

RADIO'S LIVEST MAGAZINE



October
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Radio-Craft

HUGO GERNSBACK Editor



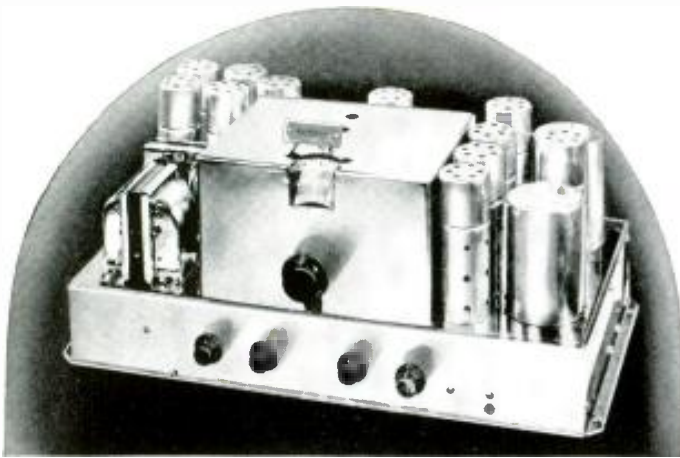
How to Make an
**EXPERIMENTAL
RADIOPHONE**

See Page 200



An All-Current Midget Set—The Iconoscope—The "Shoebutton" Tube
Making an "Analyzer Unit"—A.F. A.V.C. Circuits—Radio Beginners

NOT JUST WORLD-WIDE RECEPTION BUT CLEARER, STRONGER.. REALLY ENJOYABLE



13-570 meters, strictly one dial. Interstation noise suppressor, 10 watts undistorted output and giant theatre speaker four times as efficient as ordinary speakers. Sensitivity less than one-half microvolt. Selectivity—absolute 10 k.c. Each set logged on three foreign stations before shipment.

Creative genius is never content with things as they are. Ahead somewhere there is always a brighter goal that would antedate all previous achievement.

McMurdo Silver is never satisfied with radio as it is. His official record of 40 previous major advancements in the reception art, bears witness to this simple but glittering truth. His standing in the highly exclusive field of engineering research, and his thousands of followers testify to the worth of his leadership.

It would hardly seem probable, therefore, that Mr. Silver would offer his Masterpiece unless it could readily demonstrate an unmistakable superiority over anything else available. And it would be absurd to assume that Admiral Byrd would select two Masterpiece receivers for his forthcoming Polar expedition, unless he, too, knew that the Masterpiece was the best he could get.

YOUR EARS WILL QUICKLY PROVE THE CORRECTNESS OF THESE FACTS

The story of any receiver is conclusively told by engineering curves plotted of its sensitivity, selectivity, fidelity and signal-to-noise ratio. The sensitivity curve of the Masterpiece shows that this receiver will give you louder and clearer reproduction of transoceanic reception than any other receiver you can buy. And your own ears will instantly bear this out on London, Paris, Berlin, Madrid or any of the other far-off stations the Masterpiece so easily receives. The signal-to-noise ratio curve of the Masterpiece shows clearly that this receiver will give you 10,000 mile reception over and above a lower noise level than has ever been reached before. Your own ears will readily bear this out too. The fidelity curve of the Masterpiece, as compared to the fidelity curves of other receivers, shows the Masterpiece to be responsive to a wider range of frequencies at all degrees of volume. And no critical ear is required to discern the difference as poured forth from the Masterpiece speaker. The selectivity curve of the Masterpiece shows that this receiver is exactly as you wish it to be; namely, capable of distinctly separating all channels.

10 DAY TEST OFFER

LETS YOU PROVE THE MASTERPIECE TO YOURSELF

The Masterpiece is unconditionally guaranteed to satisfy you, or your money back instantly... no questions asked. All of which means that you can order the Masterpiece for 10 days test without risking a dollar. In that time you can compare the Masterpiece to other receivers and thereby see for yourself why McMurdo Silver has earned international recognition as an engineering leader. The coupon will bring you the full technical story of the Masterpiece.

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1735 BELMONT AVENUE, CHICAGO, U. S. A.

McMurdo Silver, Inc., 1735 Belmont Ave., Chicago, U. S. A.
Send me full technical information of the Masterpiece.

Name

Street

Town State



McMurdo Silver who is officially credited with 40 major radio advancements

1. First practical and popular superheterodynes in the world—1923.
2. First portable superheterodyne—6"x8"x12" including batteries—1923.
3. First practical and popular really portable superhet 1924.
4. First all wave t.r.f. receiver—1925.
5. First all wave superhet, 15 to 3000 meters—1925.
6. First high quality audio transformer with 5000 cycle cut-off—1926.
7. First selective power-supply filter—1926.
8. First popular one dial t.r.f. receiver kit—1926.
9. First short wave receiver—1926.
10. First plug-in coil short wave receiver—1926.
11. First B power unit to use glow voltage regulator tube—1927.
12. First shielded all wave superhet, 15 to 3000 meters—1927.
13. First shielded 200 to 3000 meter t.r.f. receiver kit—1927.
14. First shielded t.r.f. receiver kit—1927.
15. First screen grid t.r.f. receiver—1927.
16. First screen grid shielded superhet—1927.
17. First single unit shielded i.f. amplifier unit—1927.
18. First tuned i.f. amplifier unit—1927.
19. First shielded A.C. t.r.f. receiver kit—1927.
20. First A.C. superhet—1927.
21. First popular high quality push pull audio transformers—1927.
22. First portable A.C. public address amplifier—1928.
23. First one dial, five tuned circuit t.r.f. receiver—1928.
24. First receiver to use four screen grid tubes—1928.
25. First tuned audio transformers eliminating hysteretic distortion—1928.
26. First audio transformer for screen grid tubes—1928.
27. First generally available rack and panel public address system—1929.
28. First A.C. screen grid receiver—1929.
29. First hand selector receiver—1929.
30. First screen grid power detection—1929.
31. First receiver having now universally used practical tone control—1929.
32. First A.C. short wave receiver—1929.
33. First R.C.A. license to announce superhets—1930.
34. First midrange superheterodyne—1930.
35. First 15 to 550 meter receiver not to use plug-in coils—1931.
36. First dual tone control system—1931.
37. First receiver to use variometer or super control screen grid tubes—1931.
38. First 16 to 550 meter superhet with single accurately calibrated dial—1932.
39. First regular broadcast superhet to also be able to get police calls—1932.
40. First "Class A prime" high quality audio power amplifier

TESTIMONY AGAIN PROVES LEADERSHIP OF SILVER ENGINEERING

OFFICIAL REPORT SAYS, "BEST"

"Possibly with our letterhead identifying us as an experimental laboratory, it might be well to mention that we are not interested in the sale or advertising of any make of radio. At present we are interested in preparing data relative to intermediate, short wave and ultra short wave reception as affected by various conditions, day light and darkness, humidity, barometrical pressures, etc. with different types of antennae. Naturally we must have instruments built to the highest laboratory standards of selectivity, tone, sensitivity and, above all the receiver must be versatile.

