surmise, a blocked audio stage is required to cut off undesired audio and noise signals.

A fundamental circuit for a blocked audio stage is given in Fig. 1. In this circuit, resistor R3 has a value sufficient to bias the tube beyond cutoff. The resistor network R1 and R2, will then determine the effective bias applied to the blocking stage. For example, if the cathode potential is 35 volts, and if R1 and R2 are so selected as to apply a positive potential of 28 volts to the grid, then the effective bias is equal to 35-28, or 7 volts, which is sufficient to provide complete cutoff for a 6SJ7 tube.

In addition to this blocked stage a control tube is required. If a triode is substituted in place of R2, as in Fig. 2, it will be noted that a control voltage applied to the grid of the control tube, will change its plate resistance. This, in turn, will change the effective voltage applied to the grid of the blocking tube. For example, if a negative voltage is applied to the control tube, its plate resistance increases to apply higher effective voltage to the grid of the blocked stage. This higher voltage (when it is subtracted from the cathode voltage) effectively decreases the bias and thereby shifts the operating point of the tube (V2) from cutoff up to some predetermined point on its plate current-grid voltage curve. The control voltage applied to the control tube may be obtained from any number of sources. For your particular application, it might be best to rectify a portion of the R.F. carrier. This can be done as indicated in Fig. 3. The control voltage circuit you select, however, need not be restricted to this form.

For example, rectification and detection can be arranged to take place in the same circuit, as illustrated in Fig. 3A. Here it will be noted the bias supplied to the grid of the control tube, is dependent upon the intensity of the R.F. carrier. When a carrier develops a sufficient bias to overcome the delay bias, then the plate resistance of the tube will increase and open the noise-gate. A tentative circuit with its voltage distribution is given in Fig. 4.

The audio signal to be blocked is injected between the plate of the control tube V1 and the grid of the blocking stage V2. In order not to greatly attenuate this signal, the coupling circuit between the control and

blocking tube should be modified from that of Fig. 2, as shown in Fig. 4. The decoupling resistor, R5, isolates the signal voltage from the bias-controlling network R1, V1.

This particular circuit has a number of other interesting applications. For example, it may be applied to an amplifier and arranged so that the amplifier is "dead" when no input signal energy is present. This would greatly attenuate residual hum and tube noises. When signal energy is present, however, the gate opens and the amplifier operates normally. The speed of control (attack and release time of the circuit) is dependent upon the values of C1, R6 and R7 (Fig. 3A). These may be varied to provide any desired timing.

MODERNIZING THE "AUDIO EXPRESSOR"

The Question . . .

Will you please inform me what circuit changes are required in the Audio Expressor, published April, 1938, in *Radio-Craft* magazine, to use a 6SK7 instead of 6S7G? Please supply if possible, a circuit diagram with value of resistors and condensers.

I prefer using the Audio Expressor for its simplicity.

ANGEL YEE,
San Fernando, Pampanga, P. I.

The Answer . . .

Virtually, no modification of the original Audio Expressor circuit is required. You may use 6SK7 in place of the 6S7G. It will only be necessary for you to change the 3,000-ohm bias resistor (of the 6S7G stage) to a 10,000-ohm variable resistor. This should be adjusted for the degree of expansion desired. All other circuit constants, as published in the April, 1938, issue of *Radio-Craft*, remain the same.

CONSERVATION OF SOUND

The Question . . .

I have been reading your Sound Engineering questions and answers in *Radio-Craft*

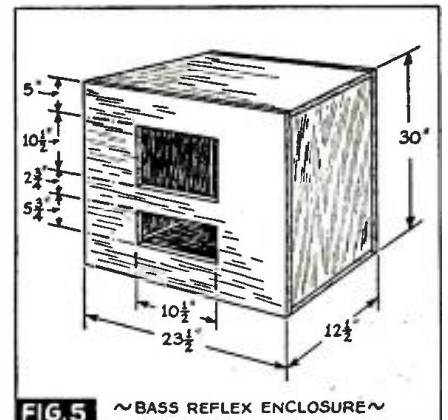


FIG 5 ~ BASS REFLEX ENCLOSURE ~

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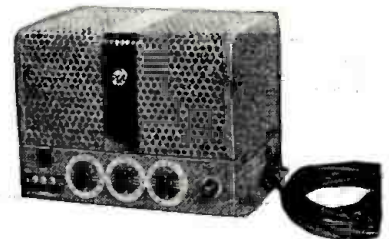
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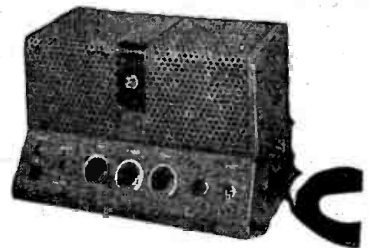


COMMERCIAL SOUND

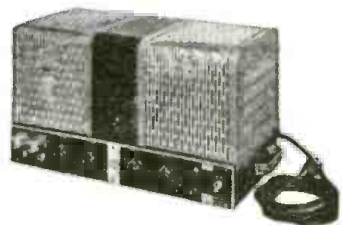
RCA MANUFACTURING CO., INC., CAMDEN, N. J.
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RCA 6-watt Amplifier MI-12209 operates from high impedance microphones and high or low impedance phonograph inputs. High gain—excellent frequency response. An outstanding value at a low price.



RCA 15-watt Amplifier MI-12202-B. This medium power, high gain amplifier has two individually controlled input positions for microphone and phonograph. Continuously variable tone control and other features. 15 to 20 watts output—Intra-Tube Mixing, two high impedance inputs, phonograph input jack. Excellent for moderate power installations.



RCA 25-watt Amplifier MI-12205 has most modern circuit design, is extremely flexible, can be used for four input positions for microphone and phonographs; Remote Electric Mixing, bass and treble controls, provision for extra inputs, automatic phonograph compensation, and other features.

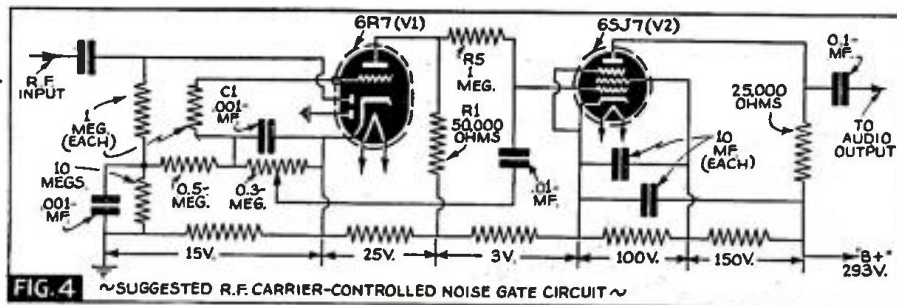


FIG. 4 ~SUGGESTED R.F. CARRIER-CONTROLLED NOISE GATE CIRCUIT ~

since the feature has been published and have benefited a number of times in the past and now I would appreciate it if you will answer a question of mine.

I have a Jensen B15-X dynamic speaker mounted in the ceiling of my shop. The ceiling and walls are of 1/2-in. Celotex and the ceiling is 8 x 12 feet. My problem is to obtain some benefit from the sound that is wasted in the attic of the shop.

The speaker is mounted in the center of the shop between 2 joists 22 inches apart. If you can tell me what kind of channel I would need, or tell me how to compute the

size and shape of this channel, I would appreciate it very much. I want to obtain results similar to those obtained with the Jensen "Bass Reflex" baffles.

I hope to see more articles by you on direct coupling in the future.

JOHN C. CRAM,
Upper Sandusky, Ohio

The Answer . . .

You may obtain the desired effects by building an enclosure similar to Fig. 5. This enclosure may be above or below your ceiling. The design factors involved for cal-

culating the size and shape of an enclosure are dependent upon a great number of variables, and are therefore too complex for treatment here.

The bass reflex principle requires as short a sound-path length as possible between the inside of the enclosure and front face. As a result, unless means can be provided in the design of the enclosure to permit this short sound-path length, it is better to discard the bass reflex principle and consider the baffle as an infinite baffle or else incorporate the acoustic labyrinth principle.

In other words, the loss in the transmission line or duct would offset any possible gain that might be expected as a result of using the bass reflex principle. One other fact to keep in mind is that the "aid-coefficient" of the bass reflex principle is effective only in the range below 200 cycles. We therefore suggest that you arrange to build the square enclosure, or if this is impractical, we believe you should forget about the bass reflex principle and simply consider the ceiling as an infinite baffle. With such an infinite baffle, there is no need to incorporate the labyrinth principle, since this is simply a method of obtaining the same results within a relatively small cabinet.

TRUE—FALSE QUIZ ON SUPERHETERODYNES

Excerpts from a Superheterodyne Theory Examination
Given to 5th Term High School Students

Submitted by

MONROE M. FREEDMAN, B.S., M.S.

(Radio Instructor, Queens Vocational High School, New York City)

Credits: Each correctly answered statement credit with 4%
Each incorrectly answered statement deduct 8%
Each statement left unanswered deduct 4%

Rating: 60-69% pass mark; 70-79% good; 80-89% superior; 90-100% excellent.

If the following statement is *true*, place a T in front of the statement.

If the statement is *false*, place an F in front of the statement. The correct answers will be found on page 192.

1. The intermediate-frequency amplifier is the unit most responsible for the selectivity and sensitivity in the "super".
2. "Translation gain" is a ratio between the modulated radio-frequency energy entering the 2nd-detector and the audio-frequency energy leaving this detector.
3. Most manufacturers now bias the high-mu triode (6Q7) control-grid via the contact potential bias method.
4. Resistance - Capacity ("RC") filters are used in A.V.C. circuits to prevent hum from the power supply entering the radio-frequency stages.
5. Diode detectors amplify as well as separate the R.F. and A.F. components.
6. The lower the intermediate frequency the greater the gain and the greater the image-frequency interference.
7. Variable-mu tubes, such as the 6K7 or 6SK7, are used in order to prevent cross-modulation and distortion on strong signals.
8. The primary purpose of the R.F. stage in front of the 1st-detector and oscillator in the superhetero-

dyne is to obtain more gain.

9. The oscillator frequency is generally higher than the signal frequency by the amount equal to the I.F. of the receiver.
10. The time constant for an A.V.C. circuit should be between 1/2- and 3/4-second.
11. "Monkey chatter" interference may be eliminated by using a higher intermediate frequency.
12. The frequency of the interfering image is equal to twice the intermediate frequency plus the signal frequency.
13. Diode detectors are used in most receivers because of their superior tone and ease of developing A.V.C. voltages.
14. An acoustically-compensated volume control reduces the very low and high frequencies from the audio response.
15. The 6K8 frequency changer is being used more extensively than the 6A8, in receivers covering frequencies above 30 megacycles, because it is a more stable oscillator and has better frequency stability at these frequencies.
16. Ten-kilocycle filters are usually found in the antenna circuit to reduce intermediate frequency interference.
17. The frequency of the interfering image is equal to the oscillator frequency plus the intermediate frequency.
18. There are 4 frequencies present in a frequency changer plate circuit, the oscillator frequency, the signal frequency, and the combination and difference between these 2 frequencies.
19. Manufacturers resort to special-shape plates for the oscillator

variable condenser rather than the use of padding condensers in order to make superheterodynes track properly.

20. "RC" filters are generally used to prevent coupling between circuits which differ in signal voltage.
21. "Dead spots" in superheterodynes are usually due to faulty volume controls.
22. Automatic volume control should be rightfully called automatic sensitivity control.
23. "Birdies" can be eliminated by adding more I.F. stages.
24. Increasing the coupling between the primary and secondary windings in an intermediate-frequency transformer will cause the top of the selectivity curve to become double peaked.

"RADIO DOCTORS' CODE"

Dear Editor:

I thoroughly agree with Brother Heoppner (Aug. 1937, issue of *Radio-Craft*, pg. 125), and Brother Lanning (July, 1936, pg. 23), that the rags of the pants will beat any man to death (?—*Editor*) if he engages in radio service work.

As many men thoroughly familiar with the situation will agree, there is nothing but slow starvation in the game, notwithstanding all that may be said to the contrary. The only really successful Servicemen are those who combine other lines with their regular service work. For instance they have bicycle repair, battery service, generator service or refrigerator service which really brings in the money. But as the saying goes, "Why keep barking and braying" if there is a remedy for all this grief? Well, I am going to holler loud

enough and long enough so that every radio man will hear me.

Here is my program of a "Radio Doctors' Code":

(1) Radio men should be dressed as professional doctors and wear smocks or jackets, and have their diplomas or organization membership certificates on display.

(2) As the long radio training involved and the expensive equipment used is along the procedure followed by doctors, it should give the "Radio Doctor" the privilege of charging for the information given; or, worded differently, his consulting service. Regardless of whether or not the radio set is fixed, when you visit a doctor he charges you \$1 or \$2 for consultation, and whether or not you buy the prescription is not his concern.

The Radio Doctor should follow this procedure: He should charge \$1 for a home visit, or 50c for a radio receiver brought to the shop. And as said before, this is only for information as to what is wrong with the set.

(3) When customers bring in a sack-full of tubes for testing there should be a minimum charge of 3c per tube to pay for the Serviceman's time of testing the doggone things. Some people will bring in all the tubes accumulated in the last 10 or 15 years.

(4) If the ethics of this Code are adhered to strictly, here are some of the net results:

A—It will greatly increase the prestige of the radio profession as a whole and at the same time greatly increase the Radio Doctors' salary or income.

B—It will teach the public to buy tubes from the Radio Doctor instead of wasting his time and then buying them elsewhere.

C—It will teach the public to regard the radio man as a highly-skilled "doctor" whose knowledge and equipment are not to be taken for granted.

(5) Not only doctors and lawyers charge for their knowledge—there are many other trades where you must pay the man giving the information. For example, take the instance of a refrigerator man. He will not come out to your home unless you agree to pay him \$1.50 for the first 30 minutes he spends in testing the refrigerator. In fact radio men are the only highly-skilled men that I know of where information seems to be free for all.

(6) If the radio set is handed-in for repairs the consulting fee should still be charged or added onto the repair bill.

When you visit a doctor you cannot escape the consulting fee, merely because you decided to buy the prescription or take his treatment. You must "come across" and give him that \$1 for telling you what was wrong, and how to remedy the trouble.

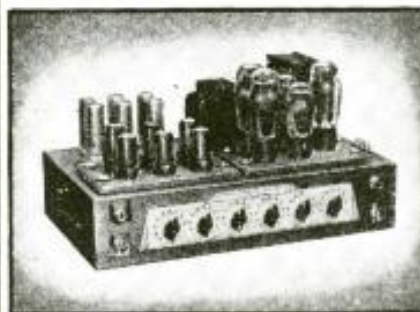
(7) Those Radio Doctors working for companies should still follow the same procedure, but there should be an equitable arrangement between the individual company and the Radio Doctor as to percentage of consultation fees collected, plus his regular salary.

(8) Those radio magazines already preferred by Radio Doctors should ally themselves with such a program, and to its perfection.

(9) Further ramifications and details may be solved at meetings of radio doctors.

(10) The organization should be strong enough to enforce the "Code of Ethics" as there is always plenty of opposition. Also it should be strong enough to protect the public from the unwarranted action of unscrupulous individuals. It should have the

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power to ostracize or oust members for violation of the Code.

(11) The Radio Doctors' fee for testing or information will be taken for granted, once the public is taught that the Radio Doctors' time and knowledge are worth money.

(12) All radio men will recall innumerable times when the customer's first question is "Do you charge for testing a radio?". The answer should be, "Yes, 50c if you bring the radio set in and \$1 for a home visit."

(13) This eliminates all those customers who call, only to use 30 or 40 minutes of a man's time and "all of a sudden" they discover that they have to ask their cousin or their nephew whether the radio receiver is to be fixed at all.

(14) All established radio shops should follow along the lines of the "Doctors' Code" and report all stray radio men who are just coming into the game.

I would like to see something done quickly and appreciate any criticism or comment on what I have written.

VICTOR CORREA,
Dallas, Tex.

Letters of comment on "Radio Doctors" and their "Code," may be addressed in care of Radio-Craft and we will be glad to forward them to Mr. Correa.

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GEORGE F. BAPTISTE,
Howard, R. I.



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Why—

- • • should the audio spectrum be balanced?
- • • is it so difficult to reproduce musical instruments realistically?
- • • do some instruments sound tinny and others boomy?
- • • is the apparent response of a system sometimes improved with bass boost or high-frequency attenuation?
- • • is a pleasant effect often produced by boosting highs or cutting lows?

What—

- • • are the limits of the audio spectrum?
- • • are the normal limits of human hearing?
- • • are the normal limits of young, acute listeners?
- • • are the effects of spreading or contracting the limits of the audio spectrum?
- • • is meant by a balanced response?
- • • are the laboratory means that have been used to prove audio balance?

"BALANCED" AUDIO SPECTRUMS

An enlightening discussion which solves the enigma of tonal balance, and focuses attention upon an important factor heretofore overlooked in gauging high-fidelity reproduction. The audio spectrum is analyzed from the viewpoint of the musician and the sound engineer. Author's Note: For simplicity of exposition, this discussion will be limited to frequency bandwidth only.

A. C. SHANEY

THE writer has always been surprised at the lack of coordinating material between musicians and sound engineers. As a matter of fact, he has always had considerable difficulty in discussing the technical aspects of sound and the audio spectrum with teachers of music in all phases of the art. To a sound engineer 1,000 cycles is a standard reference level. To the musician it is a tone that can't be found on any instrument. On the other hand, 440 cycles is the American standard for middle A, while to the engineer, it represents an odd value between 400 and 500 cycles, usually not found directly calibrated upon any commercial test audio oscillator.

While sound engineers standardize at 1,000 and musicians at 440, *physicists* have selected 512 cycles, which does not correspond to any distinct tone on any instrument. These typical, unrelated standards typify the lack of correlation between the musician, sound engineer, and physicist.

HEARING LIMITS

The range of hearing has been variously stated as ranging from 20 to 20,000 cycles, 16 to 18,000 cycles, and sometimes to 22,000 cycles. The ranges stated were dependent upon the type of tests conducted and the acuteness of hearing of the group tested.

Recent tests have clearly indicated that the average hearing range of young listeners extends from approximately 12 to 30,000 cycles; while the average hearing range is from 16 to 20,000 cycles.

Viewing the development of the audio art in the light of these extended hearing ranges, it is obvious that ultimate equipment will provide for the unattenuated transmission of a wider range than that which is presently prevalent.

As far back as the writer can remember, the reaction towards extending the range of audio amplifiers has always been met with the following query: "What is the sense of raising the upper limit of an amplifier when there isn't any speaker, microphone, pickup or radio set that can handle it?" This same question was asked

in 1925, when the upper limit was 3,000 cycles, and the lower limit 350 cycles. The question was again asked when the upper limit was extended to 5,000 cycles and then again when it was increased to 7,000 cycles. It was also repeated when the upper limit was brought to 10,000 cycles! *With frequency modulation transmitting 15,000 cycles, it is obvious that it is only a question of time before 20,000 and even 30,000 cycles will be transmitted.*

While it is true that elderly listeners suffer natural deficiencies in high-frequency response, this is no justification for restricting the audio spectrum. It is therefore the writer's contention that the frontiers of the audio spectrum should be pushed back to the very outer limits of the most acute listeners; that is, a range of 12 to 30,000 cycles. Speakers have already been developed that handle supersonic frequencies so that reproduction of the high-frequency end would involve no particular problem.

LOW FREQUENCY AND SUBJECTIVE TONES

One of the most popular misconceptions prevalent in the sound industry is that it is unnecessary to transmit low frequencies because low frequencies are subjectively perceived under normal conditions of sound perception.

A popular experiment, to prove this point, has been to listen to musical instruments through an amplifier system equipped with an adjustable low-frequency cut-off. When the filter is set to cut out the components of the fundamental and all its 2nd or 3rd harmonics, the pitch of the signal or tone will appear to remain the same.

In other words, if a tone having a fundamental of 100 cycles and rich in 2nd, 4th, 6th, 8th, and 10th harmonics of 200, 400, 600, 800, and 1,000 cycles, respectively, is passed through an amplifier having a low-pass filter to cut off 100, 200 and 400 cycles, the pitch still appears to be 200 cycles. Although this is true, an important difference exists. *While the pitch will be judged at 200*

cycles, the tone will not be quite that of the musical instrument. This is one of the reasons why it is impossible to reproduce the tone of a drum realistically on any system that does not extend down to the lowest or fundamental frequency produced by the drum.

THE AUDIO SPECTRUM

The band-width of the audio spectrum in terms of the musician may be defined as the interval between the upper and lower frequencies, and expressed directly as their ratio. Expressed mathematically, it becomes

$$I = \frac{F_2}{F_1}$$

where I = interval

F_2 = high frequency

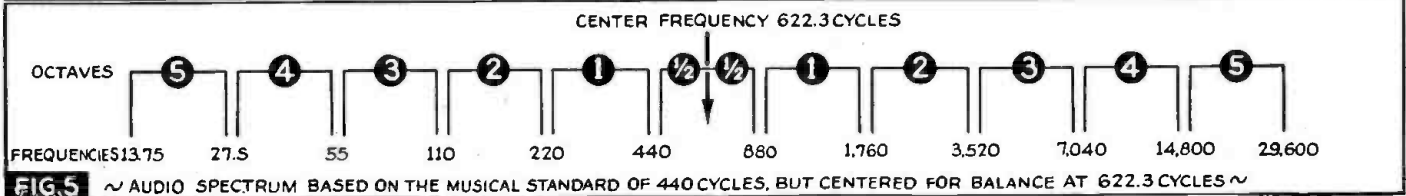
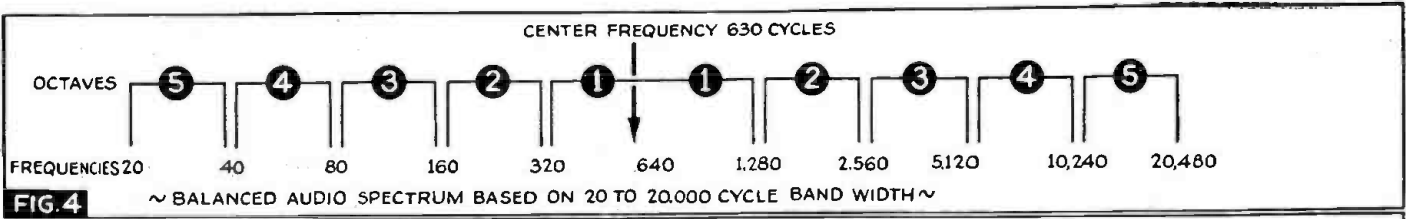
F_1 = low frequency

For many ratios in the musical field names have been standardized. For example, the ratios of 2/1 is the *octave*, 3/2 is the *fifth*, 5/4 the *major third*, 6/5, *minor third*, 9/8 the *major tone*, 10/9 the *minor tone*, and 16/15 the *diatonic semitone*.