We find the new MASTERPIECE the best receiver that we have purchased or used. Since reception of distant and local stations primarily interests the layman it is well to mention that receivers employing a multiplicity of controls and trimmers, dial calibration, not understood by the average person are playthings in a lab and in most cases useless to the average listener. THE MASTERPIECE is simplicity itself—All anyone has to do is pick out a station from any broadcast listing either broadcast or shortwave, take the first two figures of its assigned wave and tune in the station.

Although perhaps a slightly lengthy testimonial, let us divide the remainder of this communication into three parts covering broadcast, short wave and DX code reception. We will furnish proof of reception and remember we are within a radius of 40 miles of the most powerful broadcasting stations in the world including code transmission.

1. Broadcast 550 to 1500 kc Daylight—W.M.C.A., W.E.A.F., W.O.R., W.J.Z., W.G.V., W.F.C.U., K.F.O.A., M.B.Z.A., P.G., W.K.V.A., W.O.V., W.C.A.D., W.I.N.S., W.C.A.P., W.O.D.A., W.E.A.N., W.E.V.D., W.H.K., W.O.K.O., W.J.S.V., W.N.B.F., W.A.B.C.
2. Short wave: 1 Australia; 8 Canada; 4 France; 4 Germany; 1 Siberia; 5 England; 1 Africa; 2 Italy; 3 South America; 1 Switzerland; 1 Denmark; 1 Costa Rica; and 1 Spain, etc.
3. DX signals from every country in the world can be copied.

Broadcast at night. It is impossible to list all broadcasting stations heard but outstanding performance of such an 1000 watt station 150 the power of K.F.I. Los Angeles coming in with good volume, i.e., K.F.O.N., K.F.P.V. from California, Havana, Cuba, Mexico City, Del Rio and stations all over Canada.

H. B. Miles,
17 Lenox Place, Middletown, N. Y.

"FROM" R.C.A.

"Before me is your recent letter with numerous testimonials of the wonderful results enjoyed by MASTERPIECE owners. Frankly, I see no excuse for anything but the best in a receiver designed by you. This, I explain by saying that in my twelve years of close relationship with every type of receiver and transmitter the name McMurdo Silver is frequently mentioned. When I studied and trained with R.C.A. your name was often mentioned as a foremost authority on superheterodyne tuner design."

M. O. C., Los Angeles, Calif.

EXACTLY AS PROMISED

"I cannot say too much in praise of the MASTERPIECE. My set arrived safely March 3rd and I set it up the table for a try out. The tone is excellent and the selectivity is wonderful. I did not have the time to properly install the set until Sunday, March 5th when at 3:30 P.M. all was ready—and right off the handle I tuned in EAQ with more volume than I could use. This was using the comparatively short indoor aerial. The reception was remarkably clear and free from static. Later on I received the same station with the speech tube in but, of course, at times the signal 'went out.'

Germany was also received in the afternoon and at 9:45 P.M. the E.I. Germany was picked about 6000 kc. and the German election returns were heard clearly.

To cap the climax I got up early today and at about 6:30 A.M. after some juggling I received VK 2PC at 10520 kc. right on the button. This is Sydney, Australia. I forgot to say that Saturday, March 11th (on the short antenna) I picked up England with good speaker volume and received the news of the California earthquake at 6:20 A.M. Also one of the ambitions of my radio experience was realized. I heard 'Big Ben' in London strike by direct reception.

I consider your set the finest piece of radio work in the world, if the station is on the air the MASTERPIECE will get it.

I thank you for the personal interest you have taken in my set and have followed your advice with great success. Again I repeat that I am absolutely satisfied... all expectations have been exceeded. So I look at the tuner and say 'baby you can bring them in.'

Best wishes for you and the MASTERPIECE.
G. F. B., Bridgeport, Conn.

You are invited to visit our new, greatly enlarged laboratories and demonstration rooms made possible by the world-wide acceptance accorded the Masterpiece.

OPPORTUNITIES

are many

for the Radio Trained Man

Don't spend your life slaving away in some dull, hopeless job! Don't be satisfied to work for a mere \$20 or \$30 a week. Let me show you how to get your start in Radio—the fastest-growing, biggest money-making game on earth.

Jobs Leading to Salaries of \$50 a Week and Up

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

Ten Weeks of Shop Training

Pay Your Tuition After Graduation

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



TELEVISION *and* TALKING PICTURES

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

PAY FOR YOUR TRAINING After You Graduate

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

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

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

ALL PRACTICAL WORK At COYNE in Chicago

ALL ACTUAL, PRACTICAL WORK. You build radio sets, install and service them. You actually operate great Broadcasting equipment. You construct Television Receiving Sets and actually transmit your own Television programs over our modern Television equipment. You work on real Talking Picture machines and Sound equipment. You learn Wireless Operating on actual Code Practice apparatus. We

don't waste time on useless theory. We give you the practical training you'll need—in 10 short, pleasant weeks.

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

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

COYNE Electrical School

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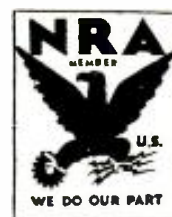
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Dear Mr. Lewis:— Send me your Big Free Radio Book, and all details of your Special Offer.

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HUGO GERNSBACK, Editor-in-Chief

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Technical Editor

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IN OUR NEXT FEW ISSUES:

HOW TO ENTER THE "TALKIES" SERVICE FIELD. An authority on the subject of sound equipment and service has prepared for the readers of RADIO-CRAFT a complete analysis of the talking motion picture field. Heretofore, the owners of motion picture houses have been accustomed to paying high prices for parts and service which it is now convenient for the radio Service Man to furnish, due to recent legislation.

ADAPTING THE A.C.-D.C. ULTRA-MIDGET FOR BATTERY OPERATION. In this interesting article the author tells how to re-wire existing A.C.-D.C. ultra-midget receivers to obtain portable, economical operation, using the latest types of 2 V. tubes. The procedure described in this article should make it convenient for the experimenter and Service Man to obtain very satisfactory operation in this manner.

LOUD-SPEAKER-DRIVEN RESONATORS. The author describes a novel reproducer arrangement, following ideas which appeared in past issues of RADIO-CRAFT, by which exceptionally fine tone quality is obtained. The finished instrument presents an exceptionally fine appearance.

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Act today. Mail the coupon. My 64-page book will be sent free to any ambitious fellow over 15 years of age. It tells about Radio's opportunities—explains the eighteen star features of my course—shows letters of what others are doing and making. There is no obligation. Mail the coupon.

**J. E. SMITH, President, National Radio Institute
Department 3KX, Washington, D. C.**

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Act now and receive in addition to my big free book, "Rich Rewards in Radio," this Service Manual on D.C., A.C. and Battery operated sets. Only my students could have this book in the past. Now readers of this magazine who mail the coupon will receive it free, overcoming hum notes of all kinds, fading signals, broad tuning limits and oscillations, poor distance reception, distorted or muffled signals, poor Audio and Radio Frequency amplification and other vital service information than is contained in it.

Get a free copy by mailing the coupon at right. **ACT NOW!**

"Made \$6,000 in 2 Years"

"Soon after the depression started, I found myself without a job, but I was well protected with N. R. I. training. I swung right to full-time Radio servicing and I have made over \$6,000 in a little over two years." — **WM. SPARTIVENT**, Sparty Radio Service, 93 Broadway, Newark, N. J.

"\$500 a Year in Spare Time"

"Although doing spare-time Radio work only, I have averaged about \$500 a year extra in addition to my regular income. Full-time Radio work would net me many times that amount." — **EDW. H. FAWCETT**, Slough Rd., Ladner, B. C., Canada.

"Good Position, Good Pay"

"I am Chief Operator at Radio Station WSMK. This is a good position with good pay. I have advanced in Radio right along. I recommend N. R. I. to anyone who wants to be successful in Radio." — **JOHN HAJDUK, JR.**, 3 Broxey Apts., Southern Hills, Dayton, Ohio.



AGC: "Prove Showing in my Research, in Radio, Circuit and full-time Radio Experts, under no obligation."

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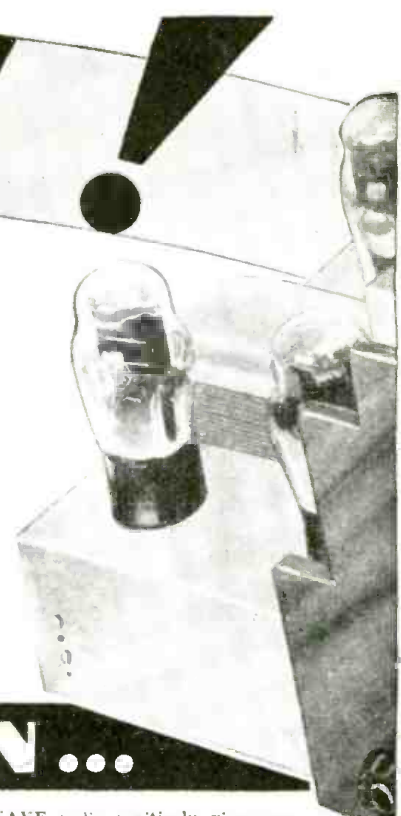
Some Other, Jobs N.R.I. Trains Men For

- Broadcast Engineer.
- Operator in Broadcast Station.
- Aircraft Radio Operator.
- Operator of Airway Beacons.
- Service Man on Sound Picture Apparatus.
- Operator of Sound Picture Apparatus.
- Ship Operator.
- Service Man on Public Address Systems.
- Installation Engineer on Public Address Systems.
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SUPER *Deluxe* 16-TUBE ALL-WAVE RADIO

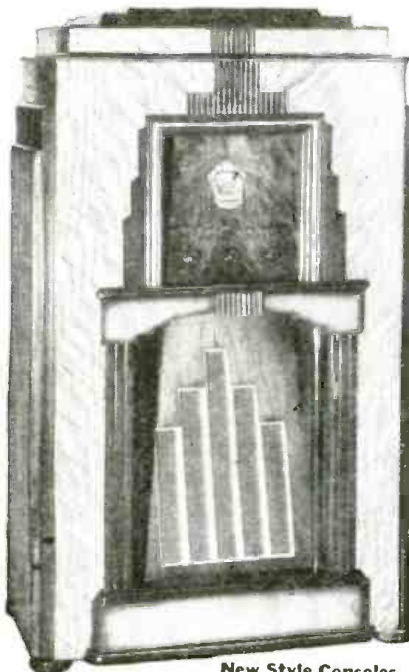


WORLD-WIDE RECEPTION...

BUY your radio direct from the Midwest Laboratories and save from 30% to 50%. This Super 16-Tube Deluxe ALL-WAVE Radio is today's most sensational radio value! Now, it is easy to secure clear, loud-speaker reception from stations 10,000 miles and more distant. It gives you complete wave length coverage of 9 to 2000 meters (33 megacycles to 150 KC)—enabling you to secure almost magical performance! Midwest users regularly log such stations as: GSC, London—VK2ME, Sydney, Australia—J1AA, Tokio, Japan—RW50, Moscow, Russia—DJB, Berlin, etc. Never before so much radio for so little money! Send coupon today!

This super 16-Tube deluxe ALL-WAVE radio positively gives you more features and more advantages than ordinary sets selling at two to three times Midwest's sensationally low price. It puts the whole world of radio at your finger tips. It has FIVE distinct wave bands—ultra short, short, medium, broadcast and long—all tuned with a single dial! You can switch instantly from U. S. programs—Canadian, police, amateur, commercial, airplane and ship broadcasts—to the world's finest short wave programs. Don't try any radio until you get all the facts! You'll be amazed at the unbelievably low direct-from-Midwest Laboratories prices. They save you from 30% to 50%. Write for the new Midwest 1934 catalog.

40 NEW 1934 FEATURES



New Style Consoles

The new, big Midwest catalog shows a complete line of beautiful, artistic, deluxe consoles... in the new, modernistic designs... and priced to save you 30% to 50%. Hand made by Master Craftsmen, they lend distinction and dignity to any home. Mail the coupon today.