Keeping in mind that an octave represents an interval of 2, it follows that successive frequencies in the scale of octaves would always double. For example, 16 to 32 cycles represents an octave. Similarly, 10,000 cycles to 20,000 cycles likewise represents an octave. It is to be noted, however, that the limits of the lower octave represent a difference of only 16 cycles; whereas, the higher octave represents a difference of 10,000 cycles. These 2 differences, though, have equivalent effects upon the ear, insofar as balance between the high and low frequencies is concerned, depending of course, upon where the center of the audio spectrum is set.

DETERMINING THE CENTER OF THE AUDIO SPECTRUM

The center of the audio spectrum may be defined as that frequency which produces equal intervals to either end of the spectrum. As there are 3 conflicting centers, i.e., 440, 512, and 1,000 cycles, it will be interest-



ing to examine an expansion of the octave scale based on all of these frequencies.

Figure 1 shows the scaling of a spectrum based on a center frequency of 1,000 cycles. Here it will be noted that if the spectrum is extended 5 octaves to the upper region, it passes the highest limit of hearing. Whereas 5 octaves below, it is far above the lower limit of hearing. If, on the other hand, an additional octave is added to bring the lower limit to 15.675 cycles, it will be noted that we have a characteristic unbalanced spectrum wherein 6 octaves are below 1,000 cycles and 5 octaves are above. Inasmuch as this spectrum is a total of 11 octaves, it stands to reason that its center should be 5½ octaves from either end. The center, or mean, frequency may be determined from the following formula:

$$C = \sqrt{F_1 F_2}$$

wherein C is the center of frequency balance. F₁ is the lowest frequency in the spectrum. F₂ is the highest frequency in the spectrum. Substituting, we have

$$C = \sqrt{15.675 \times 32,000} = \text{approx. } 708 \text{ cycles}$$

The center of this spectrum would therefore be slightly above 700 cycles.

Figure 2 shows a scaling of a spectrum based on a 512-cycle center. Here, it will be noted, when the spectrum is extended 5 octaves to the lower region, it approaches the lowest limit of hearing. Whereas 5 octaves above, it is definitely below the upper limit of hearing. If, however, an additional octave is added to bring the higher limit to pass the upper threshold of hearing, a total of 11 octaves will be present

in this band and its center will fall at approximately 725 cycles.

If we were to scale a spectrum based upon the lowest limit of hearing, we would have one as illustrated in Fig. 3. This spectrum, although composed of 11 octaves, does not cover the entire acute hearing range. It is actually short by the interval 30,000

— which is about equal to the interval 24,576

of 1.22, which is almost equal to a major tone and a minor tone. The center of this spectrum would fall at approximately 600 cycles.

If we were to plan another spectrum based upon a popular conception of a hearing range of from 20 to 20,000 cycles, we would have Fig. 4, wherein a total of 10 octaves will be found. The center of this spectrum is 640 cycles.

If the musical standard of 440 is used as the basis for scaling the spectrum, Fig. 5 results. Here it will be noted that we have a total of 11 octaves, which most nearly approaches the extreme limits of hearing. The center of this spectrum falls at 622.3 cycles, which is D sharp above middle A.

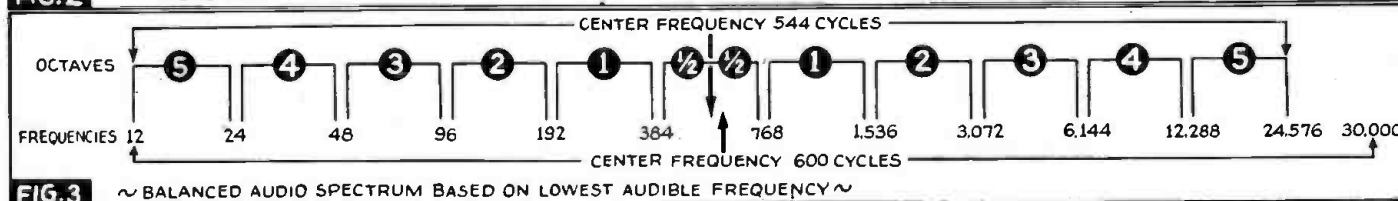
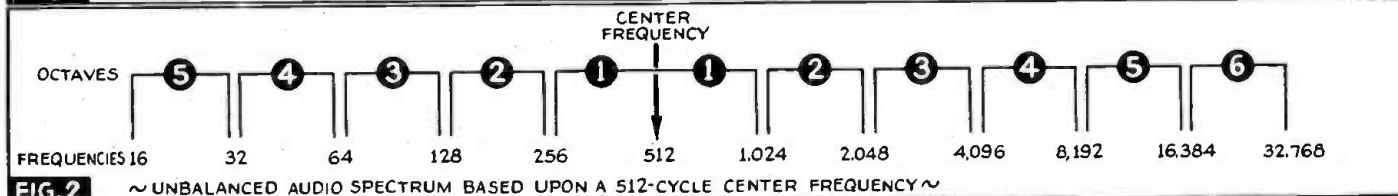
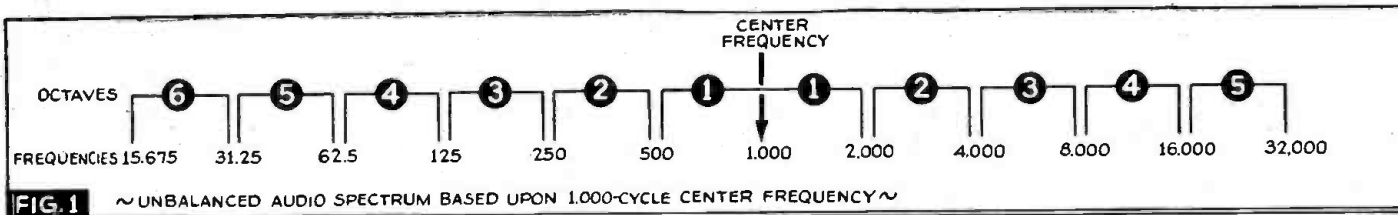
It will be noted when the center of all these spectrums is examined, that none will be found to fall near 1,000 cycles, which proves that the 1,000-cycle reference level used in sound work has no justification for its use other than the fact that it is a preferred number and readily lends itself to simple mathematical manipulation. The musician's standard of 440 cycles is too low, for a balanced spectrum based upon this value, would produce an upper limit of

14,500 cycles and a lower limit of 13.75 cycles. The physicist's standard of 512 cycles more closely approximates the desired reference level, but even this value is too low, as is indicated in Fig. 2.

A frequency of 622.3 cycles seems to be an ideal standard, and while it may not be convenient for the sound engineer, it represents a definite note in the musical scale and can easily be intelligently estimated on a standard laboratory audio oscillator.

BALANCE IN THE AUDIO SPECTRUM

Balance in the audio spectrum simply means that any band-width which is decided upon, should be so proportioned as to provide an equal number of octaves on either side of the center frequency. In other words, assuming that for purpose of economy, it is necessary to restrict the transmission band to 7 octaves, the selection of the best band would be dependent upon the type of program to be transmitted. For musical programs the audio spectrum should be proportioned so that 3½ octaves will be on either side of 622.3 cycles. This would give us a band-width of from 55 to 7,400 cycles. If, for some reason or other, the low-frequency limit can only be extended to 110 cycles (which is 1 octave above the desired low-frequency limit), then 1 octave should be removed from the high-frequency spectrum in order to maintain balance. This would then ultimately give us a frequency band-width of 5 octaves, ranging from 110 to 3,520 cycles. If, for some reason or other, the band-width is maintained from 110 to 7,040 cycles, we have what is termed an unbalanced audio spectrum. This type of un-



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balance will tend to provide an unrealistic reproduction of any musical instrument whose fundamentals or harmonics extend beyond the upper and lower limits of the spectrum.

For transmission of speech, however, some other center in the spectrum may be selected. For example, frequencies of the average male voice range from 100 to 9,000 cycles; this gives us a central frequency of approximately 950 cycles. Female voices have a band-width of 150 to 10,000 cycles, or a central frequency of approximately 1,225 cycles. If the entire band of male or female voices can not be covered, experience has shown that it is best to select a balanced spectrum in preference to favoring either the high or low end.

Some technicians may advance the argument that transmission systems based upon a reference frequency of 1,000 cycles, have always proved to be desirable, and that the establishment of a 622-cycle scale reference is purely theoretical and of no practical value. A number of careful, laboratory-controlled tests were made at Bell Laboratories, to determine the effect of cut-off frequencies at both the high and low end, upon a group of trained observers. A number of representative musical selections were played and cut-off filters were carefully introduced and checked against the observations of the listeners. It was found that whenever a balanced spectrum prevailed, it was easier to detect artificial unbalance. In other words, if an equal number of octaves was present on either side of the central frequency, an unbalancing was more easily detected. The central frequency of these detectable unbalances closely approximated 650 cycles, which proves from a physiological viewpoint, that this frequency is to be preferred to the usual 1,000-, 440-, or 512-cycle standards.

BALANCED AND UNBALANCED SPECTRUMS

It is apparent that an instrument like a bass viol having fundamentals within the band of from 40 to 1,200 cycles, would sound boomy to an ear conditioned at 625 cycles. Similarly, an instrument like a piccolo, having effective frequencies from 500 to 5,000 cycles, would sound comparatively high-pitched. If a group of instruments covers a balanced range and has nearly equal intensities, a balanced orchestration evolves. The type and number of instruments, however, are to be determined by the composer. An amplifier, though, that is to reproduce any group of instruments, must of necessity, pass the band of frequencies which the instruments produce. If a transmission channel is too narrow, care must be taken to keep the limitations equivalent on either side of the central frequency so that excessive tonal unbalance does not take place.

Unfortunately, the ear can easily be conditioned to judge relative tone qualities based upon any central frequency. It is for this reason, that a listener, who has been subjected to programs deficient in high frequencies, becomes conditioned to a new central frequency far below any standard. When this listener is in turn subjected to full-range reproduction, he appears to perceive an excess of high frequencies. Continued listening to this wider range will gradually shift his spectrum central frequency, so that should he again be subjected to the original transmission band, he would immediately note a lack of desirable high frequencies and would recognize unbalance in the transmission band.

Mellowness, harshness, boominess, etc., are expressions which indicate decided unbalance in the audio spectrum. Sometimes, this may be in the original composition, instrument, reproducer, receiver, phono pickup or in the amplifier.

Regrettably, instruments were evolved purely from an artistic viewpoint. Therefore few instruments provide equivalent intensities throughout their fundamental frequency range. In order to maintain the original tone color of any instrument it is imperative that the entire band comprising the frequencies which contribute to the characteristic tone of the instrument, be transmitted through the amplifier and its associated equipment without any variation. Trained listeners can easily detect any discrimination between an original and a reproduced version of any musical rendition, in the present state of the art.

Unbalanced spectrums may be manipulated to produce the effect of balance by increasing the intensity of the shorter end of the spectrum. For example, if a spectrum passes 2½ octaves of the lower frequencies, and 3½ octaves of the higher frequencies tonal balance may be subjectively attained by bass boosting or objectively attained by high-frequency cutting. This is one of the reasons why cutting high frequencies sometimes produces the same effect as boosting bass. Both are an attempt to obtain a balanced spectrum. This type of manipulation may be necessary to balance deficiencies in some link within the chain of the reproducing equipment.

EVALUATING THE SPECTRUM

Plainly, an amplifier and any associated equipment having a flat response of from 1,000 to 10,000 cycles or 50 to 1,000 cycles, would be unsuitable for musical reproduction. There are 2 important points to remember in evaluating a transmission spectrum. They are: (1) band-width; and, (2) spectrum balance. It is naturally desirable to have the widest band possible. The ideal is 11 octaves plus 1 major third which represents an interval of 2,500—the characteristic center of the extreme band-width of 12 to 30,000 cycles; a frequency response of 16 to 20,000 cycles represents an interval of 1,250—or 10 octaves plus a major third. A balanced spectrum should have equal intervals from the lowest frequency to 622.3 and from 622.3 cycles to its highest frequency.

If an amplifier has a flat response down to 55 cycles (which represents 3½ octaves from center towards the low frequency), it should have an upper limit of 7,040 cycles (which also represents 3½ cycles towards the upper limit). An unbalanced response would be one that goes from, let us say, 110 cycles to 14,800 cycles. In this latter condition, there is a 2½-octave band below the central frequency and a 4½-octave band above the central frequency. Signals having a fundamental range which extends beyond the limits of this transmission band would never sound realistic. For balanced reproduction, it would be necessary to increase the bass response by 2½ octaves, that is, down to 27.5 cycles; or, if this corrective measure could not be applied, the bass would need to be extended by 1 octave and the high end decreased by 1 octave.

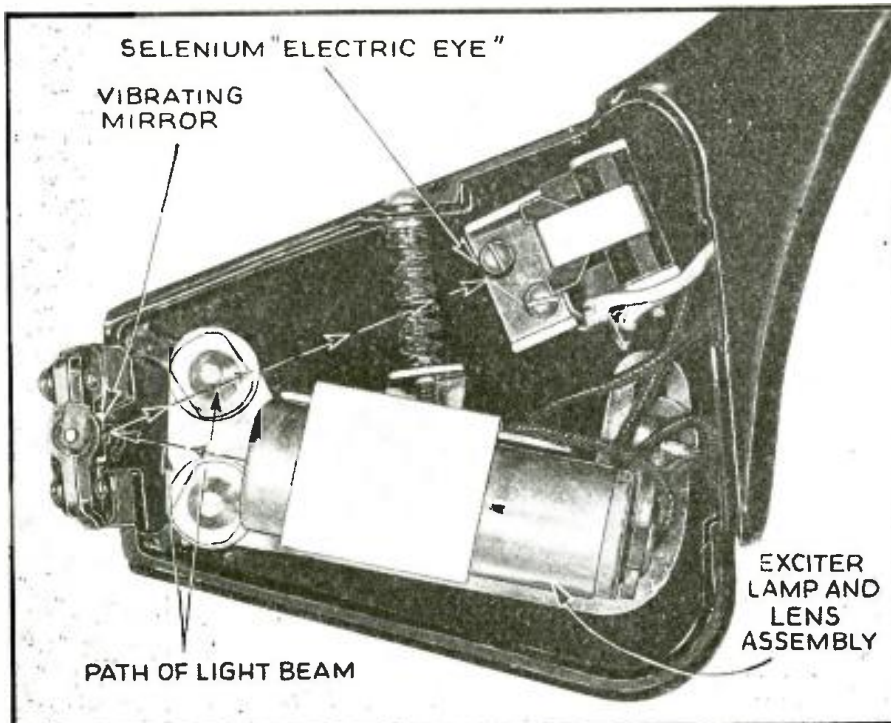
Lack of space prevents a complete and comprehensive treatment of this phase of sound. It is hoped, however, that this discussion will prove to be a stepping stone to bridge the gap between the musician and sound engineer. The author will appreciate receiving comments from musicians, teachers, sound engineers, and music lovers.

NEXT MONTH— UNIVERSAL PHONO PICKUP!

The forthcoming issue of *Radio-Craft* will contain a description of an outstanding phonograph device—a pickup which plays-back either lateral-cut or vertical-cut records without any changes in the pickup head. The device is a recent development of the Western Electric Co.

PHOTOELECTRIC PHONO PICKUP

The basic principle of the "mirror galvanometer," in which a weightless lightbeam magnifies small motions by being reflected to a distance, receives its newest application in Philco's new phono pickup unit. The result is a Photoelectric Phonograph. A number of important advantages are claimed, including higher fidelity, less needle scratch, and lengthened record life.



The Photoelectric Pickup. It is said to be 40% to 60% more sensitive than preceding types. The light from a high-intensity argon-filled filament-type exciter lamp fed by a radio-frequency current is reflected from a mirror, about 1/4 x 3/8-in. high, and paper-thin to a selenium "electric eye."

THE basis of 5 important advantages in the reproduction of recorded music, speech, etc., has been found in the use of a new "Electric Eye" Pickup in which a weightless lightbeam reflected from a featherweight, vibrating mirror, acts to generate a comparatively strong current in a light-sensitive cell.

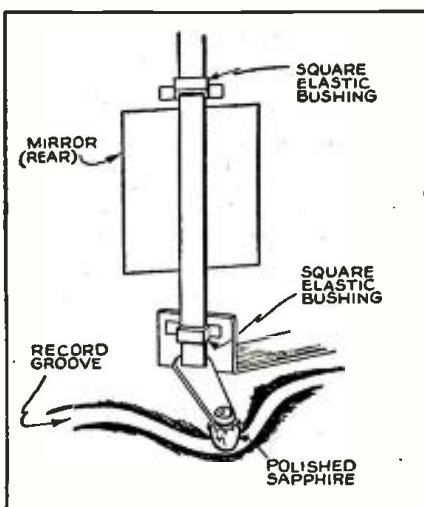
These advantages are the following: (1) elimination of the necessity of frequently changing a needle; (2) record life increase of at least 10 times; (3) greater reproduction fidelity, especially in respect to cleaner bass notes and clearer high notes; (4) greater volume and tonal range with obviously less record scratch and noise; (5) safeguarding against accidentally scratching the record, or breaking the needle as is so readily possible in ordinary phonographs (as by accidentally allowing the pickup head to drop on the record).

Philco Radio Corp. engineers have found that the way to obtain these results was to "do it with mirrors."

THE TRIGGER ACTION

It was apparent that little force would be required to move a tiny mirror mounted on the rotating axis on which the mirror would swing as the floating jewel (which replaced the old-fashioned steel needle) followed the curving record groove. Thus, by directing a beam of light into this mirror, at an angle which reflects it on the photoelectric cell, it was possible to set up a controlling source of energy without making the record do the work.

As the floating jewel (sapphire) moved along the curve of the record groove, the mirror swung from side to side on its axis,



The rounded sapphire tip, which supplants the usual, less-unyielding steel needle, rides in the record groove with a pressure said to be only about 0.9-oz.; its side-to-side motion in a lateral-cut record groove wobbles the mirror at audio frequency (*and can be operated into the super-sonic region, it is said), the resulting changes in light intensity on the light-sensitive cell generating a voltage which is then amplified.

*A laboratory worker is said to have obtained response out to about 28,000 cycles by resting the sapphire on a crystal speaker driven by a beat-note oscillator.—Editor

flashing the beam of light on and off the photoelectric cell. Since the photoelectric cell translates light into electrical energy—such being the peculiar property of certain materials—the flow of current generated by the photoelectric cell varies in proportion to the amount of light flashed in the cell as the mirror is swung by the jewel.

There are 4 definite stages, then, in the process of taking the music off the record and transmitting it to the ear. *First*, the photoelectric phonograph employs mechanical vibration as the jewel pulses in the groove of the record. *Second*, light vibrations are brought into play when reflections of the light beam shining on the mirror play on the photoelectric cell. *Third*, electrical vibrations generated by the photoelectric cell are transmitted to, and operate, the loudspeaker. *Fourth*, acoustical vibrations carry the sound waves to the ear and complete the process.

Such, in brief, is the fundamental operating principle of the new photoelectric pickup built into the latest Philco radio-phonograph combinations. However, in order to make it work properly and practically, a number of other refinements and innovations were necessary.

STRUCTURAL DETAILS

One of these contributing features is represented by the mirror itself. To minimize the amount of energy required for the jewel to swing the mirror, it was necessary to utilize a paper-thin mirror specially designed for use in galvanometers. This is silvered with a vaporized aluminum and mounted on a tiny block which swings on an axis which floats on 2 flexible bearings.

The solution of another problem involved the design of a tiny bulb to supply the light beam directed against the mirror and reflected on the photoelectric cell.

To meet technical requirements as to size and weight a tiny bulb filled with argon gas to lengthen the life of the filament was designed—the first of its kind commercially produced to have the refinements of the regular high-powered domestic bulb.

It was also necessary that the beam of light at its source have no waver or flicker as this would register on the sensitive photoelectric cell in addition to the music and result in a hum in the loudspeaker. Consequently, the household alternating current which operates the radio-phonograph had to be transformed into a steady flow of light by an oscillator which generates high-frequency currents, stepping up ordinary domestic A.C. from 60 cycles to 1,800,000 cycles (1.8 mc.).

In this same connection—to insure a steady and unvarying flow of light—it was necessary to build the filament supports in the little bulb in the photoelectric reproducer of extra heavy wire to minimize any shaking on the part of the filament. Otherwise the musical reproduction would be marred by microphonic howl or noise generated by the flickering beam of light.

Still another problem solved by the engineers was to cover the entire range of the piano, reproducing the bass notes without any thumping sound and yet reproduc-

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PROMPT SHIPMENTS



A view into one of Philco's phono-radio sets using the new pickup.



No. 1
HOW TO BUILD FOUR DOERLE SHORT WAVE SETS

Thousands of radio fans have built the famous DOERLE Short Wave Radio Receivers. So insistent has been the demand for these receivers, as well as construction details, that this book has been specially published. Contains EVERYTHING that has ever been printed on these famous receivers.

No. 2
HOW TO MAKE THE MOST POPULAR ALL-WAVE 1' and 2-TUBE RECEIVERS

This book contains a number of excellent sets, some of which have appeared in past issues of RADIO-CRAFT. These sets have been carefully engineered. They are not experiments. Not only are these sets described in this book, but it contains all of the illustrations, hookups, etc.



No. 3
ALTERNATING CURRENT FOR BEGINNERS

This book gives the beginner a foothold in electricity and Radio. Electric circuits are explained. Ohm's Law, one of the fundamental laws of radio, is explained; the generation of alternating current; sine waves; the units—volts, amperes, and watts are explained. Condensers, transformers, A.C. instruments, motors and generators.

No. 4
ALL ABOUT AERIALS

This book explains the theory underlying the various types of aerials; the inverted "L," the Doublet, the Doublet, the Doublet, etc. It explains noise-free reception, how low-impedance transmission lines work; why transposed lead-ins are used. It gives in detail the construction of aerials suitable for long-wave broadcast receivers, for short-wave receivers and for all-wave receivers.

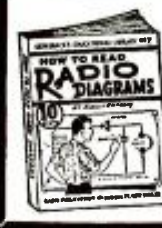


No. 5
BEGINNERS' RADIO DICTIONARY

Are you puzzled by radio language? Can you define Free-Kitowels? Tetrodes? Screen grid? Baffle? Anode? Triode? Pole? Ionization? Joule's Law? Harmonic? Crayley Cell? If you cannot define these very common radio words and dozens of others, more technical terms used in all radio magazines and instruction books, you need this book in your library.

No. 6
HOW TO HAVE FUN WITH RADIO

Stunts for parties, practical jokes, scientific experiments and other amusements which can be done with your radio set are explained in this fascinating volume. It tells how to make a newspaper talk—how to produce silent music for dances—how to make visible music—how to make "silent radio" units usable by the deafened—how to make toys which dance to radio music, etc., etc.



No. 7
HOW TO READ RADIO DIAGRAMS

All of the symbols commonly used in radio diagrams are presented in this book, together with pictures of the apparatus which represent and explanations. Kivink an easy method to memorize them. This book by Robert Eichberg, the well-known radio writer and member of the editorial staff of RADIO-CRAFT Magazine, also contains two dozen picture-wiring diagrams of simple radio sets that you can build.

No. 8
RADIO FOR BEGINNERS

Hugo Gernsback, the internationally famous radio pioneer, author and editor, whose famous magazines, RADIO AND TELEVISION and RADIO-CRAFT are read by millions, scores another triumph with this new book. Any beginner who reads it will get a thorough ground work in radio theory clearly explained in simple language, and through the use of many illustrations. Analogies are used to make the mysteries of radio clear.



No. 9
SIMPLE ELECTRICAL EXPERIMENTS

Over 100 interesting and practical electrical experiments are described in this book, covering every branch of electricity—from simple experiments with magnets to high frequency "stunts." All of the experiments described can be carried out with simple apparatus, most of which can be found about the home.

No. 10
TELEVISION

Every one is asking the question: How does television work? This book explains all of the different systems of television from the simplest to the most complex. It describes in A-B-C style just how the image is scanned, how the scene is picked up by the television camera and broadcast to your home, etc. Various types of television systems are described.



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ing the high notes to the desirable maximum range without transmitting the hiss and record noise audible at these high frequencies on ordinary phonographs.

This faithful reproduction of highest frequencies is made possible by employing both mechanical resonance and electrical resonance. Electrical resonance is produced in the ordinary manner when the vibration of the jewel in the groove is translated into a varying flow of electric current operating the loudspeaker.

Mechanical resonance—an extra contribution to the tone value—is achieved by having the tiny arm which supports the floating jewel made of phosphor bronze of the exact thickness and length required to make that arm vibrate when a high note is reproduced. In other words, both the jewel and the jewel arm are vibrating with extra intensity in the high-frequency range, consequently an additional motivating force acts on the mirror, causing it to flash a more effective light signal to the photoelectric cell.

This achievement is possible only because of the free-floating construction of the photoelectric reproducer; its lightness and flexibility make the jewel's tiny arm an additional source of energy and result in transmission of the high notes with a clear fidelity never before achieved, Philco states.

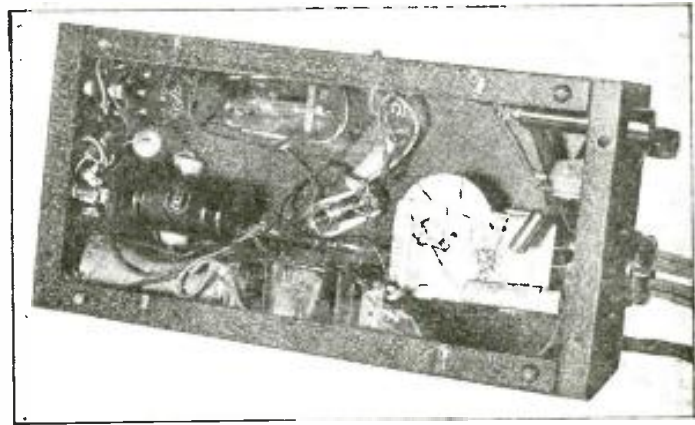
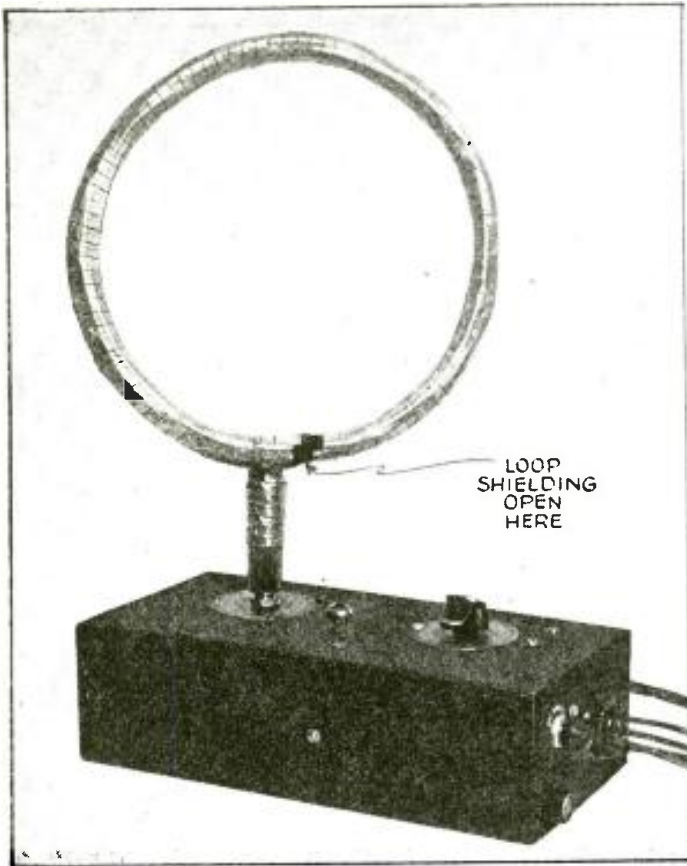
Another construction feature involved building and hooking-up a special shielded transformer to relay the current generated by the photoelectric cell to an amplifying tube.

Still another contribution to the science of sound transmission is presented by the floating jewel itself. Carefully ground to the most exacting dimensions, this floating jewel has a rounded tip instead of the old-fashioned needle's dagger-like point. As a result it moves through the record groove without digging into the record in an injurious manner. Because a freely floating sapphire jewel has replaced the steel needle to detect what is on the record, wear and tear are reduced to a minimum, and gouging and fraying of the record are virtually eliminated. The jewel has a life of 8 to 10 years. Use of it increases the life of records so greatly that they may be played 1,000 times.

Such is the newest miracle of modern science—a phonograph which like talking pictures, reproduces sound on a beam of light!

ARMY RECRUITING TRANSCRIPTIONS

Electrically-recorded appeals by President Roosevelt and other prominent persons urging enlistment in the U. S. Army are the newest application of Sound. Airing of these transcriptions was delayed by bad weather last month but, eventually, 2 Army planes, a bomber and a small attack ship, left Mitchell Field, L. I., to deliver these transcribed recruiting messages throughout the Second Corps Area, reported the *New York Times*.



Above, interior of the Loop Adapter.

◀ Left, front view of the Loop Adapter. Many advantages are secured by connecting the output of this unit to the antenna and ground posts of any radio set. Paramount are greater sensitivity and fidelity, and less interference (noise, crosstalk and whistles).

Increased sensitivity, fidelity and freedom from interference are the products of adding to existing radio sets the easily-built Loop Adapter, incorporating a stage of R.F. amplification, here described. Built in cooperation with R. D. Washburne, it is described in 2 types, viz., (1) Tuned and (2) Aperiodic; and in self-powered and set-powered designs.

How to Make a Practical LOOP ADAPTER FOR B'CAST. SETS

CHARLES R. LEUTZ

IN recent broadcast receiver designs, there is a definite trend towards the use of *loops* (a number of turns of wire in a single "bundle" or "pancake," as desired), either plain or shielded, to replace the conventional indoor and outdoor aerials. A properly designed loop aerial, if adjustable to direction, offers several important advantages.

First, all loops have bi-directional characteristics and instead of picking up signals and noise indiscriminately from all directions, the reception is confined to 2 general directions in 1 plane. Furthermore, if the loop is provided with a *Faraday shield* a further reduction of noise reception may be obtained.* Therefore by using a loop, and assuming the noise arrives in equal amounts from all directions, a reduction of noise interference of approximately 50% may be obtained. Some types of noise interference may or may not arrive from one definite direction. Other noise interference that apparently arrives from all directions cannot be eliminated or reduced by the use of a loop.

To date, the application of loop aerials to broadcast receivers has apparently been applied as a means to eliminate noise and also to eliminate the necessity of an outdoor aerial. In such applications where the loop position is fixed, the full possible advantages are not available. If the receiver is operated at a location having high external noise level, the results are inferior to operation with a good outdoor aerial, with the latter being removed from the noise source as far as practicable.

By making the loop adjustable in direction, new advantages can be secured which so far appear to have been overlooked; these benefits, which pertain to the possible elimination of *adjacent-channel* and *image interferences*, external to the receiver, may be summed-up as resulting in higher fidelity.

HIGHER-FIDELITY RECEPTION WITH LOOP ANTENNAS

The present, accepted method of eliminating adjacent-channel interference involves the use of highly-selective receivers, a condition which automatically excludes the possibility of high-fidelity

*See "How The Beam-a-Scope Works," Radio-Craft, April 1939.



reception. A better solution, found in the higher-grade receivers, calls for the use of *band-expanding* intermediate-frequency transformers having 3 or more coupling positions. Even with this desirable feature, high-fidelity reception is only possible when the desired signal is tremendously strong as compared to possible interference from adjacent-channel transmitters. Otherwise it becomes necessary to increase the degree of selectivity in the I.F. amplifier, which of course automatically sacrifices part of the possible audio-frequency range, depending upon the degree of sharpness to which the selectivity must be increased. As far as adjustments within the receiver are concerned, *there is no known method* of simultaneously providing high selectivity and high fidelity.

However, in using a broadcast receiver in connection with a loop, depending upon the geographical location of the receiver and the relative direction of desired and undesired signals, it often becomes possible to eliminate adjacent-channel interference external to the receiver; full-range high-fidelity reception and reproduction is then simplified and practical. In view of this fact, it is likely that the use of loops will become more important to broadcast receiver designers in the near future, not only for the broadcast band but also for the high-frequency and possibly ultra-high-frequency bands.

A loop can be added to existing receivers in several ways. It is not always convenient to alter a standard receiver for loop connections. A better method calls for a loop which can be connected to the doublet or antenna input circuit of any standard receiver. The accompanying photograph shows a Loop Adapter, which can be readily connected to any standard receiver. A stage of radio-frequency amplification is added with the loop, this being of special advantage when used with superhet. receivers that do not have a stage of R.F. ahead of the mixer or 1st-detector.

THE LOOP ADAPTER

Figure 1 is a complete schematic wiring diagram of the Loop Adapter, arranged for A.C.-D.C. operation. The tuned loop is

connected to the 6SK7 R.F. amplifier input. The output of the R.F. amplifier tube can be connected to standard receivers in either of 2 ways.

First, if the receiver has a doublet input transformer, the primary winding A-D can be used as the plate winding for the 6SK7 output. In that case the plate connects from No. 6 to A and the "B"-positive from No. 7 to D. Second, where the receiver has an ordinary antenna-ground connection, the R.F. tube is resistance-capacity coupled, using the 0.1-meg. plate resistor and 100 mmf. mica coupling condenser. The connection is then made from No. 4 to A, and grounds connected as shown. The power loop chassis must not be grounded directly.

Figure 2 gives the drilling dimensions for the standard chassis specified. A detail shows the method of mounting the tube sockets within the chassis, one for the 6SK7 and one for the 25Z5 rectifier. The output connections are taken from a flush octal socket using an octal male plug.

In connecting the loop to the receiver it is very important that the connecting leads are shielded so they cannot pick up signals directly. In the case of connecting to a doublet input, a piece of low-loss coaxial cable is suggested.

MAKING THE LOOP

The size loop to use is a matter of appearance. The largest possible size is of course most desirable from the standpoint of efficiency. For this model the loop consists of 27 turns of 10/No. 32 Litzendraht wound on a form 7 inches in diam. These turns are random wound, coated with a low-loss, moisture-proof coil dope such as Amphenol 912B or Millen High Q. Upon hardening the coil can be removed from the winding form. The loop is terminated to a phone plug. Using a standard open-circuit jack, the plug and jack not only provide the electrical connections but also provide a mechanical means to rotate the loop direction.

The loop may be used unshielded or shielded as desired. A convenient way to shield the loop is to use a flexible shielding tape. This consists of a thin gummed cloth strip 1/4-in. wide covered with a thin layer of tinfoil. The method of winding the shield is shown in the detail, Fig. 3. The shield can be connected to the loop chassis connection or to a separate ground. In the latter case a 3-contact microphone-type plug and jack should be used. In order to eliminate a "shorted turn" effect the shielding must be left open at 1 point (see photo).

A more efficient Loop Adapter can be made at slightly higher expense by using a power transformer and rectifier to supply the necessary plate and screen-grid voltages as per Fig. 3. This enables operating the R.F. tube at the maximum rated voltages and with substantially improved results. In this case it is suggested that both the loop tube input and plate output circuits be tuned with a 2-gang condenser. The output transformer has a plate winding L1 which tunes the broadcast band. The secondary winding matches the input doublet circuit of the receiver. With tuned input and output, there will be a tendency for the R.F. tube circuit to oscillate unless great care is taken in separating and shielding the control-grid and plate leads. The connection between the output secondary L2 and the receiver input should be a piece of coaxial cable.

Figure 4 shows another method of making a shielded loop conveniently. A piece of brass angle 1/2 x 1/2 x 1/32-in. thick is bent to a square of the size desired, for example 7 ins. as shown. Saw cuts are made at the corner before bending. The loop turns are now wound around this frame, using well-insulated wire so there will be no danger of shorted turns. Then another piece of angle brass is bent to shape to enclose the winding. The 2 angles can be fastened together by soldering lightly at several points. The construction is shown in the cross-sectional detail (Fig. 4). The metal shield must not be a closed loop and is left open at the point of connection to the phone plug.

(The exact number of turns required in the loop will vary in every instance and must be determined experimentally. Such factors as the proximity of the loop wire to its shield housing, and the capacity range of the tuning condenser, will tend to throw the loop tuning off-match with the associated receiver. Perhaps the simplest method of checking alignment of the loop resonance with the receiver's tuning system is to set-up a Colpitts oscillator, as described in the article in this issue by Mr. Lorensen on oscillator coils, and zero-beat the loop against the radio set to which it is ordinarily used. Thereafter, it may be used with any radio set tuning over approximately the same wavelength range; note however that the dial readings for a given station then may not always coincide.—Editor)

REMOTE CONTROL

In some receiving locations, subject to severe local noise disturbances, it becomes necessary to remove the loop a substantial distance from the receiver. For example the receiver might be on a lower floor of a tall building. As long as high grade coaxial cable is used between the loop output and receiver input, the distance involved is not a problem. However, some means must be

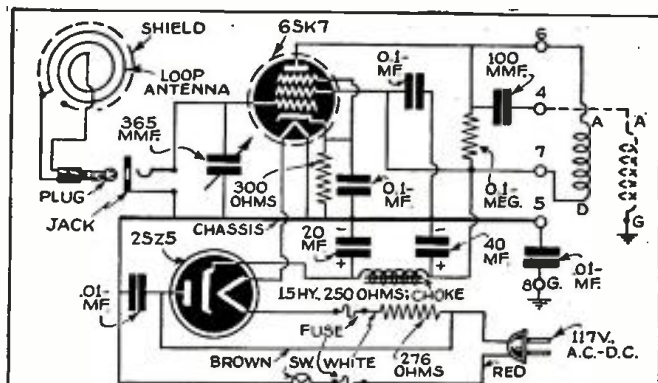


FIG. 1 ~ A.C.-D.C. TUNED LOOP ADAPTER ~

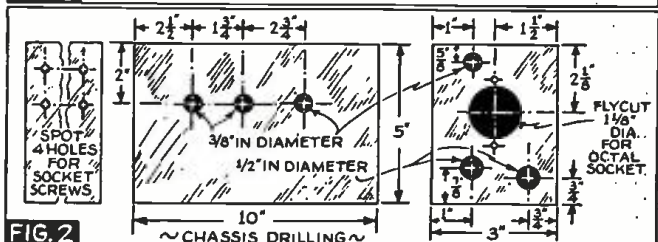


FIG. 2 ~ CHASSIS DRILLING ~

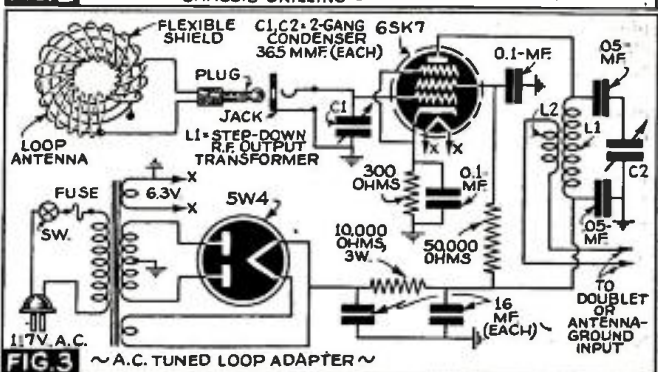


FIG. 3 ~ A.C. TUNED LOOP ADAPTER ~

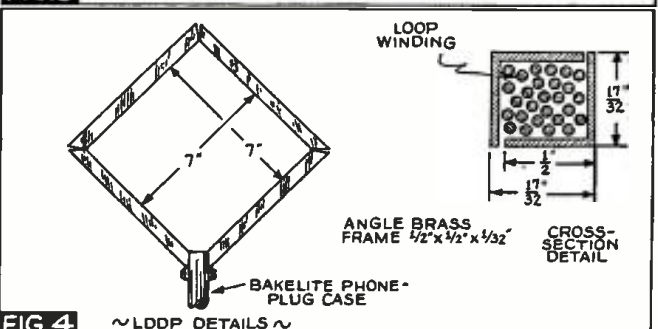
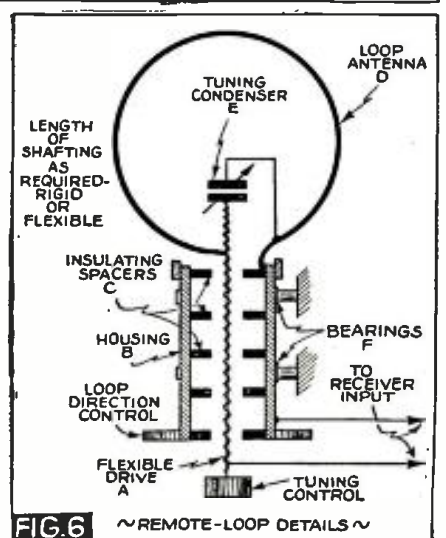


FIG. 4 ~ LOOP DETAILS ~

A Above, construction details of the Loop Adapter, its circuit, and alternative circuit and loop arrangements.



Right, a method for securing increased gain by placing the loop at a distance and controlling it from a remote point.

FIG. 6 ~ REMOTE-LOOP DETAILS ~

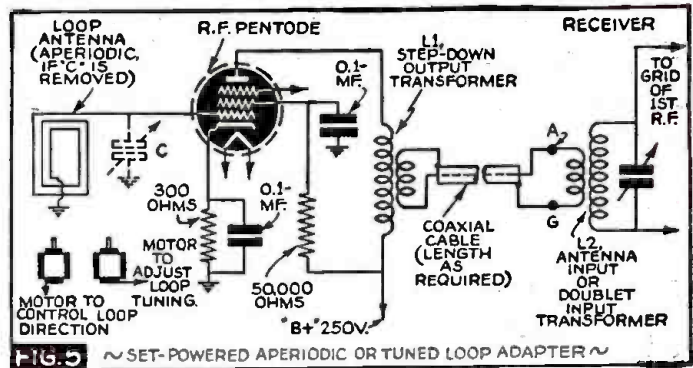
provided to tune the loop and to adjust the loop direction, by remote control. Figure 5 shows a suggested method using small motors of the type used formerly in receiver remote control tuning systems.

COMBINED TRANSMISSION LINE AND LOOP-DIRECTION CONTROL

Where the distance between the loop and receiver is not too great a combined mechanical control and electrical transmission line can be used as shown in Fig. 6. (Also see Fig. 3, in "Rebuilding for Profit," August *Radio-Craft*, pg. 82.) The housing B can be either a rigid copper tube or flexible tube and it is supported at intervals by the bearings F. The loop is fastened to this housing and changing the rotation of the housing changes the loop position. Within the housing, is a series of insulating spacers C, and the center conductor and drive shaft A. The latter may be rigid or flexible; if flexible, more spacers will be required to provide insulation. The drive shaft A is connected to the loop tuning condenser rotor shaft; the shaft A is therefore used to control the loop tuning. The loop is connected to A and B at the top end of the housing. The receiver input is taken off the lower end of the housing at A and B. This application should be very useful on board ship to extend the control from the radio room or chart house to above-deck.

In addition to adjusting the loop as to direction, if provision is made to adjust the loop as to plane, that is from vertical to about 45° off vertical, it is often possible to obtain a more sharply defined null point. Under the same condition, the loop is more responsive in one of the 2 receiving directions and the device can be used as a direct direction indicator without any supple-

Fig. 5. A remote loop antenna may require a coaxial-cable transmission line, as here shown. Note that condenser C can be eliminated, making the system an aperiodic (non-resonant) loop. Coil L1 must then be very closely coupled; only 1 control is then required, that for loop direction. However better results are obtained by including provision to tune the loop as well as to rotate loop direction.



mentary sensing aerial. The above system is applicable to both shielded and unshielded loops.

List of Parts

CONDENSERS

- One Meissner single-gang No. 21-5200 Compact, 365 mmf.;
- Two Mallory 0.1-mf., 400 v., paper;
- One Mallory 0.01-mf., 400 v., paper;
- One Mallory 100 mmf., mica.

RESISTORS

- One I.R.C., 300 ohms, 1/2-w.;
- One I.R.C., 0.1-meg., 1/2-w.;
- One Clarostat line cord resistor, 276 ohms.

CHASSIS

- One Parmetal type B-4508 with BP-4508 bottom plate 5 x 10 x 3 ins. high.

TUBES

- One RCA type 6SK7;
- One RCA type 25Z5.

MISCELLANEOUS

- One U.T.C. choke, R14, 15 hy., 40 ma.;
- One Amphenol type RS-6 socket;

- Two Amphenol type RS-8 sockets;
- One Amphenol type PM8 plug;
- One Littelfuse extractor post and fuse, 1 ampere;
- One Meissner type 25-8221 knob;
- Three Meissner type 25-7615 tie points;
- One Mallory type A-1 open-circuit jack;
- One Mallory bakelite phone jack (for loop);
- One Mallory No. 720 S.P.S.T. switch;
- One Mallory type B310R pilot lamp bracket and 2.5-v. bulb;
- One-quarter lb. Consolidated No. 20 B.&S. S.S.C. copper wire (for loop);
- One roll Consolidated flexible shield (for loop);
- One Mallory 20-40 mf., 175-v., electrolytic;
- One rubber grommet 3/8-in. dia;
- Four No. 6/32 rd. hd. brass mach. screws 1 1/4-ins. long;
- Six No. 6/32 rd. hd. brass machine screws, 1/2-ins. long;
- Eighteen No. 6/32 hex. nuts and lock washers;
- One roll resin core Solder.