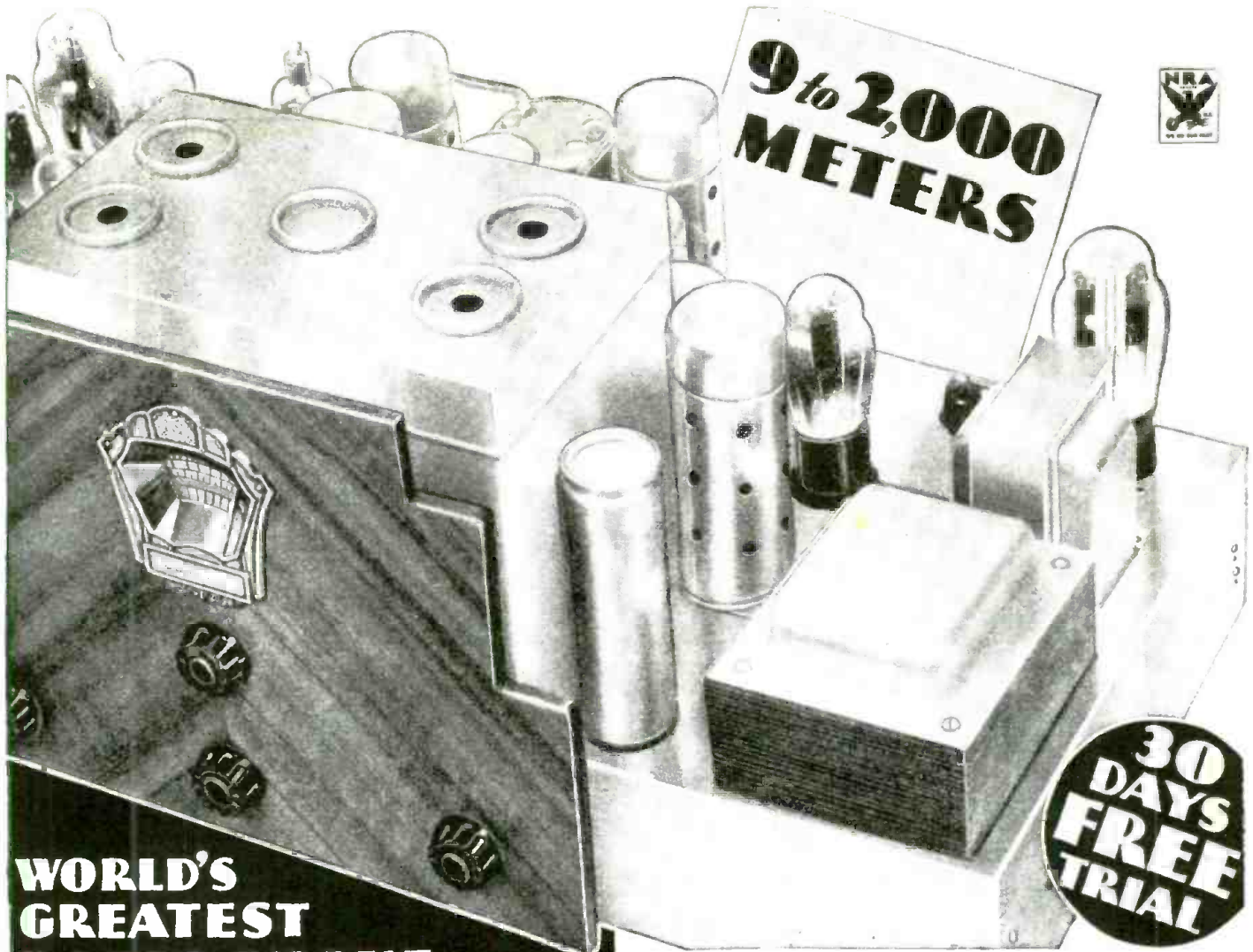
These sensational new features give you amazing performance, perfect realism, new beauty of tone, new wealth of power, fractional microvolt sensitivity, better than 7 KC selectivity. For example—Automatic SELECT-O-BAND (exclusive with Midwest) simplifies short wave tuning by instantly pointing out wave length of station. Some of the other features include:

- All-wave 9 to 2000 meter tuning range (33 megacycle to 150 KC)
- Five Full Wave Bands
- Illuminated Frequency Indicator
- Station Group Locator
- Dial Frequency Calibration in Kilocycles and Megacycles
- Balanced Unit Super Heterodyne Circuit

- Slow Motion, Velvety Action Tuning
- Positive Amplified Automatic Volume Control Bias Fully Delayed
- New and Improved Electro-dynamic Auditorium Type Speaker
- Latest Type, Higher Efficiency Tubes
- 7 KC Selectivity, Automatically Adjusted
- Scientifically Shielded (Coils and Switch Catacombed)
- Positive Signal Control
- Stat-O-Mit Interstation Silencer
- Super Power Class "A" Audio Amplifier
- 29 Tuned Circuits... 10 in Cascade—3 Variable
- All Police and Airplane Bands
- New Duplex—Diode—High Mu Pentodes
- Fractional Microvolt Sensitivity
- 16-Tubes... Equivalent to 18 tubes
- New Thermionic Rectifier

	<p>EXPERIENCED RADIO MAN PRAISES MIDWEST</p> <p>I am firmly convinced that I have received the most radio for my money. In all my experience over a period of 15 years, I have received, on my Midwest Deluxe Model-16, reception at sufficient volume in all parts of my home, from 1280, Rome, FAQ Madrid, FVA Palatelo, France GSA-CSS Daventry, England, VK2ME Sydney, Australia, DJC 133 D Berlin, T14 Barroquinha, Columbia, YVBC Caracas, Venezuela... Rio Mamba, Ecuador, and numerous American and Canadian stations.—K. M. Scheid, Jr., 28 Boudinot St., Trenton, N. J.</p>		<p>VERIFIED RECEPTION</p> <p>We think our 16-tube Midwest set is great. We have logged at least one station on every wave length on the broadcast band. We tuned in WGB on 740 KC while XER was going on 735 KC. Have all the important phone stations in the U. S. and two in Canada. We have verification from VK2ME Sydney, Australia, VK2ML Melbourne, EAQ Madrid, Spain, and YVBC, Caracas, Venezuela. We get the latter every evening with plenty of volume. Have also had FVA, Paris and 1280, Rome.—Leslie King, 433 1/2 Lusk St., Omaha, Neb.</p>		<p>OUT-PERFORMS \$200.00 SET</p> <p>I am writing this unsolicited letter in regard to my Midwest radio. It is more than you claim for it in many regards. It is more selective than any radio I have come in contact with. It will whip or outperform any set even above the \$200.00 class and it must be great when your competitor owns up that it is superior to any machine that he sells. I have received South American stations and European stations during the short time that I have had the set. I consider that the radio is worth three times what you ask for it.—L. E. Wallace (Member I.R.E.), 1521 S. W. 7th St., Miami, Fla.</p>
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MIDWEST RADIO CORP.