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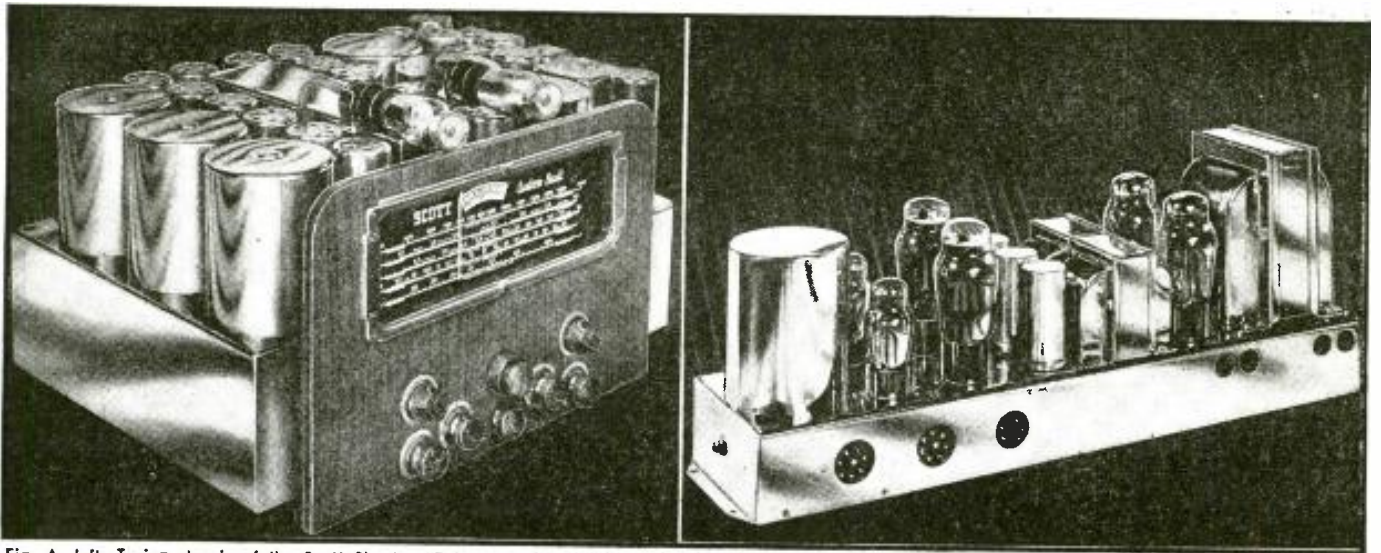


Fig. A, left. Tuning chassis of the Scott Phantom DeLuxe combined F.M. and A.M. hi-fi receiver. Note dual visual indicators. Fig. B, right. Chassis of the Phantom's power amplifier; its circuit innovations contribute to wide-range audio-frequency response.

Latest 28-Tube DeLuxe High-Fidelity F.M. AND A.M. B'CAST RECEIVER

Here is an exceptional custom-made all-wave receiver, combining amplitude and frequency modulation receiving systems, with a power output of up to 40 watts and a frequency range of 30 to 15,000 cycles! Its sound system therefore takes full advantage of F.M.'s hi-fi characteristic; the A.F. amplifier is particularly suitable for phonograph reproduction and includes a needle scratch suppressor system. Other circuit innovations are described.

MARVIN HOBBS

THE receiver described here employs 28 tubes and is designed for the reception of amplitude-modulated signals in the frequency range of 540 kc. to 23 mc. (about 13 to 550 meters); and frequency modulated signals of the wide-band type in the frequency range of 41 to 50 mc.

The amplitude and frequency modulation sections are separate superheterodyne receiving systems up to the input circuit of the 1st stage of the audio-frequency amplifier, which is capable of handling either type of program with full fidelity and volume range as transmitted. Eight of the tubes function solely for the benefit of frequency modulation; 9 tubes for amplitude modulation; 8 tubes in the A.F. ampli-

fier; 2 in the power supply and 1 tube as a common voltage regulator. Eight controls on the front of the chassis, including the tuning knob and its associated vernier, permit adjustment of the performance characteristics to meet varying conditions of reception.

THE R.F. SYSTEM

In Fig. A a front and side view of the main chassis is shown. The R.F. and I.F. systems and the 1st 2 audio-frequency stages are assembled on this base; with the remainder of the A.F. amplifier and the power supply on a separate chassis, which is usually mounted with the speaker system in the lower section of the cabinet. The

variable condenser associated with the F.M. section is assembled on a common shaft with the standard tuning condenser, and both are housed under the long, rectangular shield toward the left-center of the chassis. The R.F. and mixer tubes of this section are located near this shield. The F.M. intermediate-frequency section is located on the extreme right-hand side of the chassis with the audio output feeding through a shielded cable to the band switch, where it is connected to the A.F. amplifier input circuit when the F.M. range is selected.

Separate antenna connections for the A.M. and F.M. are provided in the rear of the chassis, so that a double doublet system may be used for the shortwave-and

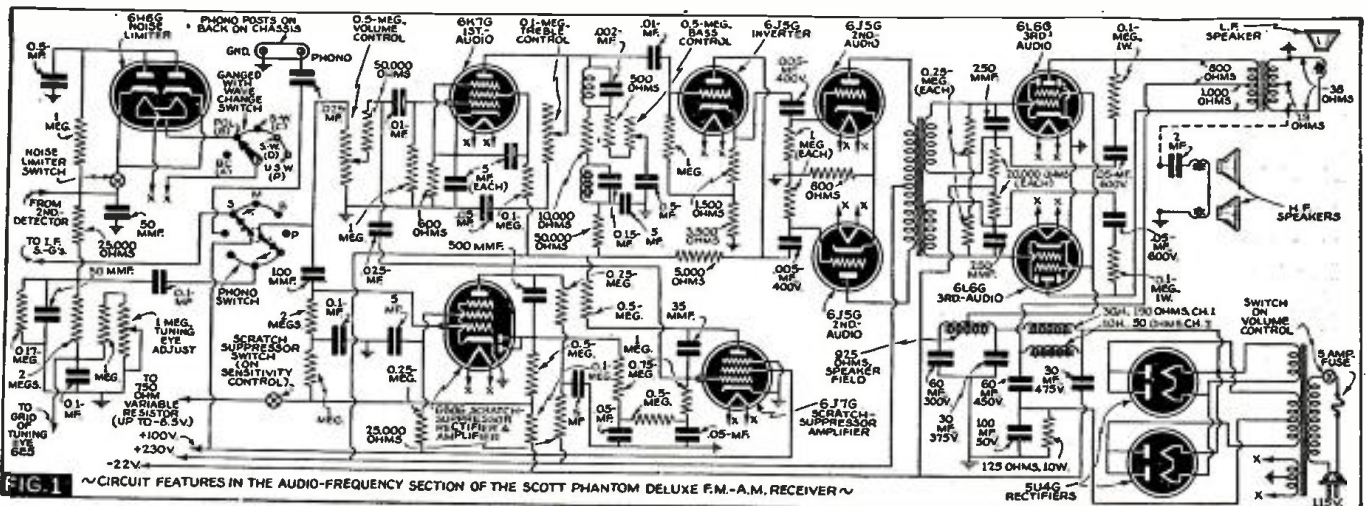


FIG. 1 ~CIRCUIT FEATURES IN THE AUDIO-FREQUENCY SECTION OF THE SCOTT PHANTOM DELUXE F.M.-A.M. RECEIVER~

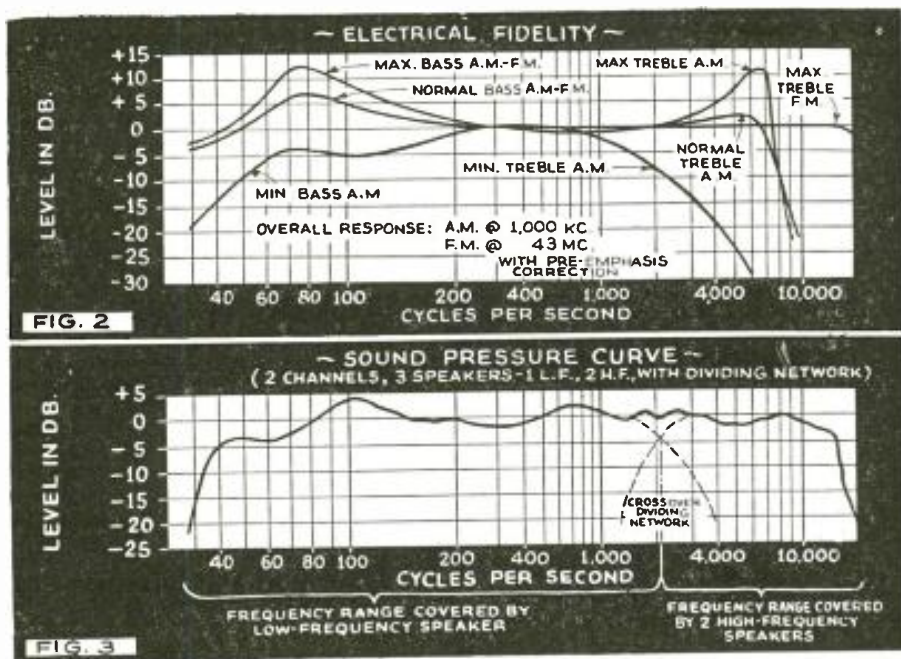


FIG. 2

FIG. 3

broadcast-band signals, with a separate dipole of the proper length for the F.M. signals. This arrangement insures maximum efficiency on all bands and is quite practical where the listener is desirous of obtaining the best results. The F.M. antenna transformer is designed to match a low-impedance line and dipole as an added precaution against noise pick-up in the lead-in, which should be of the close-spaced type for this band. Electrostatic shield rings are employed between the primary and secondary windings of all of the A.M. antenna transformers to insure a minimum of noise pick-up from the lead-in.

THE F.M. SYSTEM

In the F.M. section the high sensitivity level possible with this tube line-up results in limiting action on signals having a strength as low as 1 microvolt-per-meter. The screen-grid and plate potentials of the limiters have been adjusted so that the overall action is absolutely flat after the knee of the output curve is passed. Therefore, no distortion from any artificially-

created amplitude modulation is possible once the limiters have commenced to operate. The I.F. selectivity is adjusted at the laboratory so that it is sufficiently broad to prevent phase distortion which can result when the selectivity is too sharp or unsymmetrical.

An intermediate frequency of 5.25 mc. is used to obtain high image and spurious signal rejection ratios; and the temperature-compensated oscillator operates on the low-frequency side of the incoming signal to avoid image signals from the television bands and to insure maximum stability.

The F.M. tuning indicator, which is located on the right-hand side of the chassis above the dial, is operated by the D.C. voltage across the discriminator load resistors and, therefore, it is a true zero-center meter. The discriminator circuits are properly loaded to eliminate distortion and are tuned by air dielectric condensers to prevent any drift in that characteristic. The peaks of this curve are separated by 250 kc. to allow a sufficient margin of linearity beyond the total wide-band modulation swing of 150 kc.

The adjacent-channel selectivity of the I.F. amplifier is such that any portions of the detector characteristic outside of the 200 kc. channel receive a minimum amount of voltage from any adjacent-channel signals.

THE A.F. SYSTEM

In Fig. B a view of the amplifier and power supply chassis is shown; the diagram of this portion of the receiver is given in Fig. 1. Degenerative feedback is used to keep the distortion level at a minimum. A maximum output of 40 watts, with approximately 35 watts of undistorted power, is available.

In Fig. 2 the electrical fidelity of the audio amplifier as it operates in both the A.M. and F.M. bands is shown. The high-frequency peak around 6,500 cycles compensates for the attenuation of the 455 kc. I.F. system used in all A.M. bands. This peak is eliminated in the F.M. position by contacts on the wave-band switch which selects all of the circuits required for that type of reception. Treble and bass response controls on the receiver provide a certain degree of quality adjustment.

To obtain a high degree of electrical fidelity a special loudspeaker system, Fig. C, consisting of 2 high-frequency tweeter units

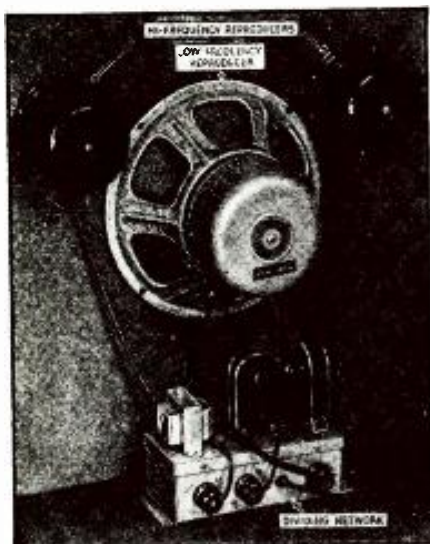


Fig. C. Loudspeaker system of the Phantom. The wide frequency response necessary to take full advantage of the high-fidelity characteristics of Frequency Modulation is due in good measure to the use of this triple-speaker sound system and associated matching network.

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and one 12-in. low-frequency unit has been developed and has been found to provide a sound pressure response which is effective up to 15,000 cycles as measured on the axis of the high-frequency units. The high-frequency output energy is separated from the low-frequency energy by a constant resistance filter before it enters the high-frequency speakers. Figure C shows the speaker units mounted on a baffle together with the special filter network. The sound pressure characteristic is plotted in Fig. 3.

PHONO NEEDLE SCRATCH SUPPRESSOR

An interesting feature in the audio amplifier is the *phonograph needle scratch suppressor system*, which is mentioned below in connection with the tube complement. It functions by reflecting an appreciable shunt capacity across the input terminals of the audio amplifier when weak audio voltages are applied. As soon as the audio signal level rises above the threshold level the shunting capacity is automatically removed and the fidelity is restored. The result is that relatively weak needle scratch and surface noise between the musical passages of a phonograph record are effectively silenced; but as soon as a musical passage appears, the audio voltage becomes sufficient to release the bypassing action. This circuit

is also capable of increasing the intelligibility value of some weak A.M. signals in the shortwave band.

TUBE COMPLEMENT

The tube complement of this receiver is divided in the following manner:

F.M. Section—1853, R.F. amplifier; 6SA7, mixer and oscillator; 1232, 1st I.F. amplifier; 1232, 2nd I.F. amplifier; 6J7G, 1st limiter; 6J7G, 2nd limiter; 6H6, discriminator detector; and 6E5, tuning indicator.

A.M. Section—6U7G, R.F. amplifier; 6L7G, mixer; 6J5G, oscillator; 6B8G, R.F. A.V.C. amplifier and rectifier; 6K7G, 1st I.F. amplifier; 6K7G, 2nd I.F. amplifier; 6B8G, 3rd I.F. amplifier, and 2nd-detector; 6H6G, noise limiter; 6E5, tuning indicator.

Audio Amplifier—6J7G, phonograph record scratch suppressor control tube; 6B8G, phonograph record scratch suppressor amplifier and rectifier; 6K7G, 1st audio amplifier; 6J5G, audio inverter; 2—6J5Gs, push-pull audio driver stage; 2—6L6Gs, push-pull audio output stage.

Power Supply—2—5U4Gs, rectifiers; VR150, oscillator and tuning indicator voltage regulator.

This article has been prepared from data supplied by courtesy of Scott Radio Laboratories, Inc.

The B.B.C. Airs An Exciting Recorded Program

The following item vividly portrays the progress which has been made in England in the sound recording type of radio program—and one of its possibilities during time of war—to which WMCA has given the name "Documentary Radio."

The British snapped out of their propaganda pomposity with a bang today, presenting what New York listeners considered the most stirring and dramatic radiocast of the entire war.

The broadcast, picked up shortly after 1 a.m., was in German and directed to Germany. On it was heard the voice of Germany's Air Marshal, Hermann Goering, as he spoke to the German people months ago, his voice having been recorded by the British at the time.

The program, following a regular news-cast, opened with sound effects—the rattle of machine guns, the roar of planes and the blasting of bombs. As these sounds of war climbed to an intense crescendo, there came the cries of women—pathetic, heart-stirring cries.

Then, against the background of power-diving planes and screeching bombs, there sounded the voice of Goering:

"I have personally inspected and supervised the construction and installation of anti-aircraft defenses. Not a single enemy bomb will drop on German soil!"

Then: "Sieg Heil; Sieg Heil; Heil Hitler!" It was shouted from thousands of throats, just as the British had picked it up from the air and transcribed it.

Pictures Suffering Women

The exultant cries faded . . . then there rose other voices: perhaps a dozen, chanting like dead men:

"Bremen — Berlin — Kiel — Cuxhaven—"

Bremen — Berlin — Kiel — Cuxhaven—"

In the background, as the voices droned the names of German cities which the Royal Air Force has bombed, were the roars of planes in power dives, of bombs exploding, of the screams of women.

That faded, too . . . then came the murmur of women's voices, talking one to the other:

"I have a son at the front—but I can't see him."

At the end the voices faded away. There was the spitting bark of machine guns, the drone of planes, the explosion of bombs; and these sounds too slowly died away. . . . The broadcast was over.

Hitler's Triumph

Germany, generally more adept at this sort of thing than the British, had nothing on the shortwaves to equal this propaganda. Berlin rebroadcast the Caesar-like entry of Hitler into Berlin, Nazi commentators shouted anew of England's "betrayal of France" and "Churchill's war-mongering." Constance Drexel, introduced as the "Philadelphia socialite and heiress," gave another of her Sunday night eulogies of the "cultural rehabilitation" in Germany.

The British were chuckling over what an announcer called "an Italian victory." It seems that two factions of the Italian army met in the sand-dunes of the North African desert and, after bitter fighting, "succeeded in disengaging and routing each other."

"It was a double victory for the Italians," said the BBC announcer. "The Italians succeeded in routing themselves after fighting valiantly against each other. The cowardly British were nowhere near."—J. P.—D. H.

(Copyright 1940. The Newspaper P.M. Inc., New York City. Reprinted by special permission of the copyright owners. New York's newest daily newspaper, P.M., as has been noted above, carries an active Shortwave department.)

NEW "LEARN BY RADIO" TEACHING TECHNIQUE

Every Wednesday at 4 P.M. WCNW puts "Gene Gae's Piano School of the Air" on the air—and will for 36 weeks. Listeners learn the fundamentals of keyboard harmony, including a comprehension of the musical staff, clef, keyboard, and tempo. Interested listeners-in are invited to write to Gene for lesson questionnaires. Filled-

out by the student, they are returned to Gae for grading; the student is then advised of his errors and is able to correct them. This department believes Mr. Gae, in arousing and creating musical interest which otherwise would remain dormant perhaps for years, is creating lucrative business for higher-calibre music teachers.



At left, Art Linkletter talks with Mayor Angelo J. Rossi of San Francisco in a recorded interview; right, WMCA's sound-car announcer is making a news pick-up on a street.

How over 100 mobile 2-man sound-recording units, strategically located throughout the country, make special spot-news phono records is the subject of this article. To date some 50 radio stations in the United States are subscribers to such a "radio news reel" which affords nationwide coverage of news events.

DOCUMENTARY RADIO

LEON GOLDSTEIN

EVENTS during the last year have spotlighted radio as a medium for news coverage. Originally, radio depended primarily upon press services to furnish this news which came over the air as local bulletins. The competition with newspapers however stiffened the attitude of publishers and radio had to adopt supplementary channels of news coverage.

Thus, the shortwave broadcasts from Europe became an important factor in American news coverage. Beginning with events at Munich, radio evolved a technique which has since been adopted by newspapers and other mediums of newsgathering groups. Now comes another method evolved by station WMCA called *documentary radio*.

This latest method of news coverage provides for recording news in the same way that news reels "shoot" news for the screen. These recordings are later edited into a regular news broadcast containing items of spot news from the world over. The broadcasts have already passed the experimental stage and now are furnished to stations from coast to coast through an organization known as Radio News Reel.

THE "RADIO NEWS REEL" TRUCKS

Radio News Reel, operating from KMTR in Los Angeles, has a fleet of mobile recording units equipped to make instantaneous recordings and handed by a crew of 2 men. One man acts as engineer and driver, while the other is producer and announcer. Because of WMCA's pioneering in this type of news, the Eastern part of the United States is covered by WMCA and a special Radio News Reel truck is stationed permanently in New York City operating under the direction of the WMCA news department.

The news reel trucks are standard Ford V-8 Sedan Delivery wagons with interiors adapted for the equipment which was designed and built specially for the news reel purposes by General Communications Laboratories in Hollywood, California. The equipment is powered by a special unit installed in the rear of the truck containing six 6-volt batteries which drive a rotary converter supplying 110 volts A.C.

The self-powered equipment makes the unit entirely independent for recording purposes almost anywhere.

Microphone cable, 600 ft. of it, is carried as a permanent part of the equipment, of which seldom more than 200 ft. are ever required for a pick-up. In addition 300 ft. of A.C. line are also carried and provisions are installed for using 4 microphones and mixing their outputs.

SOUND-ON-DISC

The recording apparatus cuts 16-in. records only, cutting from inside out, at 33 1/3 r.p.m. for standard radio playback. Altogether, the equipment has a total weight of 1,000 pounds and its quality, according to engineers, is as good in the work it turns out, as any stationary laboratory equipment.

WMCA's extensive use of the news reel technique dates back to the coverage of the arrival and departure of ocean going liners 3 years ago. At that time, the difficulties encountered in obtaining passengers for a spot broadcast evolved the idea of transcribing the material for rebroadcast later in the day. Accordingly, several hours of interviews were obtained and then edited for a 15-minute broadcast.

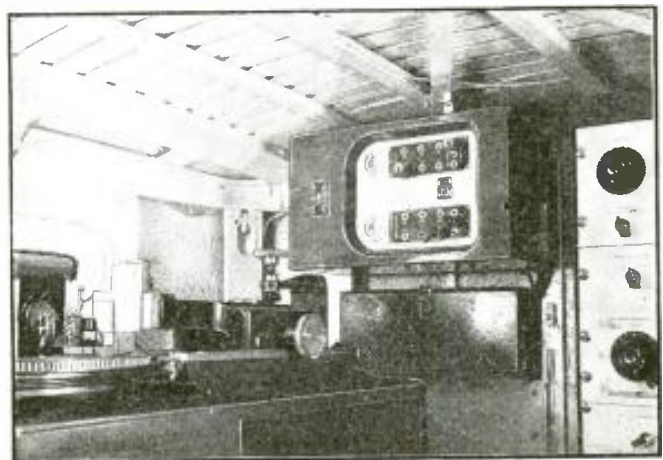
Subsequently, WMCA began regular experimental broadcasts with mobile recording equipment. News feature programs were picked up throughout the week and edited for special airings. The experimental phase

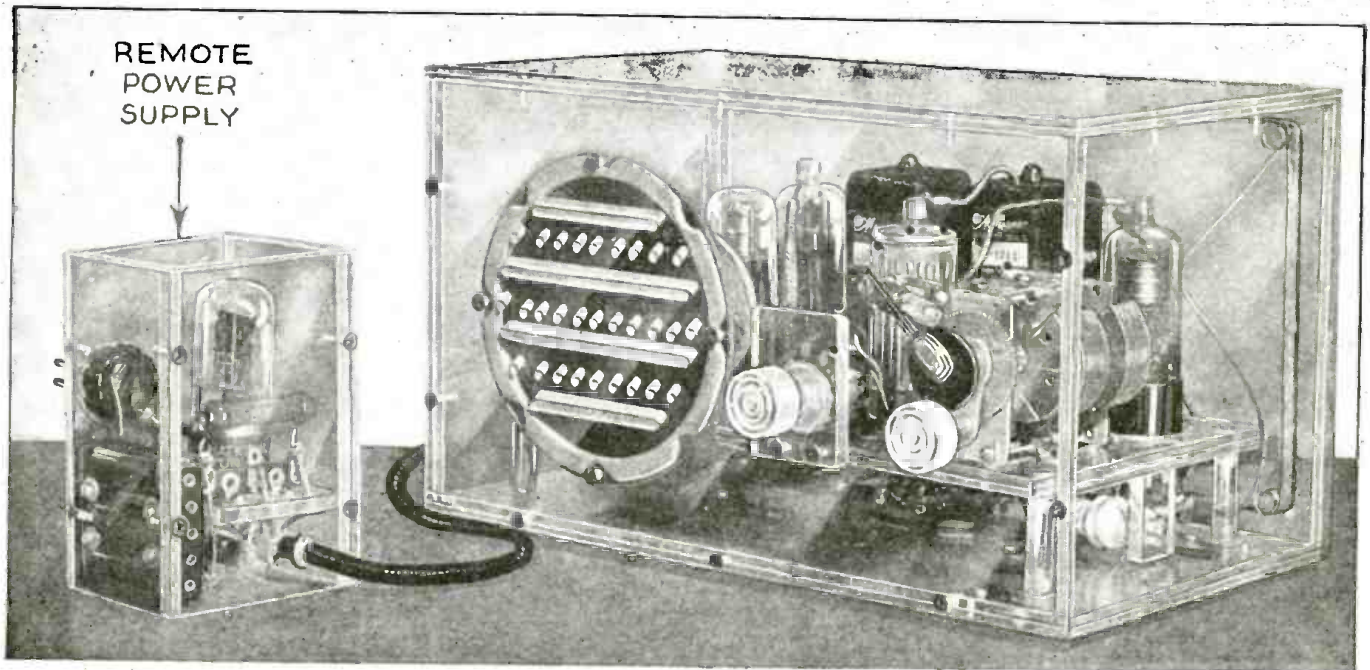
passed with the coverage of the United States Army maneuvers last summer. At that time, WMCA mobile equipment was sent to Plattsburg to follow the engagements of 2 mythical armies. Each night during the maneuvers the recordings were edited at Plattsburg and then shipped by Army plane to New York City for airing the same night.

At the present time, Radio News Reel is heard Saturdays on WMCA comprising the spot news programs recorded throughout the country during the week. These include all major events as well as numberless interviews with important personalities in the news. Such interviews are obtained in the business establishments and homes of the persons concerned with cables strung from the truck to the living room or private office.

The future of documentary radio is too early to predict. WMCA officials are inclined to believe that it will not be a substitute for live news broadcasts but will develop into a powerful supplementary feature just as motion pictures have developed news reels as supplemental coverage on news appearing in newspapers. Continually expanding to take in more cities, *arrangements are being made to send a mobile unit to Europe for special war coverage.*

Interior of Mobile Unit No. 6. More than 100 such trucks are located at foremost news-centers throughout the United States. Plans are under way to operate additional "sound news reel" units in Europe; Radio-Craft has reported how the B.B.C. operated sound-recording trucks on the French warfront.





THE "X-RAY" DISPLAY RECEIVER

Servicemen can greatly increase the value of their store windows with attractive, dynamic displays which invariably draw business. This article describes a very interesting and educational display which can be constructed by any ambitious Serviceman—a 110-V. A.C.-D.C. broadcast receiver (using 1.4 V. tubes!) built on a transparent chassis and housed in a striking, transparent cabinet. An innovation is the remote plug-in power supply.

N. H. LESSEM

It costs about \$75.00, but if you charge it up to advertising, it's dirt cheap. The author cannot understand why the independent Serviceman pays so little attention to his store window. Other merchants pay high rents for small stores with large display windows in order to advertise the merchandise which they sell inside; yet Servicemen merely clutter up their windows with a collection of dusty radio tubes, 1 or 2 testers, 2 or 3 rolls of hookup wire, a midget receiver and—in more than one case

—the customer's hat, for want of some more convenient place to put it. The author is only speaking now of small independent Servicemen—not large dealers.

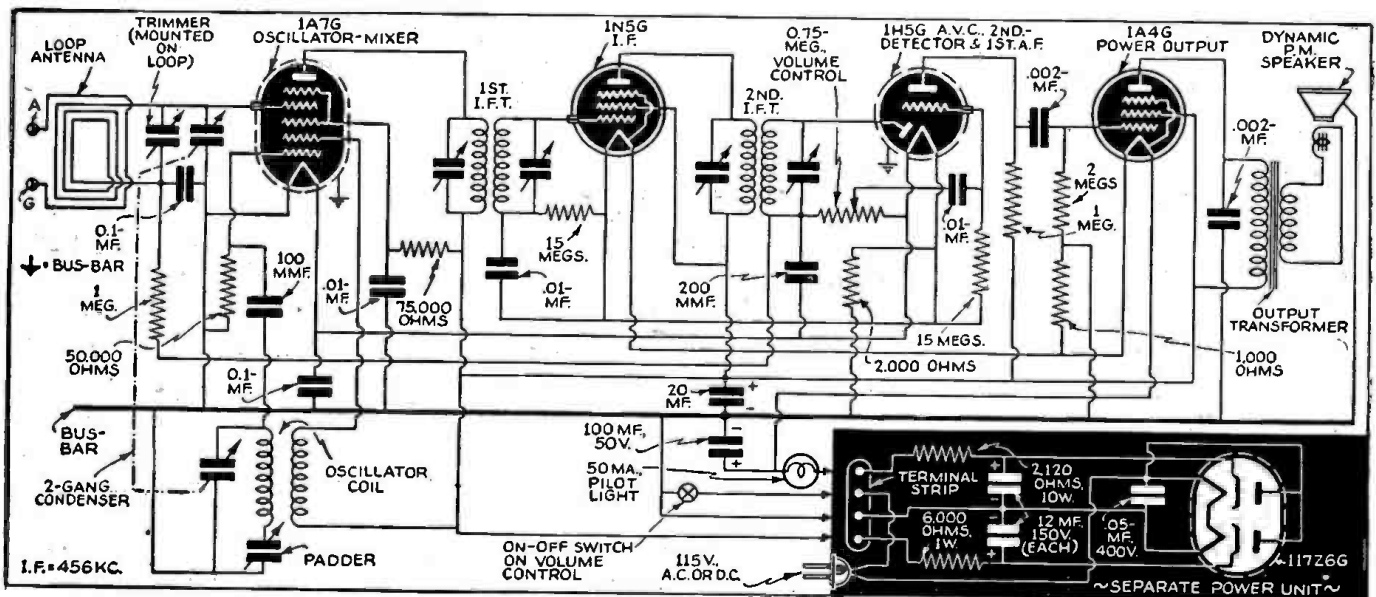
The radio Serviceman, as a rule, is a pretty handy and technical fellow and should be able to turn out any number of interesting and dynamic displays for his front window in order to attract the attention of the passing crowds. There is no question but what such a procedure would increase his business manifold. Such dis-

plays as revolving chassis, photoelectric equipment actually operating, capacity-operated devices, etc., always interest the passers-by.

WHY A TRANSPARENT SET?

The receiver described and illustrated here is a very interesting and educational display which has considerable attraction value for either a show window or inside the store.

It is a typical radio receiver, built on a





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DRAFTING SCHEMATIC DIAGRAMS SEND US A rough sketch of your circuit. Estimates by return mail. Our prices are moderate; our work guaranteed. No jobs too big or small. Wm. Kadlecik, Jr., 440 East 85th St., New York, N. Y.

TEST INSTRUMENTS

BARGAIN—HICKOCK MODEL 33X DYNAMIC MUTUAL conductance tube checker and analyzer. Tests everything. 25 cycle model \$35 complete. Almost brand new. Gerry, 4016 Twelfth Street, Long Island City, N. Y.

transparent chassis and housed in a transparent cabinet. The receiver while on display should be constantly operating—its operation being indicated by the glowing pilot light—and customers should be permitted to tune-in stations and swing the entire set around on its turntable. It's nothing tricky—merely a straightforward receiver so constructed as to attract the attention of the public, inasmuch as very few, if any, have ever seen the "innards" of a radio receiver while in operation. And if you don't think the idea is a good one, you might ask the Radio Corporation of America why they spent several thousand dollars turning out a single television receiver enclosed in a transparent cabinet. This receiver may be seen at the RCA Exhibit at the New York World's Fair. Incidentally, there is always a crowd around this truly marvelous display.

POLYSTYRENE

The transparent material used for this receiver is a water-clear transparent insulating material called "polystyrene" which is mixed with certain plasticizers so that it can be easily machined on ordinary lathes, drill presses, etc. It is used extensively in the radio industry for high-frequency work, inasmuch as its low-loss qualities are extremely fine. It is an excellent material to work with since it machines like very soft brass. Known in the trade as "Amphenol-912-B," this material is available in sheets, rods and tubes.

No sizes or cutting dimensions are given since constructors may wish to follow plans of their own, perhaps more suitable to their particular windows, etc. At any rate, size doesn't matter, so long as the receiver is not brought down to midget proportions.

The loop may be either a commercially available one or one which is self-wound. At any rate, it should be mounted on the back cover of the case.

In constructing the cabinet, which is very simple in design, being merely a rectangular-shaped box, all edges of all sides were rabbitted, cemented and finally screwed together with self-tapping Phillips-head type screws obtained from the American Radio Hardware Company. No difficulty whatsoever was experienced in the handling of this polystyrene material except in making the speaker grille.

Speaker Grille.—Here extreme caution must be exercised. This grille-work consists of 3 rows of 1/8-in. holes, alternating with 3 parallel grooves. All this work was done on a drill-press, the table of which was tilted at an angle of approximately 40°. Three horizontal slits are made in the back panel in order to provide for sound-pressure release. All grooving and rabbitting was done with a 5/16-in. milling bit, held in the drill-press chuck.

Cementing.—The cement used is known as "Amphenol 901" liquid. Since this cement contains the solvent of the polystyrene material, the joints thus formed are mechanically as strong as the material itself, since the sheets actually fuse together.

Buffing.—Machine marks and scratches can be removed by using No. 2/0 flint or sandpaper and No. 721 Norton crocus cloth.

All grit and dust should then be wiped off before a buffing wheel is applied. This buffing wheel should be a 7-in. dia. solid felt wheel revolving at 2,500 r.p.m. Dress the wheel with Clover grinding compound, grade No. 2A. Simonize cleaner should be used frequently on the face and sides of the wheel. Press the material to the buffing wheel lightly.

Polishing.—Final polishing may be obtained by the use of a 6-in. dia. loose white cotton buff consisting of about 50 discs of cloth pressed together but unstitched. Apply a thin paste of magnesium carbonate to the buff with a brush. Move the material under the wheel lightly. After sufficient buffing, wash the magnesium paste off with water and dry to a high lustre with a soft cloth. Much more detailed information on the machining, sawing, punching, forming, drilling and cement operations on this material may be obtained from the American Phenolic Corporation.

NEW: OUTLET POWER SUPPLY

The 115-V. A.C.-D.C. receiver itself (see schematic diagram) is conventional in all details but one—the power supply—this being an entirely separate unit!

Inasmuch as the 117Z6G rectifier tube gives off considerable heat, it was thought inadvisable to house this tube in the transparent case, which starts to soften slightly at a temperature of 175° F. Although this temperature probably would not be reached even with the tube inside the cabinet, it was thought advisable to have a separate power supply. This unit is connected by cable to the main receiver and is itself plugged directly into the electric outlet. That is, the 115-volt plug is mounted directly on one side of the small power unit which then, naturally, hangs from the electric outlet. Inasmuch as its weight is very light, there is no danger of it falling out. The circuit of the receiver is that of the conventional 3-way portable, except that batteries, of course, are not being used (although they can easily be connected into the circuit without any circuit changes).

In wiring up the set, all "grounds" should be brought to a common bus-bar. Make certain that the shield cans of both I.F. transformers and the shields around the 1A7G and 1H5G tubes are grounded to this bus. It is also important to ground the speaker frame to the bus.

Now as to the parts used. All polystyrene material, including the octal sockets (made of the same material) were supplied by the American Phenolic Corporation. The tuning condenser, I.F. transformers, loop antenna, oscillator coil and oscillator padder were supplied by the Meissner Mfg. Co. The 5-in. P.M. dynamic speaker and output transformer were supplied by the Cinaudagraph Company. All resistors, including the volume control and line switch, were supplied by the International Resistance Co. All condensers, including the micas and electrolytics, were furnished by Cornell-Dubilier Electric Corp. All hardware, tie-in strips, etc., were furnished by the American Radio Hardware Co. The 1.4-V. tubes are National Union. The 117Z6G rectifier tube, which has a filament that connects directly across the lightline, is Sylvania.

NEWS SHORTS

Add ingenious programs: "Station K-I-D-S," a 15-min. serial over WOR Sunday mornings. Sketch concerns the adventures of a group of youngsters who organize a make-believe radio station from odds-and-ends, produce amateur shows, and finally get on the air over a regular station. Give

the boys your support by tuning them in. WMCA's Gaston ("I go queeck, get my citizen papers!") now appears at various events, in N.Y.C., togged-out in frock coat and topper, with mustache and goatee carefully groomed—and carrying a portable radio set tuned to WMCA!

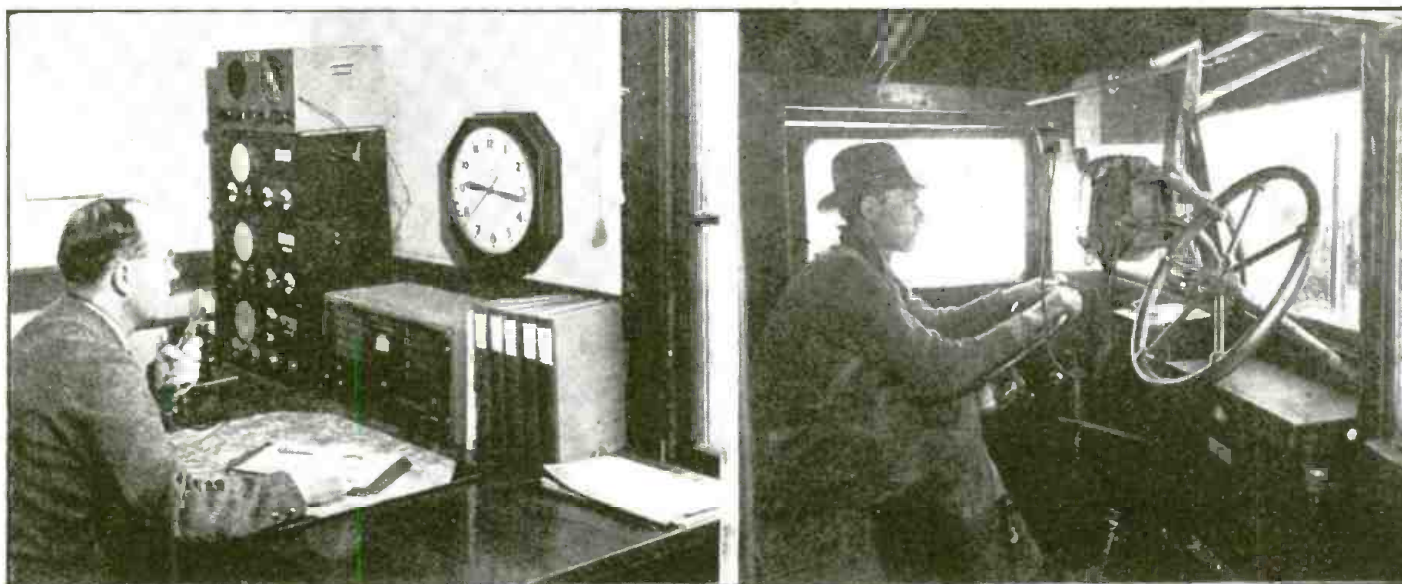


Photo at left, interior of Redding District Headquarters Station KASN on U. S. 99. Station output is 200 W. Photo at right, inside radio-equipped snowplow operating on U. S. 99; transmitter of 2-way mobile unit radiates 50 W. on 2,726 kc.

MOUNTAIN SNOWPLOWS' RADIO LIFELINE

RADIO-CRAFT readers now feeling the heat of vacation suns may enjoy contemplation of the work atop snow-capped mountains and in snow-filled mountain passes, by members of the Division of Highways in California, where snowplows are equipped with shortwave 2-way radio telephone installations.

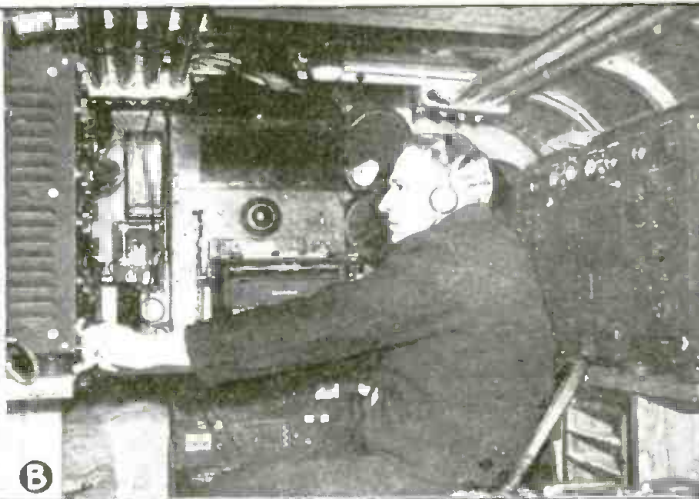
The Donner Summit Radio Station on U. S. 40, for example, is one of 20 fixed stations, on 2,726 kc., which comprise the California Division of Highways radio system. These stations are licensed by the Federal Communications Commission under the Special Emergency classification. Fixed stations are located at District Headquarters in Redding, Marysville, Bishop and San Bernardino; other land stations are strategically located at Highway Maintenance Stations on the important State highways traversing the Siskiyou, Sierra Nevadas and San Bernardino Mountains. Thirty mobile stations are also operated in conjunction with the fixed stations; 23 of these are mounted on rotary snowplows, 4 on snowplow trucks, and 3 are automobile installations.

The mobile units output 50 W. except three 20 W. car units. The land stations, except Redding and Bishop, 200-W., are 50 W.



Radio-equipped rotary snowplow in operation near Donner Summit on U. S. 40.

U.S. COAST GUARD'S EMERGENCY RADIO



The United States Coast Guard's remarkable Emergency Truck shown in these 2 photos and on the cover of this issue of *Radio-Craft*, is equipped for 2-way radio communication, and is the first of a fleet of 15 due soon. The truck is equipped with every facility for handling any emergency—first aid, communication, etc.—that may arise during hurricanes, floods, and so on; its radio equipment consists of 2 transmitters and 2 receivers, both operable simultaneously on different wavelengths, while an additional receiver in the truck cab picks-up orders from headquarters while in transit. In Fig. A one of these trucks is shown functioning as an ambulance; radio and other equipment (range, 50 miles)

inside the truck is shown in Fig. B. Up to 15 radio operators and portable 2-way radio sets may be dropped-off at strategic points in establishing an emergency communication network (see photo on cover); the truck, as "net control," then maintains contact with Coast Guard headquarters over long ranges. Coast Guard boats and planes can also be contacted. Pole antennas are used in mobile work; otherwise trailing antennas are used. The staff can sleep on bunks in the truck. Each truck generates its own power. The transmitters (working as "homing" beams), plus the searchlights, may be used to aid planes in landing blind during fogs!

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LARGE-SCREEN TELEVISION RECEIVERS

Allen B. Du Mont Labs.
Passaic, N. J.



PICTURED above is a television receiver using a 20-in. diameter image tube. Other models are available with 14-in. tubes. It seems as though the "peep-hole" receivers may soon pass out of the picture—provided the price of the 20-in. jobs can be kept sufficiently low. The actual image size of the 20-in. tube is 11½ x 15 ins.—a total of 169 sq. ins. of image. The receiver illustrated is known as the model 195X, a combined radio and television receiver.

NEW STAPLE DRIVER

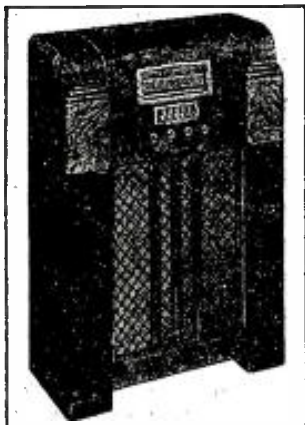
Walter L. Schott Co.
5264 W. Pico Blvd., Los Angeles, Calif.



THIS tool is a very handy device for radio Servicemen and P.A. specialists. It very quickly staples wires and cables to wooden moldings, making possible neat installations and eliminating the hazard of tripping over loose wires.

NEW 1941 RECEIVER

Stewart-Warner Corp.
1826 Diversey Parkway, Chicago, Ill.



ILLUSTRATED is one of a new line of 1941 receivers. Known as model 6U7 it is a 2-band job utilizing a 6-tube superhet. circuit. All modern features are incorporated plus a built-in "magic antenna." The set is wired for record player, television, or frequency-modulation sound.

VOLT-OHM-MILLIAMMETER

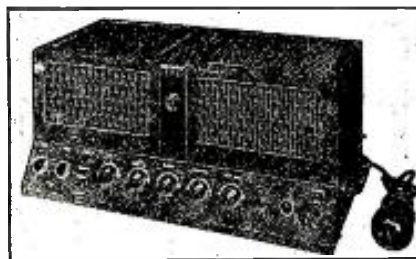
Readrite Meter Works
Bluffton, Ohio



MODEL 860 is an A.C.-D.C. volt-ohm-milliammeter utilizing a 6-in.-scale direct-reading meter. Ranges are as follows: D.C. volts 0/10/50/250/500/1,000 at 1,000 ohms/volt. A.C. volts 0/10/50/250/1,000 at 400 ohms/volt. An added advantage is the special chart which permits decibel readings against volts from -20 to +55. D.C. milliamperes 0/1/10/100. Resistance 0/500 ohms, shunt-type circuit, accurate readings to ½-ohm; 0/100,000 ohms and 0/1.5 meg., series-type circuit. Knob-operated zero adjustment.

50-W. AMPLIFIER

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



ALOW-PRICE 50-W. amplifier designed for general public-address applications. The amplifier incorporates reverse feedback for low distortion and automatic bass compensation network, 2 microphone and 2 phonograph inputs. Frequency response essentially flat within 3 db. between 50 and 10,000 cycles. Output impedances available are 4, 7½, 15, 60 and 25 ohms. By varying connections additional impedances from 0.05-ohm to 192 ohms may be obtained. The amplifier is known as model MI-12214.

AUTOMATIC VOLT-OHM-MILLIAMMETER

The Triplett Electrical Instrument Co.
Bluffton, Ohio

THE model 1200-F automatic volt-ohm-milliammeter is designed for maximum speed and minimum switching. Only 1 button is pressed for any range and test setting. Sensitivity of meter is 25,000 ohms/volt D.C. Its ranges are:

- D.C. volts 0/10/50/250/500/1,000 at 25,000 ohms/volt.
- A.C. volts 0/10/50/250/500/1,000 at 1,000 ohms/volt.
- D.C. milliamperes 0/1/10/50/250.
- D.C. microamperes 0/50 (through separate jacks).
- Resistance, 0/500 low ohms, shunt-type



circuit; 0/300,000 ohms; 0/3 and 0/30 megs., series-type circuit. Self-contained batteries for all ranges.