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GREATEST
RADIO VALUE ...**

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*with New
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Auditorium Type
SPEAKER*

Deal Direct with Laboratories

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ANNOUNCING THE 1934 OFFICIAL RADIO SERVICE MANUAL

This new manual has been in actual preparation for several months. The vast amount of important data received from manufacturers who are assisting in the compilation of the book, leads us to believe that the 1934 Manual will be more valuable than any previous editions.

THE necessity of GERNSBACK Manuals in the radio field has been shown by the fact that the total sales of the first three OFFICIAL RADIO SERVICE MANUALS, including the new CONSOLIDATED EDITION, now exceed 80,000 copies. Radio Service Men and others engaged in various branches of radio know the importance of such books, and how they must depend upon them for reliable information. Whether for public-address work, tube information or a circuit diagram, the material needed is certain to be found in one of the OFFICIAL RADIO SERVICE MANUALS. The GERNSBACK Manuals have been constantly used in reference work by leading radio set manufacturers, mail-order houses, jobbers, dealers and, most extensively, by Service Men, for whom these books are invaluable.

In the planning of the 1934 OFFICIAL RADIO SERVICE MANUAL many things have been taken into consideration. First, how we could reduce our own costs, and in turn pass these savings on to our readers. Second, what information not contained in previous editions of the Manuals must be incorporated in the 1934 edition and would be of utmost importance to its users. Third, what advance information we could print that would be useful in the future.

After careful analysis we found that the total cost of producing the 1934 Manual would be considerably less than in former years, and that at this time we could reduce the price of the book to our readers. The Fourth Edition of the OFFICIAL RADIO SERVICE MANUAL will sell this year for \$3.50. The book will be published like the 1933 Manual—the volume will be sent to you complete. As usual, we urge that all our readers place their order early so that they will get a copy of the first printing. Usually, at the last minute a tremendous number of orders come to us and quite often orders are held up while the book is going through a second printing.

Anticipating such information as may serve future radio needs, we are holding many pages of the Manual open until the very last minute. Any timely "dope" which

we then receive will be included before going to press.

In preparing this new edition many of the outstanding problems of the Service Men have been considered—methods of servicing, the new equipment constantly needed to cope with new tubes and sets, and the other fields of radio, such as pub-

As in previous years, the 1934 Manual will also include a FREE QUESTION AND ANSWER SERVICE. In each book will be found 25 coupons, which entitle you to free consultation on any radio service topics. These coupons give you a complete mail service—questions on servicing and operating on any set or circuit are answered promptly and accurately by the editors. Remember that, at the regular rate of 25c per question which is usually charged by radio magazines, this service alone is worth \$6.00. And for the Manual, we charge only \$3.50.

It is quite evident that the 1934 Edition of the OFFICIAL RADIO SERVICE MANUAL will be a decided improvement over previous volumes, and will even surpass the high standard of the former Manuals.

ORDER YOUR COPIES NOW

It is important to every Radio Service Man and Dealer that he receive his copy of the 1934 OFFICIAL RADIO SERVICE MANUAL as soon as it is published. The new book will prove itself to be invaluable as those volumes of previous years. The book as usual comes to you postpaid and free of additional charges.

No need to delay sending us your order—the 1934 MANUAL, like its predecessors, is a necessity in your business. We strongly advise you to order your copy today, and then you will be certain to get one from the first printing of the book. The 1934 Manual will be ready in about eight weeks.

Mail the coupon today.

Contents of the 1934 Manual in Brief

- Diagrams and service notes, more complete than ever before in any MANUAL. Not merely the schematic hook-ups will be found, but also chassis drawings showing parts layouts, positions of trimmers, neutralizers, etc.
- Voltage readings for practically all sets, as an aid in checking tubes and wiring.
- All values of intermediate-frequency transformers used in superheterodynes, with the manufacturers' own suggestions as to correct balancing.
- Detailed trouble-shooting suggestions and procedure as outlined by the manufacturers' own engineers—in other words, authentic "dope" right from headquarters.
- Values of all parts indicated directly on all diagrams. WE WILL POSITIVELY NOT INCLUDE DIAGRAMS FOR WHICH PARTS VALUES CANNOT BE OBTAINED.
- A special section for reference to A.C.-D.C. cigarbox midsets.
- A special section for reference to automobile radio.
- A special section for reference to public-address amplifiers.
- A special section for reference to short-wave receivers.
- A special section for reference to remote-control systems.
- A complete compilation of radio tube data, covering both the old and the many new types.
- A special section devoted to test equipment, analyzers, etc., with full diagrams and other valuable information.
- A complete list of American broadcast stations with their frequencies in kilocycles; extremely useful in calibrating and checking test oscillators and in calibrating receivers.
- Free Question and Answer Service, the same as in our last two Manuals.
- No theory; only service information in quickly accessible form.
- Absolutely no duplication of any diagrams; nothing that appeared in any of the previous Manuals will appear in the 1934 MANUAL. This we unconditionally guarantee.
- A handy, easily-consulted master Index making it easy for you to find almost anything pertaining to your service problem instantly. This index will include all the diagrams published in all the previous GERNSBACK Manuals, as well as the 1934 diagrams. A big convenience and time saver!

lic-address systems, short waves, auto radio and others.

The illustrations in the 1934 Manual will be more explicit than before; inasmuch as the diagrams will not be limited to the schematic circuit, but other illustrations will show the parts layout, positions of trimmers, neutralizers, etc. There will be hundreds of new circuits included, and not one from any previous edition of the manuals will be repeated. *This we unconditionally guarantee.*

The number of pages in the new Manual will exceed 400, with hundreds of illustrations, including diagrams, charts, photos, picture layouts, etc. The size of the Manual will be the same as that of the former volumes—9x12 inches, with a flexible, loose-leaf binder.

GERNSBACK PUBLICATIONS, Inc.
96-98 Park Place, New York, N. Y.

Gentlemen: Enclosed you will find my remittance of \$3.50 for which you are to send me One Copy of the 1934 OFFICIAL RADIO SERVICE MANUAL as soon as it comes off the press. [Send remittance by check or money order; or register letter if it contains cash, currency or unused U. S. Postage stamps.]

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"Takes the Resistance Out of Radio"

Editorial Offices: 96-98 Park Place, New York, N. Y.

HUGO GERNSBACK, Editor

Vol. V. No. 4, October, 1933

RADIO EXPERIMENTING

An Editorial by HUGO GERNSBACK

WHEN radio was as yet young, there was only a single line of experimentation that could be followed. This, of course, had to do with either a transmitting or receiving set.

However, as radio becomes older, it becomes amazingly diversified—indeed, the radio experimenter of 1933 could not even be reconciled with the old-time experimenter of the 1905 vintage, when radio first got its start.