Output readings are available on A.C. voltage ranges, through a built-in ½ mf. condenser.

TEST OSCILLATOR

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



THE No. 167 test oscillator has a high R.F. output of 1 V., designed especially for locating trouble in inoperative or completely misaligned receivers as well as for single-stage alignment work. Fundamental frequency range is 100 to 30,000 kc. Dial scale, 6¼ ins. in dia. (50 ins. in length), is direct reading. External frequency modulation may be added for servicing with an oscilloscope. It has a 400-cycle output of 8 V. for audio circuit testing. Other features are 6 bands, minimum signal, 2 microphones, negligible leakage.

LOW-VOLTAGE "TATTLELITE"

Littelfuse, Inc.
4757 Ravenswood Ave., Chicago, Ill.



THIS handy device covers the range of from 3 to 25 V. and momentarily up to 50 V. A.C. or D.C. The neon lamp is housed in a molded transparent tenite case and has flexible leads with alligator clips. Draws only 70 ma. at 12 V.

HOME RECORDING AND PHONOGRAPH ASSEMBLY

The General Industries Co.
Elyria, Ohio



ALOW-COST unit using a 10-in. rim-driven turntable. Cutting mechanism utilizes a concealed feed-screw with cutting head enclosed in a pivoted supporting arm. The pickup is a high-impedance crystal-type with tangent tracking feature. Known as

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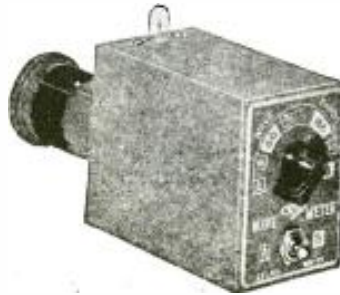
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send cash or stamps.)

model GI-R70, it is a 78 r.p.m. unit available in A.C. type for all voltages and cycles.

ALL-WAVE WAVEMETER

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



THIS instrument is intended for adjusting the various stages of a transmitter to the desired wavelength. Consists of calibrated coil and condenser combination together with pilot bulb for resonance indication. Band switching is employed, enabling the unit to cover all amateur bands from 10 to 160 meters.

7-TUBE 2-BAND SUPERHET.

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



FEATURES of this new receiver include 8-in. electrodynamic speaker, continuously variable tone control, A.V.C., 6-station pushbutton tuning, "air magnet" built-in antenna, 3-W. output and phono and television sound attachment. The circuit is a 7-tube superhet. covering 2 bands, viz., 545 to 1,550 kc. and 5.8 to 18.1 mc.

HANDY BENCH LATHE

South Bend Lathe Works
425 E. Madison St., South Bend, Ind.

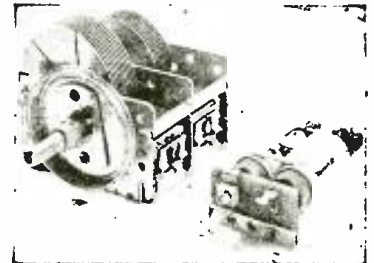


UNUSUALLY compact this combination lathe and bench takes very little room in the Serviceman's shop but fills many use-

ful purposes. It has a 10-in. swing and a 1-in. maximum collet capacity. The motor and driving mechanism are mounted to the head-stock in the left end of the bench. Twelve spindle speeds are available, permitting all types of operations from winding coils to turning wood.

COAXIAL TUNER

Sprague Specialties Co.
North Adams, Mass.



A "2-GANG" R.F. tuner which eliminates the standard 2-gang variable condenser and thereby saves considerable space. It is ideal for ultra-compact receivers. Essentially it is a permeability-tuned unit in which variable frequency is obtained by varying the relationship between the coils and the iron cores.

MARINE RADIO TELEPHONE

Transmarine Radio, Inc.
1184 Broadway, Hewlett, N. Y.

TRANSMITS and receives on any 3 channels. Normal daytime range, 50 to 100 miles. Handset has built-in pushbutton for remote operation. The instrument uses crystal-controlled frequencies and operates from 6, 12 or 32 V. with minimum drain due to a "battery economizer." Weighs approx. 30 lbs. and measures 8 x 8 x 16 ins.

"B" ELIMINATOR FOR PORTABLES

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

THIS device operates from flashlight cells or the storage battery of an automobile or motor boat. It completely eliminates the necessity of having and replacing "B" batteries in portable receivers. Delivers 90 V. at 10 ma. when operated from a 7½-V. source of supply (5 No. 2 flashlight cells in series). Also operates directly from a 6-V. storage battery. Total weight including flashlight cells is approximately 3 lbs.—½ less than equivalent "B" batteries.



SIGNAL TRACER

J. L. D. Morrison Co.
1923 35 Place, N.W., Washington, D. C.

THIS small-size signal tracer in the form of a "hand tool" comprises a detector and amplifier with variable gain control. It is used in conjunction with the power tube and loudspeaker of any receiver using a single 6-V. power tube. An adapter at the end of the signal tracer cable is placed under the power tube of the receiver.

NEW CRYSTAL UNITS

General Electric Co.
Schenectady, N. Y.



KNOwn as types G18 and G19, these are hermetically-sealed crystal units for radio service. The operating range of these new units is -40 C. to +60 C. An adjustable air gap in the G18 permits accurate frequency adjustment during manufacture. Frequency range is 540 to 2,000 kc.; in the G19 the crystal is clamped and the frequency range is 1,800 to 8,000 kc. The small metal knob on top of the G19 facilitates removal from the socket.

6-V. AND 110-V. AMPLIFIER

John Meck Industries
1313 W. Randolph St., Chicago, Ill.



THIS amplifier, model AMR-25C, is a 25-W. job which it is claimed operates equally well from a 6-V. battery or a 110-V. power line. No external power packs are required. Self-contained current-changing switch permits plate current to be cut off between announcements. Designed for use with phono pickup and microphone inputs.

RADIO COMMUNICATION AND NAVIGATION SYSTEM FOR AIRPLANES

Lear Avia, Inc.

Roosevelt Field, Mineola, L. I., N. Y.

THE complete equipment includes a transmitter, receiver, direction finder and power pack. Designed for use on private and commercial planes. Permits pilot to receive all types of information, navigate on all radio beams and to "home," on radio-range stations from any position. Equipment is compact and lightweight. Frequency range of crystal-controlled transmitter is 2,700 to 6,300 kc.; range of receiver, 200 to 400 kc. Direction finder operates with an electrostatically shielded loop manually rotated from cockpit. Azimuth dial shows position of loop with respect to longitudinal axis of plane.

DUPLEX FACSIMILE UNIT

Finch Telecommunications, Inc.
Passaic, N. J.

MODEL F-111A duplex facsimile unit is designed for transmitting and receiving simultaneously. Well suited for mobile use in connection with portable radio transmitters, for aviation, police cars, and marine

use. A self-synchronizing system keeps all receivers in step with the transmitter. Size of copy is 8½ x 7 ins. high and requires about 5½ mins. for transmission or reception. This is at the rate of approximately 140 words per minute of typewritten copy.

POWER RESISTOR DECADE BOX

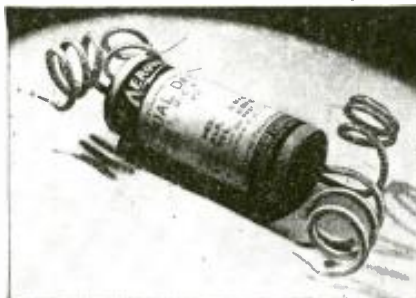
Clarostat Mfg. Co., Inc.
285 N. Sixth St., Brooklyn, N. Y.



THIS instrument designed for handling large amounts of power can be connected in actual circuits to simulate working conditions. Intended primarily for laboratory use, for calibration of meters and for development work in general. On sloping front panel 6 decade switches select resistance range from 1 ohm to 990,999 ohms at a maximum of 1,000 V. Each decade will dissipate up to 225 W. Instrument measures 13 x 8½ x 5½ ins.; weight, 11 lbs.

MIDGET DUAL ELECTROLYTICS

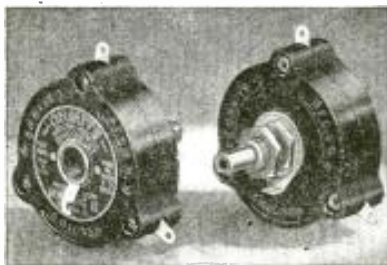
Aerovox Corp.
New Bedford, Mass.



THE PRS 450 (volts) and the PRS 250 (volts) series dual electrolytics, 8-8 and 16-16 mf., respectively, measure but 1 x 2½ ins. The new PRS 150 (volts) dual electrolytic, 20-20 mf., measures only 1 x 2¼ ins. These dimensions are claimed to be the smallest for any midget dual electrolytic of corresponding values. Both sections in all units are independent, 4 leads protruding from each.

DIRECTION-INDICATOR RHEOSTAT

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



KNOwn as model DR-125, this device is connected to the moving part of rotary beam antennas, direction-finding loops, wind vanes, etc., in order to send an indication of position to a remote point. The unit

has a 360-degree continuous winding and is designed for use on D.C. up to 24 V.

RADIO NOISE FILTER

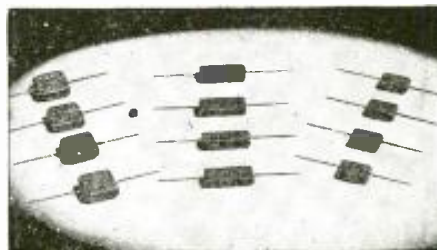
Cornell-Dubilier Electric Corp.
South Plainfield, N. J.



TYPE IF-18 is a noise filter designed especially for use in the home. Both inductance and capacity are used in the circuit. It is rated to carry 5 A., making it suitable for use with any radio receiver or electrical appliance normally used in the home. May be used at the radio set outlet or at the source of the noise-producing machine. Unit measures only 5 x 3¼ x 2¼ ins.

SILVER MICA CONDENSERS

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



A LINE of improved silvered mica condensers for use in electronic circuits of high frequency stability. Especially useful in I.F. tuned circuits, fixed-condenser tuned pushbutton selectors, oscillator circuits, etc. Available in values from 1 mmf. to 0.0025-mf. at a D.C. working voltage of 500; and from 0.003- to 0.005-mf. at a 300-V. rating. Standard capacity tolerance ± 5%.

MIDGET RELAY

Advance Electric Co.

1260 W. Second St., Los Angeles, Calif.

ACTUAL dimensions are 1½ x ¾-ins. High D.C. efficiency and hum-free A.C. operation are claims for this new relay. Dependable service may be attained with as little as 10 W. Safe continuous-duty rating is 2 W. Contact combinations: double-pole, single-throw or double-pole, double-throw, employing ¼-in. silver contacts handling up to 200 W. on non-inductive A.C. loads.

"RADIOMETER" SERVICING INSTRUMENT

Dayton Acme Co.

2339 Gilbert Ave., Cincinnati, Ohio

THE functions of several instruments are combined on one, as follows:

Vacuum-tube volt-ohm-milliammeter with 7-in. meter has ranges to 10,000 V., 3 megs., and 10,000 ma.; audio and supersonic oscillator, 20 to 150,000 cycles; I.F.-R.F. oscillator, 50 kc. to 100 mc.; signal tracer, 5 bands receive video and amplitude modulation signals, and 2 bands receive frequency modulation; oscilloscope uses 2-in. C-R tube, sweep generator covers 10 to 25,000 cycles, sweep amplifier has internal 60-cycle calibrated

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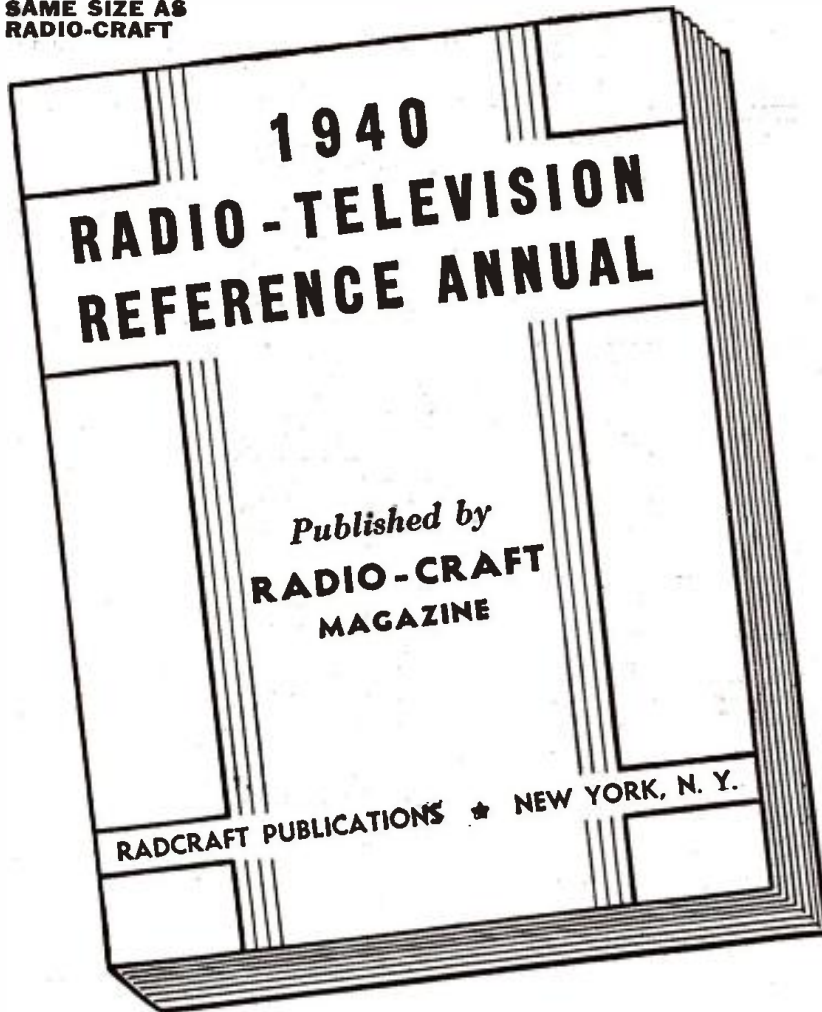
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Beginner's Breadboard Special - a 1-Tube High-Gain All-Wave Receiver—Wiring Pointers for Radio Beginners—A Watch Charm Size 1-Tube Set—Beginner's Simple Volt-Milliammeter—Making a 1-Tube Broadcast Loop Receiver—A.C.-D.C. Power Supply for Battery Portables—A 1-Tube Short-Waver with Band Coil Switching.

MORE ADVANCED SET CONSTRUCTION

The "High-Seas" 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 3" 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.

THE SERVICEMEN'S SECTION

Bass Tone Control—Simplified Variable Selectivity—Practical Servicing Pointers—Servicing Universal A.C.-D.C. Receivers—Killing the "Intermittent" Bug—A Service Shop A.C. to D.C. Power Supply—Sideline Money for Servicemen—Adding A.V.C. to any Screen-Grid T.R.F. Receiver—Iron Particles in Speaker Air Gap.

TEST INSTRUMENTS

A Useful Neon Lamp Tester—An Inexpensive Output Meter—Making Milliammeter Multipliers—Home-Made Frequency Modulator—The Busy Servicemen's V.T. Volt-Meter.

PUBLIC ADDRESS AND AMPLIFIERS

Build this Combination A.C.-D.C. Radio and Inter-Communicator—Speaker Placement in P.A. Work—The Design and Construction of an Inexpensive All-Push-Pull 10-Watt Amplifier—Obscure Sources of Hum in High-Gain Amplifiers—How to Build a High-Fidelity 5-Watt Versatile Amplifier.

"HAM" SECTION

Ultra-High Frequency Antennas—The Beginner's Low-Cost Xmitter—Modulator Meter—Phone Monitor—The Beginner's "Ham" Receiver—2½ Meter Acorn Transceiver.

TELEVISION

How to Build a 441 Line T.R.F. Television Receiver—Useful Notes on Television Antennas.

MISCELLANEOUS

Simple Photo-Cell Relay Set Up—Making a Burglar Alarm—How to Build A.C.-D.C. Capacity Relay—How to Make a Modern Radio Treasure Locator.

USEFUL KINKS, CIRCUITS AND WRINKLES

Making a Flexible Coupler—Two-Timing Chime—A Simple Portable Aerial—An Improvised Non-Slip Screw-Driver. NOTE: The book contains numerous other useful Kinks, Circuits and Wrinkles, not listed here.

(approximately)

45 ARTICLES

(approximately)

170 ILLUSTRATIONS

68 BIG PAGES

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voltage; a P.M. loudspeaker completes a unit of great flexibility for the Serviceman. Complete job measures only 32 x 24 ins. wide x 19 ins. deep, slanting to 7 ins. at top.

RADIO-RECORDER COMBINATION

Homocord Mfg. Co., Inc.
457 W. 45th St., New York, N. Y.

MODEL 110 is a table model combination radio and home recorder. It is the newest addition to the growing list of radio receivers incorporating "make your own phono records" facilities. It cuts and plays a 12-in. disc with the cover closed. Crystal cutter and crystal pickup are both housed in well-balanced arms. A simple patented feed-screw is employed. Dual motors—both center- and rim-drive—make for stabilized speed. Receiver is a 7-tube superhet. with 8-in. speaker.

1-KW. F.M. TRANSMITTER

Western Electric Co.
195 Broadway, New York, N. Y.

THIS type 503A-1 transmitter generates what is called "synchronized frequency modulation" in which the average or carrier frequency of the F.M. carrier wave is locked in-step with the vibrations of a precision quartz oscillator; this confines carrier drift to extremely close limits. Completely self-contained, and functions either as a transmitter for powers up to 1 kw. or as a driver for high-power R.F. amplifier where more than 1 kw. output is desired.

RADIO CHEMICAL KIT

General Cement Mfg. Co.
1041 Kilburn Ave., Rockford, Ill.

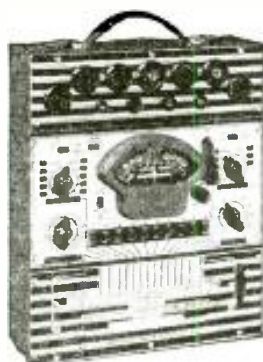


COMPRISES service cement, carbon-x, grapholine, scratch polish, non-slip compound, dial oil, contact cleaner, and dial-drive cement—all the chemical necessities for radio servicing.

TUBE TESTER

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

A NEW 3-way switching system and "unit design" are new features designed to minimize obsolescence. The 3-way switching system includes an off position for each switch so that any tube prong can be left entirely disconnected from any part of the tube-testing circuit. This permits the testing of individual elements, regardless of base connections or internal connections



between the elements. The front panel of the model 400 is divided into 3 sections, viz., the socket panel, the meter panel with its knobs and switches, and a speedy roll chart which shows the proper settings for each tube. The roll chart and the socket panel are designed as separate units and can be easily removed without disturbing the meter.

SET TESTER

The Hickok Electrical Instrument Co.
10514 Dupont Ave., Cleveland, Ohio



MODEL 133 portable radio set tester features a 40-microampere range for sensitive current measurements; and a portable dry-battery testing circuit. A 5-in.-sq. meter with 4 color scales is employed. Ranges: 40 and 500 D.C. microamperes; 5/50/500 D.C. milliamperes; 2.5/10/50/250/500/2,500/ volts A.C. and D.C.; 25,000 ohms/volt D.C.; 1,000 ohms/volt A.C.; 0/30/10,000 ohms, and 1 and 10 megs. resistance. Decibels. All ohmmeter ranges operate from self-contained batteries. Battery tester has complete range up to 135 volts.

MICROPHONE SWITCHES

American Phenolic Corp.
1250 W. Van Buren St., Chicago, Ill.



NO. MC1S is a crystal microphone switch of the "press-to-talk" type. By pushing it down it may be locked in the "on" position. The switch has a coupling ring at one end and coupling threads at the other, machined to fit standard MC1S microphone connectors. The switch spring is silver-plated for low-resistance contact and noise-free operation.

... PHILCO 46 D.C.

If the tubes do not light and the set is dead, try reversing the line plug. If reversing the plug causes the tubes to light but you get a weak signal, then the trouble is in the field coil. In checking this set, the simple test referred-to above will save you from taking the chassis from the cabinet; you simply take the speaker out and replace the coil. The field is in series with some of the filaments. (This set is D.C. operated.)

HAROLD R. KUNTZ,
Brooklyn, N. Y.

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AND MAIL!

SO YOU HAVE INTERFERENCE?

COMPLAINTS about local interference to radio broadcast reception continue to be received in large number by the Federal Communications Commission.

The Commission has no authority to investigate, or require, the elimination of interference caused by diathermy and other electrical apparatus, ignition systems of automobiles, electrical signs and other contributing agents. A number of States and municipalities have enacted ordinances to meet this problem. In connection with interference caused by power systems, some of the power companies maintain investigating departments which cooperate with individuals in an effort to remedy interference conditions. Complainants can generally, and should be ready to, furnish detailed information as to the type of interference experienced, which in all probability will be of value in locating the cause.

Low-power radio frequency devices, used for control purposes, are under the jurisdiction of the Commission, although licenses under certain circumstances are not required. (Rules 2.101 to 2.109, appearing in Part 2 of the Rules and Regulations of the Commission, cover this subject in considerable detail.)

The general problem of interference has been approached by the Commission from the point of view that the public as a whole will be best served through cooperation in the industry. Efforts in this direction have been centralized in a coordinating committee of the American Standards Association, with headquarters in New York, which

affords representation to all those interested in the reduction of electrical noise. Among organizations represented are the American Transit Association, ASA Telephone Group, Association of American Railroads, Bureau of Standards, Canadian Department of Marine, Edison Electric Institute, Federal Communications Commission, Institute of Radio Engineers, Institute of Radio Service Men, National Association of Broadcasters, National Electrical Manufacturers Association, Radio Manufacturers Association, Radio Manufacturers Association of Canada, Society of Automotive Engineers, and the Radio Club of America.

The States of Maine and Washington, and the Territory of Hawaii, have had statutes on the interference problem for years, 2 of them since 1921. Los Angeles passed a controlling ordinance in 1931. Other municipalities having kindred regulations are Crescent City and Santa Ana, Calif.; Bloomington and Franklin, Ind.; Storm Lake, Iowa; Atchison, Kans.; Bunkie, La.; Bay City, Two Harbors, Iron River, and Munroe, Mich.; Minneapolis and St. Paul, Minn.; Lincoln, Nebr.; Boonville, N. Y.; Dumright, Okla.; Marshfield, Rosenberg, and Portland, Ore.; Waynesboro, Va.; Spokane, Wash.; Antigo, Ashland, North Fond du Lac, Oshkosh, Stevens Point, Watertown, and Waupaca, Wis.

Reallocation of frequency assignments under the North American Regional Broadcast Agreement is expected to eliminate the interference of high-powered stations operating in Cuba and Mexico, which are, of

course, outside of the jurisdiction of the Federal Communications Commission.

Interference caused by diathermy equipment presents a problem with which the Commission has been very much concerned of late, particularly because of its supplemental effort on television programs. Among the many complaints received is a resolution adopted by some 30 police departments, pointing out that police transmitters in the emergency service are required to maintain rigid tolerance but that no similar regulations have been placed on diathermy, and requesting the Commission to declare diathermy a nuisance to police radio. In some instances, diathermy interference to radio communication is observed over distances involving thousands of miles.

While legislation clarifying the Commission's jurisdiction in this matter may be the final solution, during study of the problem every effort has been made by the Commission to alleviate the situation through the cooperative efforts of the manufacturers, the medical profession, and the radio industry. The Commission has been in close touch with the Council on Physical Therapy of the American Medical Association in this respect.

Radiation of electrical energy is not essential to the proper functioning of diathermy apparatus and can be eliminated or controlled without impairing the usefulness of the apparatus. There has never been any attempt on the part of the Commission to suppress the use of this important device; however, since the radio and medical services both involve the use of equipment in connection with the safety of life and property, and since the radiation of energy from the electro-medical apparatus can be controlled at small cost by screening the room in which such apparatus is used, it is felt that the interested parties should cooperate to the adoption of standards of good engineering practice which will permit both services to operate without mutual interference.

As for simpler types of interference:

When operating a receiving set in the immediate vicinity of a broadcast station, cross-talk interference will be experienced if the receiver does not have at least 2 preselector tuned circuits between the antenna and the grid of the 1st-detector tube. Further, it must be properly shielded to prevent strong unwanted signals from entering the set except through the antenna.

An average set should be capable of receiving a desired station 50 kilocycles removed, even if operated within a few blocks of a broadcast station. The performance of many receiving sets encountering cross-talk interference may be improved materially both for selectivity and sensitivity if properly aligned and tubes checked and replaced if found defective. Some receivers which are not capable of separating the desired from the undesired station 20 or more kilocycles removed may be improved materially by employing the simple "wavetraps," obtainable at most radio stores.

.... A.K. 812

A "receiver dead" complaint may be due to an open 1st-detector plate filter choke; or, "no volume" may be caused by an open input transformer secondary winding, in that only 1 tube of the push-pull audio system is working.

GEORGE F. BAPTISTE,
Howard, R. I.

All the worthwhile Radio Trade News of the past month—digested for busy radio men.

RADIO Trade Digest

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

IMPORTANT HAPPENINGS OF THE MONTH IN THE RADIO INDUSTRY

No. 25

SEPTEMBER, 1940

No. 25

NEW LAW NEEDED TO LET STATIONS BAN UNWANTED RADIO BROADCASTERS

Law Granting Equality to All Political Candidates Puts Networks in Embarrassing Position as Convicted Candidate Holds Forth on Platform

When does liberty become license?

That is the question raised by Neville Miller, pres. of the Nat'l Assoc. of Broadcasters. In a recent statement, Mr. Miller points out that the Federal Communications Act orders that if any station permits any one, legally-qualified candidate for office to use its facilities, it shall afford equal opportunities to all other candidates for the same office and shall have no power of censorship over such material.

The question arose when Earl Browder, candidate for president on the Communist ticket, broadcast a speech accepting his party's nomination. Many stations apologized for this broadcast, explaining that the fact that Mr. Browder has been convicted of a crime in no way impairs his eligibility as a broadcaster under the law enacted by Congress some 6 years ago.

The inference is that the stations are powerless to control the material which they are forced by law to transmit and that if any change is to be made it must be through a new law enacted by Congress.

R.T.D. BOWS OUT

With this issue, the Radio Trade Digest department of RADIO-CRAFT makes its farewell appearance. Other interesting trade news will appear next month.

BIG TELLY SHAKE-UP SEEN COMING SOON

Shift to 507-Line Scanning Will Add to Woes of Present Telly Stations

Industry sources see stormy seas ahead for the television trade, long the Little Orphan Annie of the radio biz. Not satisfied with shuffling allocations—and, incidentally, thus hampering production by mfrs. who don't know what channels will be covered—the FCC is reported ready to revise standards. This means that 441-line scanning, as used in all receivers sold commercially, may soon be abandoned in favor of 507 lines.

While this is startling news, it is not quite as bad as it sounds. Many of the better sets, originally designed for 441-line operation, will operate satisfactorily on the higher-definition images. This is due to the latitude allowed in the sweep circuits with which they are furnished. However, some engineers claim that the tuning circuits are insufficiently broad to get full benefit from the higher video frequencies required.

The sets will not need to be "junked"; repairs costing an estimated maximum of \$15 should put them in shape. This should mean a harvest for Servicemen, as it has been hazarded that each job will take no more than about 2 hours.

Big. cos. will probably use house Servicemen and factory-rebuilt chassis.

FAIR FACSY FAN



Facsimile transmission and reception is a feature of the RCA exhibit at the N.Y. World's Fair, and this pretty watches the special facsy edition of the N. Y. Evening Post come in. Material, sent to Fair from N.Y.C. by messenger, is transmitted from a facsy pick-up in the exhibit.

GATHER TO PUSH POLICE RADIO



A drive to make sales of police and emergency communication equipment is under way at RCA. Above picture shows group at Camden meeting. At the left end of the table is George Pettengill, Mr. Mickel's assistant; clockwise around the table from him are H. M. Leighley, Atlanta; Irving Strauss, Boston; T. Griffin (standing), installation and service activities in the East; K. B. Russell, Chicago; J. C. Fields, New York; Harry Hill, Dallas; Harry Mickel, Manager of RCA Police Radio Sales; O. H. Mackley, in charge of installation and service in the West; S. J. Combs, San Francisco; D. J. Veasey, Kansas City, and J. W. Kirschner, Cleveland.

PRESS AGENT PULLS POWERFUL PIC GIVES SET NEWS SLANT WITH TIE-UP



Brilliant press agent of Galvin Mfg. Corp. staged hot news photo of Jimmy Dykes and Luke Appling seated at rummy game and "De Luxe" Motorola with sliding door front. Set is 3-way job with built-in antenna in airplane luggage or leather case. Players are manager and short stop respectively, gentlemen at upper-right are said to be no relation to Sally Rand or Gypsy Rose Lee.

TELEVISION THRILLS CROWDS IN EXHIBITOR'S WORLD'S FAIR DISPLAYS



Picture directly above shows small part of crowd waiting to see television demonstration. Groups wait outside 10 "Television Living Rooms" and indoor and outdoor studios. Other picture shows interior of one of studios where various

entertainment programs such as interviews, puppet shows, musicals, etc., are presented. In good weather pick-ups are moved outdoors to "Garden Studio." Some of these shows are put on the air.

Sales Helps and Deals

*New Paths to More Business
(How Leading Mfrs. Help YOU Make Money)*

A new master antenna to handle both FM and all-wave AM by means of a single antenna system has been announced by **TECHNICAL APPLIANCE CORP.** Designed especially for store demonstrations the system offers full noise-reduction performance on all wave-bands and handles up to 8 sets simultaneously without noticeable loss of signal strength. The system will handle FM, AM and television signals even when the receiving antenna is so positioned that as much as 200 ft. of transmission line is required to connect the antenna to the demonstration rooms.

George Duvall, nat'l pres. of the **RADIO SERVICEMEN OF AMERICA**, appeared on WOR to announce that reconditioned radios would be sent to any hospital sup't. requesting one during National Radio Festival Week. This besides a charitable act on the part of the Servicemen built much good will for their organization.

TRANSFORMER CORP. OF AMERICA will boost Clarion streamline public address

\$'s & No.'s

39.2% INCREASE in sales over the same interval in the preceding year is claimed by V.P. G. V. Rockey of Meissner Mfg. Co., for the 1st third of 1940. An aggressive sales and advertising campaign is credited with a goodly portion of this gain.

25c DIVIDEND per share was voted by directors of Stewart-Warner, payable to stockholders of record at the close of business June 7. Payments were made June 30th.

35c DIVIDEND per share was paid on July 25th to stockholders of record of the General Electric Co.

\$4,034,622 WAS THE TOTAL NBC network billing for May compared with \$3,702,102 for the same month of 1939. This represents an increase of 9%. Of this amount the Red network carried \$3,216,940 and the Blue, \$817,682. The increase for the Red network was 6.3% over that of May last year, and 20.9% for the Blue network.

equipment with such sales aids as window displays, newspaper mats, blotters and letters furnished to distributors without cost. This is a new type of promotion in the P.A. field. Feature of the sales helps is a new 24-pg. 2-color catalog.

Two-color postcards boosting **SEEBURG** wireless remote control music system carry local distributor's imprints. Radio broadcasts offering listeners premiums for interesting local bars are also part of the campaign. The premiums are small radio sets.

G. E. has prepared a strong campaign to sell appliances to leap-yr. brides. This gives birth to the thought that you might dig up a list of local brides at your county clerk's office and circularize them for radio sets or service.

ENGINEERS INSPECT F.M.



Assistant engineer D. E. Chambers and C. A. Priest, Engineer Radio Transmitter Dept. (l. to r.), inspect new G. E. 1 kw. F.M. transmitter on test floor at Schenectady. They point out how all parts are accessible for inspection, test or repair.

Personal

RICHARD GRAVER, RCA district sales mgr. at Chicago, spent a mo. at the home plant in Camden to study advertising & sales plans. WILLIAM H. KELLEY took over his duties during his absence.

ROSCOE L. HAMBLETON, formerly of **GENERAL MOTORS**, has been made mgr. of the foreign div. of **CROSLEY CORP.**

JACK CLUNE, office mgr. of **NAT'L UNION RADIO CORP.**, was graduated a B.S. from Fordham U.

ALLAN R. ROYALE is the new **STROMBERG-CARLSON** sales rep for the Phila., Baltimore and Wash. districts, taking over the spot left open when CLIFFORD J. HUNT became mgr. of the co.'s distributor div. Royale, a member of **JOSEPH E. HORNBERGER CO.'S** sales staff, has moved from Reading, Pa., to Baltimore.

MAJOR LENOX R. LOHR has been named chairman of the **RADIO BROADCASTING COMPANIES** div. of the Greater New York Men's Committee of The Queen Wilhelmina Fund, Inc., to aid refugees of the Netherlands.

W. H. "WIN" ALLEN has moved to Camden to assist Fred D. Wilson in promoting the sale of RCA tubes & parts.

HERBERT M. HUCKE, former communication engineer of the Air Safety Board of the C.A.A., has been appointed mgr. of aviation radio sales for same co.

JOHN ALTMAYER, formerly adv. mgr. of **BRUSH DEVELOPMENT CO.**, has been made ass't sales mgr. in charge of jobber sales & advertising at **WARD PRODUCTS.**

RALPH N. WEISENBERGER, pres. of the same co., distributed bonus checks to 136 employees at a company dinner. He and the other officers of the co. were given handsome bronze plaques by the employees to whom the checks came as "a complete surprise."

LESTER S. LAPPIN, formerly of **CORNELL-DUBILIER** and **FEDERAL TELEGRAPH**, will specialize on engineering, police, plane, marine, governmental & commercial radio equipment for **HARVEY-WELLS COMMUNICATIONS, INC.**

HOWARD J. TYZZER, formerly chief eng. of **CROSLEY CORP.'S** household radio div., has been appointed sup't of the **FINCH** facsimile plant in Passaic, N. J.

FRANCE (remember?) has conferred the decoration of Officer of the Legion of Honor on DAVID SARNOFF, pres. of RCA, in recognition of his radio work.

(Continued on page 189)

AN EDITORIAL

By Artie Dee

You are the public. The Federal Communications Commission is authorized to administer radio broadcasting in your "interest, convenience and necessity."

You are the public. You pay the generous salaries which the Commissioners and their multitude of assistants receive. Are the Commissioners earning their salary or is it about time they got their 2 wks. notice?

You Are the Boss

When the FCC was the Federal Radio Commission some years ago, the body was formed to do a certain job—to eliminate the confusion which resulted from the fact that there were no radio regulations and anyone who wished to enter the broadcasting business merely put up a transmitter and ran hog-wild on the ether. Stations too close to each other picked interfering wavebands and both blasted away with all the kilowatts their purses could stand. The result was one of the finest collections of heterodynes and overlaps that it was possible to produce.

The FRC corrected this evil. The FCC kept up the good work until recently. Then this august body emulated the early broadcasters. It ran wild.

First manifestation was in its statement taking a rap at television. Its second step was its successful attempt to dictate what sort of newspaper advertising television mfrs. might not use—surely a matter for the Federal Trade Commission, if for anyone. The next step was a ruling which virtually forbids the entrance of the major companies into the television broadcasting field—an entry necessary if television broadcasting is to be adequately financed.

Dictator Coming?

Informed circles in the radio manufacturing field are badly frightened. They look upon these incursions as merely the entering wedge to the entire broadcasting industry's being deprived of its freedom of speech and action. They dread a dictatorship being set up over their means of livelihood.

You are in the radio industry. You are part of this picture. You are the public. If you too fear the grab for power being made by the FCC, let your servants—the FCC—know that you do not like their work.

To do so, take your business letterhead and write on it, "I endorse your editorial in the September issue of *Radio-Craft*. I am in favor of limiting the FCC's power to its true function—that of regulating stations' power and wavelength to prevent interstation interference. I do not approve the FCC's assumption of power to dictate the business methods of the radio industry."

Mail this letter to RTD Editor, *Radio-Craft*, 20 Vesey St., New York, N. Y.

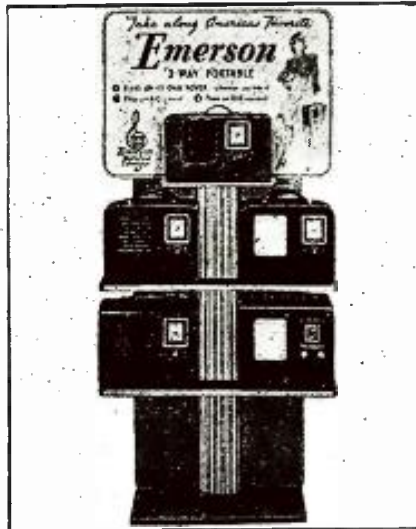
PERSONAL

(Continued from page 188)

GLADYS M. TOOTH of HYGRADE SYLVANIA was runner-up and a finalist in a nation-wide contest, to select the girl who best typifies the intelligent young business woman of today, run by *National Foreign Trade Week*. Blonde Miss Tooth is sec'y to Walter A. Coogan, the co.'s foreign sales mgr.

HYMAN KAHN, for many yrs. with LEEDS RADIO CO., has joined the staff of SUN RADIO CO., N.Y.C.

SALES HELP TO BUILD YOUR BUSINESS



Emerson's new portable shelf display holds 5 of the new 3-way portables. Left illustration has strong eye appeal and suggests action. Display is designed for store or window. Same co.'s single unit display (right) makes striking background for single portable and uses same attractive figure as on top card of larger display. It likewise can be used on counter or window.



Servicemen will welcome the new Philco photoelectric pickup; it takes a Serviceman to change the needle (but each needle is good for 30,000 to 40,000 playings) . . . Over 200 leading parts wholesalers attended RCA Mfg. Co.'s convention for discussion of distribution . . . New Bankers Life Co. bldg. in Des Moines, Iowa, has 100-W. RCA sound system—one of biggest in world . . . KTMR has just equipped 2 sound trucks with Universal Microphone Co. recorders & amplifiers.

Nearly 100 La., Miss. & Ark. hams and Servicemen attended Schneider & Son's annual meeting; high spot was bingo game with baby chicks & ducklings as prizes . . . 300 Crosley distrib. & reps attended convention to see new line . . . "A complete planograph service" (whatever that is) for jobbers has been announced by United Catalog Publishers . . . Andrea Radio Corp.

LATEST F.M. NEWS

Foreseeing a boom in the frequency modulation field, Dr. Ray H. Manson, gen. mgr. of Stromberg-Carlson, says, "FM will stimulate the marketing of receivers more than any development in the past decade, particularly to those people who have purchased good receivers, and over a long period of time have been offered no improvement that would warrant buying a new radio. FM brings a plus service with reproduction so vastly superior to anything heretofore that it is of sufficient interest and value to create replacement buying on a large scale."

Strengthening Stromberg's position in the field, company engineers explain that in order to get the best possible results from FM, that to be at its best FM must be heard through a coaxial speaker backed up by a labyrinth baffle—both of which are of course found only in Stromberg sets.

Canadian radio dealers are enthusiastic over FM, although, according to *Radio Trade-Builder* there was little likelihood that the C.B.C. will issue FM licenses at present. However, the belief is that U.S. FM stations near the border will create a Canadian demand for suitable receivers.

(Continued on page 190)

is dumping 150 television kits which listed at \$79.95 to Servicemen for only \$24.95.

Atlas Sound Corp. has a new line of "Dyna-Flux" compression-type permanent-magnet speaker units . . . Westinghouse has announced 7 new "21st birthday" radios . . . Sylvania held a 3-day open house at its factory for relatives and friends of its employees, to let them see what a modern plant their living comes from . . . National Carbon Co.'s old "Reserve" type drycell was shipped dry and activated by filling the hollow carbon with water; their new "Air Cell" type of "A" battery is shipped the same way but has far greater service capacity than the older model.

Six Hammond organs and 7 Novachords are in use by exhibitors at the N.Y. World's Fair . . . Finch has just been granted patent 2,203,461 on a mobile facsimile scanning unit suitable for home broadcasting or in use in planes, ships and cars . . . And, speaking of patents, J. R. Fouch, pres. of Universal Microphone Co., has been granted No. 2,198,080 on a cutting head . . . American Radio Transcription Agencies has been taken over by Artransa Pty., Ltd.; Dr. R. L. Power, Los Angeles, is American rep.

Trend to home recording is noted in new Farnsworth line which contains 45 units including some for F.M. Line also has 9-in. and 12-in. telly sets; only 22 tubes are used in latter models . . . RCA has dropped prices on 3 transmitter tubes & 1 gas-filled rectifier . . . Selector Mfg. Corp., makers of precision instruments, has entered the professional & home recording market with equipment built around the Bruno products; Bill Bruno will direct the Corp.'s manufacturing & technical activities.

P.A. FOR BALLYHOO



Warner Bros. use 6-foot exponential trumpets and compression-type speakers to ballyhoo "Virginia City," World Premiere, according to Atlas Sound Co. Sales Mgr. R. C. Rinehart. (Why don't you get after local movie house and sell sound for promotion?)

TELEVISION TRENDS

At press time the FCC granted construction permits or licenses for 23 television stations and had issued a ukase that no one company could have more than 3 stations. Informed circles were of the opinion that this would do much to hamper the industry as it might prevent the expenditure of the large sums necessary for good programming. Observers in the New York area stated that NBC's television programs have hit a new low in entertainment value since the Commission's adverse action in denying commercialization rights.

Gene W. Latham, former metropolitan sales mgr. of Allen B. Du Mont Labs., has become gen. sales mgr. of American Television Corp. Victor E. Olson (Bklyn & Queens), E. Thornton Rice, Jr. (N.J.), and Henry J. Bell, Jr. (Bronx & Westchester), have also switched from Du Mont to A.T.C. This co. announces that it has entered production on "videor" sight & sound sets for home use. (Whatever happened to the co.'s plan for an inter-store television network?)

Kolorama Labs. of N.J. went out of business and had their assets sold at public auction.

Allen B. Du Mont Labs. have discontinued all models save the 14-in. and 20-in. jobs. The co. has also appointed distributors for its C.-R. oscilloscopes and electronic switches. Coincident with the granting of its license for N.Y.C. transmitter the co. has appointed Will Baltin program director of W2XWV. Baltin was radio and movie editor of New Brunswick papers.

LATEST F.M. NEWS

(Continued from page 189)

E. E. Williams, G.E. radio expert, addressing the A.I.E.E. and I.R.E., foresees wide use of FM in the emergency service field because of its great freedom from interference caused by static, ignition noises, street cars, extreme shadow effects, etc. He also sees a great future for air transport, airport control, relaying and program pick-up.

Dick Dorrance has resigned from WOR's press dept. to direct publicity for FM Broadcasters, Inc., N.Y.C.

OFF THE PRESS

CATALOG B. Allen B. Du Mont Laboratories, Passaic, N.J. Complete list of commercial television equipment including cameras, synchronizing signal generators, monitors, transmitters, electronic switches, and various sizes of cathode-ray tubes.

BULLETIN. Same co. 8 pages. Describes in detail the improved features of the type 208 cathode-ray oscilloscope.

FOLDER. Andrea Radio Corp., Woodside, N.Y. Describes their model KT-E-5 5-inch television kit, which is being offered for sale at a close-out price—less than 50% of its original price.

BROADSIDE. Radio Wire Television, Inc., New York, N.Y. (Lafayette Radio). Beautiful rotogravure job listing radio receivers, portables, phono-radio combinations, auto-radio sets, radio parts and camera equipment.

CATALOG. Spokane Radio Co., Spokane, Wash. A collection of manufacturers' literature bound together. Lists Radiart auto antennas, Rider's new F.M. book, Shure microphones, Admiral portables, and a group of dynamic speakers. Also found in the collection is the latest Raytheon tube characteristic photo chart.

TUBE BASE CHART. Hygrade Sylvania Corp., New York, N.Y. A handy "stick-on-the-wall" chart, which shows at a moment's glance the base connections of a large variety of tubes. Gratis to all Servicemen. Write to Sylvania.

CATALOG. No. C-1276. National Carbon Co., Inc., New York, N.Y. 8 pages. Gives complete line-up of batteries and drycells for radio use. Of special interest is the announcement of a new line of Mini-Max "B" batteries, which is claimed to give twice as many listening hours as other types of batteries of equal size.

CATALOG. Sears, Roebuck & Co., Chicago, Ill. 64 pages. A complete listing of radio amateur equipment, test instruments, sound systems, recording and playback devices, and accessories for all these lines.

FOLDER. Cornell-Dubilier Electric Corp., So. Plainfield, N.J. Lists and describes high-voltage condensers for heavy-duty X-ray and impulse or surge generator applications. Includes a table indicating operating voltages to which the X-ray condensers may be subjected. Also, 5 schematic circuits of high-voltage X-ray and impulse generators are given.

CATALOG. Hickok Electrical Instrument Co., Cleveland, Ohio. 10 pages. Complete line of test instruments including a "traceometer," tube testers, ohmmeters, signal generators, V.-T. voltmeters, oscilloscopes, etc.

FOLDER. (Amphenol News) American Phenolic Corp., Chicago, Ill. Completely describes a new series of electrical connectors for a large variety of applications. Replete with diagrams of connectors' specifications, contacts and dimensions for various applications.

FOLDER. American Radio Hdw. Co., New York, N.Y. 4 pages. This lists a large variety of automobile radio antennas and noise-suppression accessories.

SHEET. Solar Mfg. Corp., Bayonne, N.J. Describes and lists various sizes and capacities of its new line of "Red Cap" condensers.

FOLDER. Same co. 4 pages. Describes 2 models of condenser testers, model BQC which gives condenser measurements plus qualitative checking; and model QC which merely gives qualitative checking; of all types of condensers.