Of course, a large percentage of the experimentation which is still going on is in the design of radio sets, be they intended for long waves or short. With the short-wave experimenters, who are doing the lion's share of the experimenting, there are today certainly not less than 350,000 experimenters in this country alone who pursue the art as a hobby; at least to begin with. As it frequently happens, however, the hobby soon turns the experimenter into a professional, for it is from the field of radio experimenters that our best radio engineers, our radio manufacturers, and our radio Service Men are drawn.

Radio experimentation in other words is simply a proving ground, or a graduating class for the radio industry of tomorrow. This point should never be lost track of, since it is one which is peculiar to the advancement of the radio art. Nor is it a new point, because the relation has been ever the same since the days of Marconi, when he himself was an experimenter, sending and receiving dots and dashes with a spark coil and coherer arrangement.

The radio experimenters of today, that is, those whose interests lie outside the development of radio sets, also go in for the following fields, each one of which is becoming larger every year:

Audio amplification, also called Sound or Public Address, which is already a huge adjunct to radio itself, and which attracts thousands of experimenters who find new uses (and most surprising ones) for sound amplification.

Electronics, which is so huge an activity that it has already been sub-divided into many classes. By electronics is meant the use of the radio vacuum tube in its many applications, chief of which, today, is in conjunction with photoelectric cells. This particular field, which came into prominence only during the past few years, threatens to become one of the largest, and is rapidly becoming an art all by itself. Here is an excellent and most fruitful field for the dyed-in-the-wool experimenter. Without touching them, he now can open doors; he can sort cigars, beans, nuts; he can catch burglars, he can light his car headlights at sundown; he can switch on the lights in the house at sundown, and in fact, do thousands of other, entirely unsuspected things, all by means of the photoelectric cell in conjunction with the radio tube. Electronics is, indeed, a great and rich field, which is only now being opened up; and one which will become tremendously large, due mainly to the endeavors of radio experimenters during the next few years.

Then, we have the neglected field of the "limited" radio telephone, which is suitable for communication in the same building, across the street, for use at camp, and for many other services. While you are not supposed to operate a radio telephone without a license, the use of such an instrument, where it does not disturb others, especially at isolated points, is not unlawful; particularly, if the effect of the transmitter does not go beyond the State border. If no aerial and ground are used, and only a single small tube is made use of, the action of the instrument becomes identical to that of a Service Man's oscillator, which also is a miniature transmitter. The design of either instrument, however, is such, that the radius is probably not more than about 100 feet, and therefore little disturbance is created, particularly when the instrument is operated on a frequency below the broadcast band. The experimenter finds good use for such an instrument for inter-office communication, as an inter-house radiophone, at garden parties, for "mind-reading," and for other stage performances where intelligence is to be transmitted to another party by means of a mobile receiver, a mobile transmitter, or both.

There are also many other uses to which the radio tube can be put, and it might be said that the surface has not yet been scratched.

There is hardly a field of human endeavor into which the ubiquitous radio tube will not be fitted, sooner or later. Among the odd uses which experimenters have found for vacuum tubes, I will mention the following:

Ultra-fine measuring devices; a billionth of an inch can be measured today by means of a vacuum tube. A steel bar, half an inch square and about 3 feet long, and forming one plate of a condenser, will indicate the weight of a fly which has hopped onto one end; the fly depresses the bar to a slight extent, thus causing a change in the capacity of the condenser.

Spectacular Tesla coil experiments can be performed with the adjunct of radio tubes and the old fashioned spark coil or generator devices in use years ago.

In addition, we have the radio robot for airplanes, which is also an adaptation of radio methods; and we have combinations of the radio tube with the thermocouple, by which fogs are pierced, thus making it possible for navigators to "shoot the sun" without actually seeing it.

Television, of course, is still in the offing; yet, it, too, must make abundant use of vacuum tubes. No doubt, the final solution of television itself will come about without recourse to moving parts such as the present-day whirling disc. Indeed, the entire problem of television will only be solved with some form of a radio tube, and with radio instrumentalities.

The experimenter's radio field is not only an interesting, but a lucrative one. We are still at the beginning of radio, and the great radio inventions are still to be made.

HOW TO MAKE EXPERIMENTAL



Fig. A
Exterior view of the oscillator unit at the "sending" end of the inter-phone.

● WHAT YOU CAN ACCOMPLISH WITH THIS NEW INSTRUMENT

- (1) Arrange "mind reading" acts to mystify friends;
- (2) Arrange a "portable oscillator hunt";
- (3) Install a telephone system to talk to neighbors;
- (4) Install an inter-office communication system;
- (5) Experiment with short-distance duplex radio telephony;
- (6) Experiment with "wired radio" telephony;
- (7) Make a fun-provoking "radio dictaphone";
- (8) Make a portable "call system" without wires.

—C. W. PALMER and

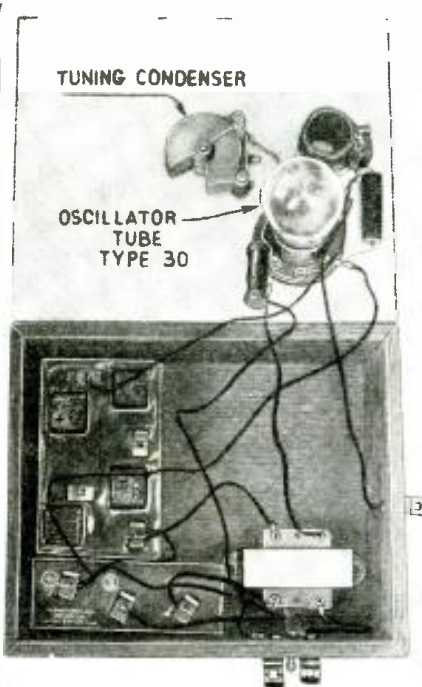


Fig. C
Interior view of the oscillator. Note the simplicity.

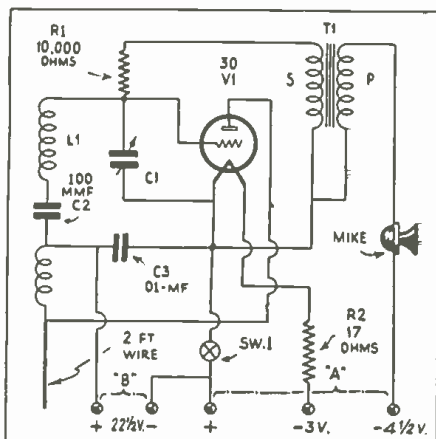


Fig. I
Schematic circuit of the oscillator shown at A & C.

RADIO experimenters will find a great deal of interest and a broad field for experimenting in the construction and use of a small portable, modulated oscillator and a single-tube portable receiver. The oscillator can be made to work on any given frequency, preferably very high, such as 60 megacycles (5 meters). An experimental unit of this type was constructed and tried in the editorial office of RADIO-CRAFT and fine communication could be accomplished over a distance of several hundred feet! In the experimental unit, a single, 30-type tube was employed for the modulated oscillator, and another of the same tubes for the receiver. The completed units are shown at A and B, respectively; interior views are C and D, respectively.

A word of caution is necessary here, regarding the regulations of the Federal Radio Commission. The modulated oscillator of the system constitutes a radio transmitter, and unless care is taken to prevent the signals of the oscillator from reaching over the boundary line of the State in which it is operated, or interfering with other radio communication, a portable transmitting license must be obtained from the Radio Inspector of your district. Otherwise, of course, the instrument is considered merely as another version of the "service oscillator." The circuit of the oscillator is shown in Fig. 1; in Fig. 2 is shown the receiver diagram.

The uses of a short-distance communication system of this type are numerous. For instance, the units lend themselves admirably to stage performances where "mind reading" acts may be performed to the mystification of the audience. Another use is for inter-office communication. A specific example of this is found in the picture on the cover in which the man on the right is taking an inventory and dictating the figures directly to the

stenographer on the left. It is obvious that this method makes the task much easier than ordinary methods, as the man taking inventory can move from place to place at will.

Another use for such a communication arrangement is for a portable call system where it is not convenient to lay regular telephone wires. As the receiver draws very little current, it can be operated continuously and the oscillator turned on whenever a call is desired.

While the experimental units were made for transmission only from the oscillator to the receiver, it is quite possible to arrange two-way communication with the same apparatus. As you can readily see from the diagrams, the oscillator and receiver are very similar. In fact, they are identical except for the value of resistance used in the grid leaks, the addition of the modulation transformer and microphone to the oscillator, and the headphones to the receiver.

The above suggestions as to the use of the system are by no means complete and the experimenter will without doubt find innumerable other uses for it.

The complete portability of the units is evident from the photographs. The filament batteries are ordinary 4½ V. "C" batteries while the "B" supply is obtained from 22½ V. "B" batteries of the smallest size. Thus the weight of the complete receiver is less than 1½ lbs.; while the oscillator weighs only 2 lbs.

The Oscillator

A glance at the circuit of the oscillator shows that it does not follow the standard design for small short-wave oscillators. The necessity for modulating the output, without the use of additional tubes, etc., and the fact that the oscillator must be tuned rather broadly, is the cause for the unusual circuit. As the oscillator is carried from place to place, the output is

AND OPERATE AN RADIOPHONE

The "Experimental Radiophone" described in complete detail by the authors was first suggested by Mr. Hugo Gernsback. For lack of space only a small number of its applications are listed in the box at the left. This device is the first one which since the advent of electronic music could be called a really and truly experimenter's instrument. And, more experimental radio units are coming.

GEORGE W. SHUART

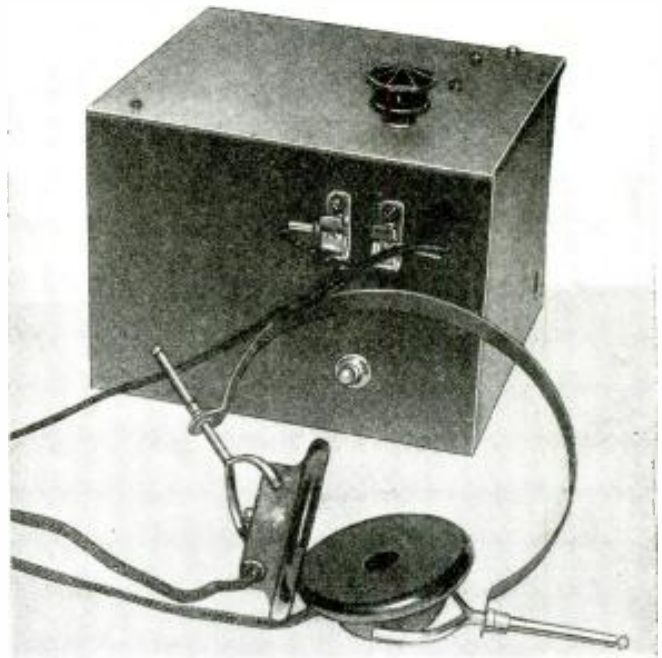


Fig. B
Exterior view of the receiver, which operates at 20 meters or less.

naturally unsteady which necessitates relatively broad tuning of both the sending and receiving units.

The positions of the parts are clearly shown in the photographs. It will be noted that a modulation transformer is used. In making the original oscillator some difficulty was encountered in modulating it. Ordinary methods such as placing the microphone in the grid circuit; in the plate circuit; or coupling it to the coils by a small loop of wire either suppressed the oscillations altogether, or resulted in insufficient modulation. However, the addition of a small modulation transformer connected in series with the grid leak successfully eliminated the difficulties.

In order to eliminate the necessity for a separate microphone battery, the primary of the "mike" transformer and the "mike" itself were connected across the full $4\frac{1}{2}$ V. of the filament battery. While this introduced an additional drain on the "A" battery, the weight of the oscillator was considered of more importance than the life of the batteries.

The coils for both the oscillator and the receiver are made by winding an equal number of turns for both the grid and plate circuits on a tube 1 in. in diameter. The number of turns depends on the frequency at which the system is to be operated. For the 5 meter band, this will consist of only one or two turns depending on the value of the tuning condenser. The experimental model was operated at about 20 meters, but as suggested before, a wavelength of about 5 meters would be more suitable. The coils for the 20 meter unit consist of about 6 turns of No. 22 cotton covered wire for both the grid and plate, separated about $\frac{1}{4}$ -in.

The values of the remaining parts are indicated on the circuit diagram. The 17 ohm resistor in the filament lead is used for reducing the filament voltage to the required 2 V. It may be either

a rheostat or a fixed resistor. The 100 mmf. condenser, C2, couples the grid and plate circuits capacitatively and completes the oscillatory circuit of the grid coil and tuning condenser. The .01-mf. condenser, C3, is a bypass unit. The 10,000 ohm resistor, R1, is the grid leak and is connected in series with the secondary of the modulation transformer. The value of the tuning condenser depends on the frequency desired. A 50 mmf. variable condenser was employed in the 20 meter experimental unit.