CATALOG. Montgomery Ward & Co., Chicago, Ill. 48 pages. A complete listing of public address systems, amplifiers, speakers, microphones, stands and accessories.

CATALOG. Sun Radio Co., New York City. 24 pages. Public address amplifiers and sound systems described and illustrated.

LAST FAST FLASHES

Make extra pennies by installing the new G.E. outdoor outlet for people who wish to use radios outdoors... 800 distributors got enthusiastic over Philco's new line at Chi. meeting... Same co.'s glee club sang at the Temple of Religion at the N.Y. World's Fair... KGB singing team announced program was for Stromberg-Carlson listeners only and offered to send set for demonstration of superiority; got 1 order during 1st broadcast... Macon, Ga.'s, 7 2-way police radios were built by engineer of WMAZ and cost \$200 to \$300 less than standard apparatus would have.

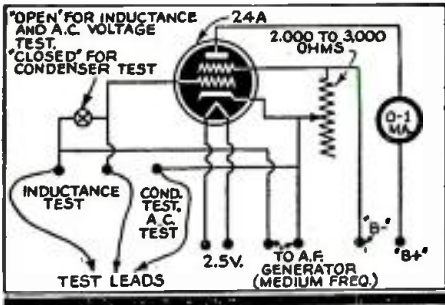
Sun Radio Co. of N.Y.C. has expanded its P.A. dept. and has put J. M. Heddaeus at its head.

RECORD CARD AIDS SERVICING

A detailed service record card form. It includes sections for 'CUSTOMER'S RECEIPT', 'LET OWNER'S WARRANTY', 'TUBES' (with a table for recording tube numbers, types, and dates), 'MATERIALS USED', and 'YOUR IMPRINT HERE'. The 'TUBES' table has columns for 'NO.', 'TYPE', 'YEAR', 'PRICE', and 'LIFE'. The 'MATERIALS USED' table has columns for 'DESCRIPTION', 'QTY', and 'LIFE'. The form also contains various checkboxes and fields for recording service details and customer information.

A service record card which itemizes tubes and materials used, together with all other necessary data for the Serviceman, and presents a receipt and guarantee (together with a bit of advertising) to the customer is available through Hygrade Sylvania at extremely low prices. Such cards simplify record keeping tremendously.

CONDENSER TESTER



● IN all of the condenser testers that I have seen, none (except commercially-made) of them were equipped to test condensers having a capacity lower than about 0.01-mf. Here is the diagram of one that will test condensers having a capacity of from 100 mmf. to 0.05-mf. Also it can be used as an inductance tester as well as a vacuum-tube voltmeter.

A 0-1 ma. milliammeter is used. The calibration curve for capacity measurement can be determined by using condensers of known values and noting the amount of deflection of the meter for each particular value tested. When testing condensers the meter should be adjusted for maximum deflection. When setting the meter at max. deflection for condenser tests the leads should not be shorted together. The switch should, of course, be set for COND. TEST.

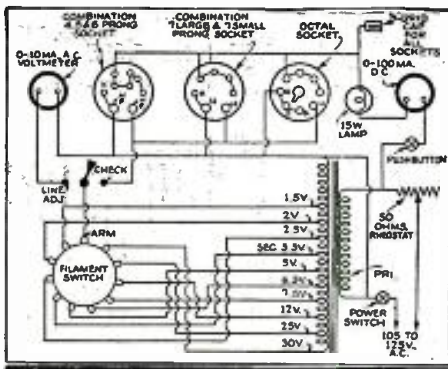
The calibration curve for inductances can be determined in a similar manner. When setting the meter at full deflection for inductance tests, the test leads should be shorted together. The switch should be set in the IND. TEST position.

An audio-frequency oscillator must be used in conjunction with this instrument to produce the A.C. (audio) voltage. Its output must be great enough to cause complete deflection of the meter, when setting it for a condenser or inductance test, at some setting of R1.

Care must be taken, when setting the instrument for condenser tests, that the lead from the grid is not in contact with the body or some other object such as a piece of metal, because it will change the amount of deflection of the meter.

DAN KNIPE,
Nampa, Idaho.

HOME-MADE TUBE CHECKER



● HERE is a diagram of a Tube Checker which, although it can be constructed for less than \$6, will give efficient service.

The filament transformer should have a 105-volt primary and a tapped secondary which will deliver 1 1/2, 2, 2 1/2, 3.3, 5, 6.3, 7 1/2, 12, 25 and 30 volts. The 50-ohm rheostat enables the voltage of 105, 110, 115, 120 and 125 V. power lines to be used. Throw the S.P.D.T. toggle switch to the position marked LINE ADJ.

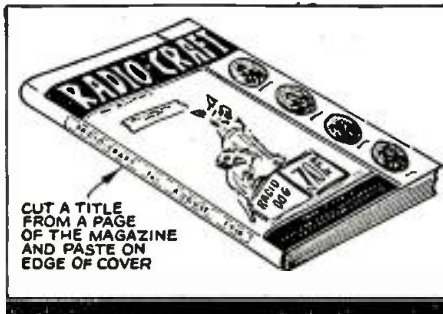
Set the filament switch at 5 volts, turn

the rheostat to the high-resistance end (so as not to accidentally burn-out the transformer primary), and turn on the power switch. Turn the rheostat to the left slowly, until the A.C. voltmeter reads exactly 5 volts. Then throw the toggle switch to the CHECK position, adjust the filament switch and insert the tube. Press the pushbutton and take a reading of the milliammeter. CAUTION: Do not hold the pushbutton down over 2 or 3 seconds, as it may injure the tube. (The technician may wish to incorporate a timer to automatically accomplish this result, but that raises the cost of the unit, and the author preferred instead just to exercise a little caution as per above.—Editor)

To check the tube further, decrease the filament voltage about 25% using the 50-ohm rheostat. If the tube is OK the milliammeter should not vary to any great extent. The Tube Checker may be calibrated by testing tubes of known quality. Although it is not as efficient as some of the elaborate, costly tube checkers now on the market, this test unit should serve for most of the needs from day to day.

HOWARD CLIFFORD BENSON,
Baltimore, Md.

HANDY RADIO-CRAFT KINK

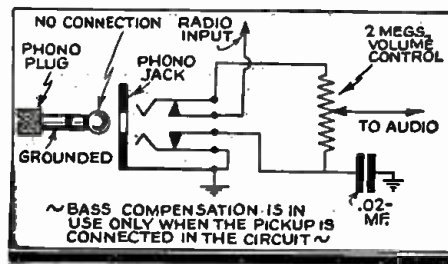


● I AM sure that the following idea will be a great time and patience saver for those who are constantly referring to the new streamlined issues of Radio-Craft which do not have a back edge wide enough to accommodate the issue date, etc.

Cut out the printed words (for example), RADIO-CRAFT for NOVEMBER, 1939, etc., at the bottom of the magazine and paste the slip on the edge of the journal as per illustration.

SAM KOIDE,
Honolulu, Hawaii.

BASS COMPENSATION



● A NOVEL bass-compensation circuit, which the writer has been using for some time on a 13-tube radio set, is shown on the accompanying diagram. It has one limitation however . . . it can only be used on crystal devices, such as record reproducers. However the amount of compensation on such a device is really remarkable. One might think that it would cause boominess, but it has worked much better in practical use than a good many more expensive types. The bass is rich and deep, and if the volume control is advanced to normal room volume, the

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highs are quite brilliant and do not seem to suffer because of the over-emphasized bass.

A 0.02-mf. condenser has a very low reactance at 5,000 cycles, but the reactance at 60 cycles is approximately 90 times that at 5,000 cycles. This means that if the capacitive reactance at 60 cycles was 200,000 ohms, and at 5,000 cycles it was 2,220 ohms, the high frequencies would be bypassed to ground, but the lows would not be fully bypassed. As the volume is advanced the resistance to ground will not change very much in the bass register, but in the higher register, the resistance will increase very rapidly. Therefore the effect of the bass compensation is only effective at low volumes, and is most favorable at room volume.

It must be understood, however, that if a good baffle is not used, the bass will appear raspy. A good baffle was described by Leroy Peters, in the May, 1940, issue of Radio-Craft. Remember! A good baffle is essential in the reproduction of bass, no matter how good the amplifier and speakers used.

Several different types of amplifiers have been used, including transformer coupled. At present the amplifier in use employs the following tubes: 1—6F5 1st audio; 2—6C5's as phase inverters; and, 2—6F6's as power output tubes. These drive a 12-inch high-fidelity speaker housed in a good solid baffle. Two volume controls have to be used in this amplifier, because of the tremendous gain.

NORMAN WILSON,
Calgary, Canada.

CHECKING SPEAKER FIELDS

● In checking for field current with the set and speaker in the cabinet, some difficulty is encountered because you can't get a screwdriver in front of the speaker to feel the pull of the magnetism. This difficulty is removed, when you use an ordinary (inexpensive-type—Editor) meter to check for field current. Just hold the meter near the field winding and observe the movement of the needle, if the needle moves then the field is OK, if no movement then the field is open or shorted.

I use any kind of meter for this test.
HAROLD R. KUNTZ,
Brooklyn, N. Y.

GEOPHYSICAL PROSPECTING OUTFITS



BLUE PRINTS and INSTRUCTIONS

For Building the Following Treasure Finders and Prospecting Outfits

- Folder No. 1. The "Radioflector Pilot"—consists of a 2-tube transmitter and 3-tube receiver. Principle: radiated Wave from transmitter loop is reflected back to receiver loop. Emits visual and aural signals. Tubes used: two 1A5G—two 1N5G—one 1H5G.
- Folder No. 2. The "Harmonic Frequency Locator"—Transmitter radiates low frequency wave to receiver, tuned to one of Harmonics of transmitter. Using regenerative circuit. Emits aural signals. Tubes used: one 1G6G—one 1N5G.
- Folder No. 3. The "Beat-Note Indicator"—Two oscillators so adjusted as to produce beat-note. Emits visual and aural signals. Tubes used: Three type '30.
- Folder No. 4. The "Radio-Balance Surveyor"—a modulated transmitter and very sensitive loop receiver. Principle: Balanced loop. Emits visual and aural signals. By triangulation depth of objects in ground can be established. Tubes used: Seven type '30.
- Folder No. 5. The "Variable Inductance Monitor"—a single tube oscillator generating fixed modulated signals and receiver employing two stages R.F. amplification. Works on the inductance principle. Emits aural signals. Tubes used: six type '30.
- Folder No. 6. The "Hughes Inductance-Balance Explorer"—a single tube Hartley oscillator transmitter and sensitive 3-tube receiver. Principle: Wheatstone bridge. Emits aural signals. Tubes used: two type '30—one type '32—one type '33.
- Folder No. 7. The "Radiodyne Prospector"—a completely shielded instrument. Principle: Balanced loop. Transmitter, receiver and batteries enclosed in steel box. Very large field of radiation and depth of penetration. Emits aural signals. Tubes used: two 1N5G—one 1G4G—one 1H5G—one 1Q5—one 1G4.

With any one of the modern geophysical methods described in the Blue-Print patterns, Radio outfits and instruments can be constructed to locate metal and ore deposits (prospecting); finding lost or buried treasures; metal war relics; sea and land mines and "duds"; mineral deposits; subterranean water veins; oil deposits (under certain circumstances); buried gas and water pipes; tools or other metallic objects sunken in water, etc., etc.

Each set of blueprints and instructions enclosed in heavy envelope (9 1/2" x 12 1/2"). Blueprints 22" x 34"; eight-page illustrated 8 1/2" x 11" fold. **50¢** or of instructions and construction data ... Add 5¢ for postage

The complete set of seven folders..... **\$3.00**
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Complete set of seven folders.

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OCCUPATIONS IN RADIO, by Kenneth G. Bartlett and Douglass W. Miller (1940). Published by Science Research Associates. Size, 6 x 9 ins., paper cover, illustrated, 48 pgs. Price, 50c.

This book is one of a series on occupational placement in various fields. Mr. Bartlett is director of the Radio Workshop, Syracuse University, and Mr. Miller is assistant to the dean, School of Journalism, Syracuse University. States the author in his foreword: "... radio is an occupational field worth talking about because it offers salaries that are far above average." The author does not take long to get down to such pertinent facts as salary prospects in the various fields of radio. The scope of the text is evident from the table of contents, to wit: The Rise of Radio; How Radio Stations Are Organized; Radio Network Organizations; Employment with Service Organizations; Radio Jobs, Qualifications and Training; Technical Jobs; Women in Radio; Getting Started and Looking at the Future.

WE PRESENT TELEVISION, edited by John Porterfield and Kay Reynolds (1940). Published by W. W. Norton & Co., Inc. Size, 6 x 9 ins., cloth cover, 43 illustrations, 298 pgs. Price, \$3.00.

This book successfully presents in easily understandable language a cross-section view of the television industry. The authors have coordinated chapters prepared by experts in special phases of the television field (see contents below). Anyone aspiring to make contact with the television field in any of its phases should read this book.

Contents: Raising the Television Curtain—Alfred H. Morton; The Technique of Television—Donald G. Fink; The Men Behind the Camera—O. B. Hanson; Programming—Thomas H. Hutchinson; The Director—Thomas Lyle Riley; The Actor—Earl Larimore; The New Newsreel—Charles E. Butterfield; Television on the West Coast—Harry R. Lubcke; Facsimile and Frequency Modulation—J. R. Poppele; The Finance Problem—Benn Hall; The Challenge of Television—Robert Edmond Jones.

DISPLAY ANIMATION (1939-'40). Published by Reeder-Morton Publications, Inc. Cloth cover, size 8 1/2 x 11 ins., 300 photos, 240 pgs. Price, \$5.00.

We would make but little progress if we attempted to describe in any detail the contents of "Display Animation" (1939-'40). This book has no practical interest for the average radio man but it does have exceptional interest for technicians who may wish to know about the latest applications of electronics and sound in displays of all types.

Considerable space is given to new devices at the 1940 World's Fairs in which P.A. systems, photocells, etc., are put to practical use. We particularly call attention to the article, "'X-Ray' View of Levi's Electronic Rodeo," in the section, "Sound Reproduction—Voice Narrative, Animation and Lighting Combined," which describes the extensive application of electronics and sound in A.M.I. Distributing Company's "Robophone."

EDUCATION ON THE AIR, Edited by Josephine H. MacLatchy (1939). Published by Ohio State University. Size, 6 1/2 x 9 1/4 ins., cloth cover, 436 pgs. Price, \$3.00.

In the 10th Yearbook of the Institute for Education by Radio, Editor Josephine H. MacLatchy presents the status of radio from the standpoint of Ohio State University at the beginning of 1940.

Chapter headings are as follows: Radio in a Democracy; Radio and Public Opinion; Radio and Adult Education; Radio and General Education; Agricultural Broadcasts; Research in Education by Radio; School Broadcasts; Using a School Broadcast; Educational Music Broadcasts; Third Annual Exhibition of Recordings; Roster of the Tenth Institute for Education by Radio.

RADIO—A Study of First Principles, by E. E. Burns (3rd Edition, 1938). Published by D. Van Nostrand Co., Inc. Size, 5 1/2 x 8 ins., cloth cover, 237 illustrations, 293 pgs. Price, \$2.00.

In this 3rd Edition of a book on the elements of radio the author presents new information, as for instance the chapter on television. No radio beginner should be without this book. Need we say more?

TRUE-FALSE QUIZ ANSWERS

(See page 162)

The following statements are TRUE: 1, 3, 6, 7, 9, 12, 13, 15, 17, 18, 20, 22 and 24. All other statements are FALSE.

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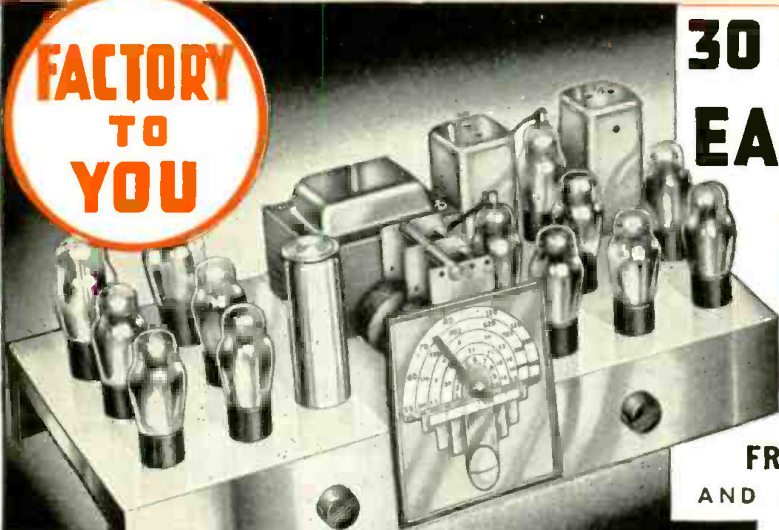
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NOW, you can enjoy the mighty power of a 14-Tube radio, at the amazingly low, factory-to-you price of only \$19.95. Brilliant performance. Beautiful tone. Now tune in broadcasts *direct* from distant overseas stations. Our famous 30-day prove-it-yourself plan, fully protects you and enables you to prove Midwest's super performance in the privacy of your own home, without obligation.

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"Wouldn't Trade For Any Other Radio"



Milwaukee, Wis. — I wouldn't trade my Midwest for any other radio. It is my second Midwest and it is improved a lot, especially the foreign stations like Italy, France, Spain, England, and Germany, etc.
— S. Caplan.

"Voices and Singing Crystal Clear"



Bethlehem, Pa. — So crystal clear and natural that one would think the person speaking or singing was right in the living room. Foreign stations come in so clear, almost like any station in the U. S. A.—Mr. and Mrs. W. Frank.

YOU BE THE JUDGE

No high pressure salesmen are needed to urge you to keep a Midwest—its performance speaks for itself. Do like thousands have done—put this new 1941 chassis in your present cabinet. Other chassis and cabinet models are fully pictured and described in our new 1941 Factory-To-You, money-saving catalog . . . from 5 to 17 Tubes, and up to 5-Wave Bands . . . including Radio-Phonograph combinations and Home Recorders.

BRINGS IN WORLD NEWS DIRECT

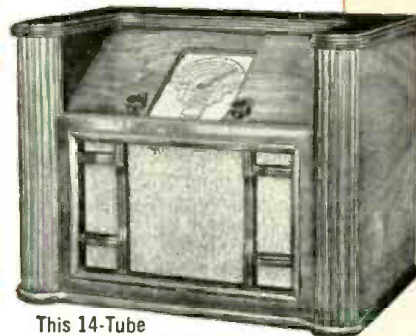
Tune in broadcasts direct from foreign countries. Hear history in the making before it appears in your local paper, and, before your local station announces its own version of the news! Listen direct to distant overseas stations in remotest parts of the globe.

14-TUBE

CABINET MODEL

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COMPLETE



This 14-Tube radio, complete in cabinet, at a price you would ordinarily pay for a set with only 7 to 10 tubes.

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FILL IN COUPON AND MAIL TODAY OR JUST SEND YOUR NAME AND ADDRESS ON 1¢ POSTCARD

MIDWEST *Factory-to-You* **RADIOS**

MANUFACTURERS OF QUALITY RADIOS SINCE 1920

Midwest Radio Corporation
Cincinnati, Ohio, U. S. A.
Dept. 12-AA

Send me your new FREE Catalog, complete details of your liberal 30-day Trial offer and factory-to-you prices.

Name.....

Address.....

Town..... State.....

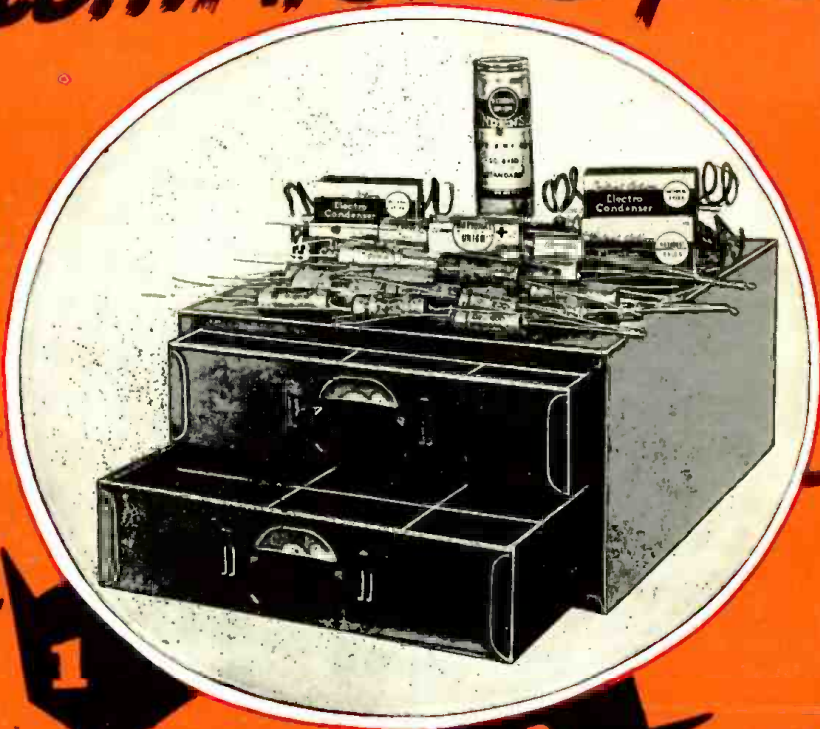
User-Agents Make Easy Extra Money. Check here () for details.



GET MIDWEST'S ANSWER TO TRADE-INS!

Special...N.U...Special

\$7.50
TAKES BOTH
 (PACKED IN ONE CONTAINER)



Two Drawer Steel Cabinet

Here's a honey of a steel utility cabinet with the drawers partitioned to make it easy for storing small parts. You'll find this cabinet a mighty useful addition to your shop equipment and best of all... you get it FREE on this limited offer. Don't delay, take advantage of this deal and get your FREE steel cabinet. Cabinet size is length 11½", width 9½", depth 5".

NO DEPOSIT ON CABINET
 You can buy the condenser assortment for \$7.50 plus 30 N. U. point contract. Points can be added to present N. U. contract. You get the steel cabinet FREE, now. There is no deposit. (The condenser assortment comes to you packed with the cabinet.)

Popular CONDENSER ASSORTMENT \$14.35

This fine assortment of popular type N. U. condensers will move fast, give you a good profit and insure the good will of your customers. If you're already using N. U. condensers, you'll be sure to snap up this offer in a hurry. If you don't know yet how really good N. U. condensers are, here's a great opportunity to try them! The assortment you get on this limited offer consists of:

- 3—JB8450
- 1—JB8845
- 1—SC8450
- 1—AT8150
- 1—AT1615
- 1—AT2015
- 1—AT8250
- 1—AT4450
- 3—AT8450
- 1—AT1645
- 3—T601
- 4—T602
- 3—T605
- 5—T610
- 2—T625

NATIONAL UNION RADIO CORP.
 57 STATE ST., NEWARK, N. J.

RC 9 Please tell me your nearest distributor or where I can get your \$7.50 steel Cabinet Condenser Special.

Name Street

City State

Ask Your N. U. Distributor
 ← Or Use Coupon