A short length of wire about two feet long is connected to the plate of the tube to increase the radiation of the oscillator. The strength of this radiation can be greatly increased by lengthening this wire, but the warning about interfering with short-wave radio communication, mentioned above, must be heeded. In using the oscillator the length of the radiating wire should be kept as small as possible to cover the desired distance.

In adjusting the oscillator, a size of coil should be chosen that will tune to the desired frequency with the tuning condenser at a point near its minimum value. The strength of the oscillations is greater under this condition than when a larger capacity is employed.

The Receiver

While the circuit of the receiver is almost identical with the modulated oscillator, the operating conditions are somewhat different. It is obvious that the receiver must be quite sensitive to pick up the feeble oscillations produced by the type 30 modulated oscillator tube working without any aerial or ground and with only $22\frac{1}{2}$ V. on the plate.

For this reason, the receiver is operated under circuit conditions that produce superregeneration. This supplies high sensitivity and broad tuning as
(Continued on page 232)

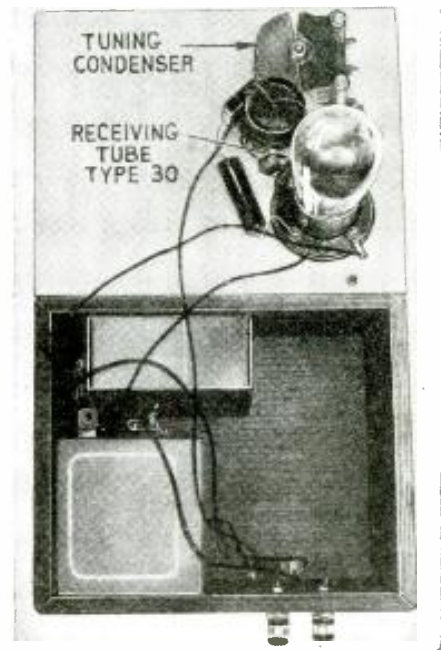


Fig. D
Interior of the receiver. Few parts are needed.

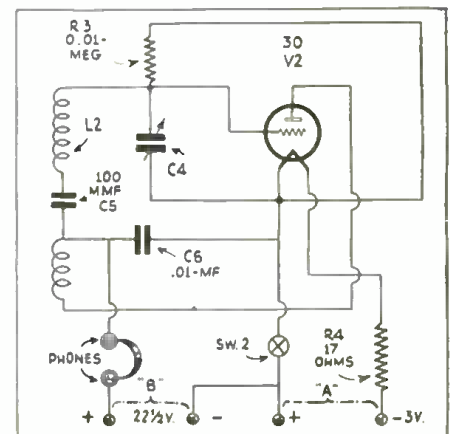


Fig. 2
Circuit diagram of the receiver, shown at B and D.

LATEST RADIO EQUIPMENT

ADVANCED ALL-WAVE SUPERHET.

THIS all-wave superheterodyne has many new features, including a "quadrotuned" I. F. amplifier that achieves practically straight line cut-off beyond the 10 kc. band; a colored illuminated frequency dial, divided into S. W. channels; fully automatic tone control that acts as a noise suppressor on weak signals; and an electron-coupled beat oscillator for finding S. W. stations.

These sets are fabricated and adjusted individually, by experienced men.



Superheterodyne Set (No. 131)

IMPROVED R.F. CHOKE

THE frequency range of this R. F. choke is much wider than ordinary, due to a better understanding of the controlling factors. It has a working range of 500 to 20,000 kc.; an inductance of 24.5 mh.; a maximum distributed capacity of 12.5 mmf.; and a D.C. resistance of 145 ohms. Inductance and capacity figures were measured at radio frequencies, with the shield in place.

The discriminating designer will welcome these superior characteristics.



R. F. Choke (No. 133) with an unusually wide frequency range.

CAR-BATTERY CHARGER

THIS new charger has been designed especially for car battery charging, to compensate for the extra drain imposed on many car batteries by radio sets, etc. It uses a tantalum rectifier, charging at 2½ amps., which tapers off as the battery reaches full charge. Two cords are provided; one for the electric socket, and a special cord and polarized plug for connections to the car.

The charger is small and compact, measuring only 8x5x7½ ins. high.



Battery Charger (No. 135)

PORTABLE RADIO-PHONOGRAPH

A 5-TUBE portable, A.C.-D.C. superheterodyne and phonograph combination using a type 77 tube as first-detector, a 78 as I. F. amplifier, a 77 second-detector, a 43 audio amplifier and a 25Z5 rectifier, has just been announced. The I. F. is 175 kc. The field-coil of the phonograph motor is tapped for voltages from 100 to 250, A.C. and D.C.

It measures 13x14x7½ ins.; weighs only 22 lbs., and carries 8 records.

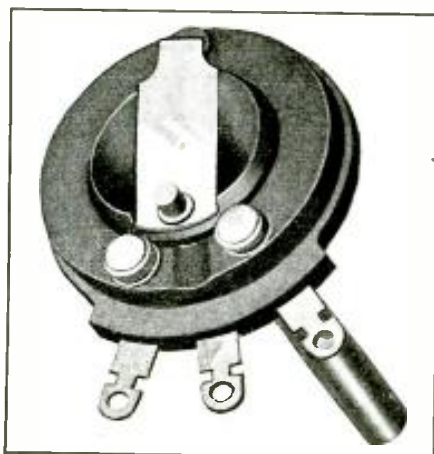


Radio-Phonograph Combination (No. 132)

REPLACEMENT CONTROLS

A SAMPLE of a complete line of replacement volume control resistors with several novel features are shown below.

The resistance element is carbon, fired at high temperatures, which gives it a hard, glassy surface, moulded directly into the bakelite frame. A nickel-chrome "shoe" slides smoothly over the resistance element, giving a smooth, unbroken variation of resistance (with any taper).



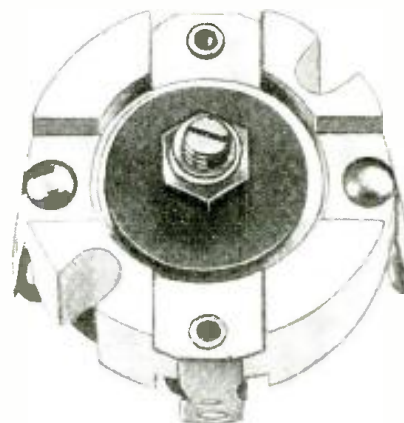
Volume Control (No. 134)

NEW TRIMMING CONDENSERS

A NEWLY designed type of trimming condenser, available in either single or double units, for use in I. F. transformers, etc., is pictured here.

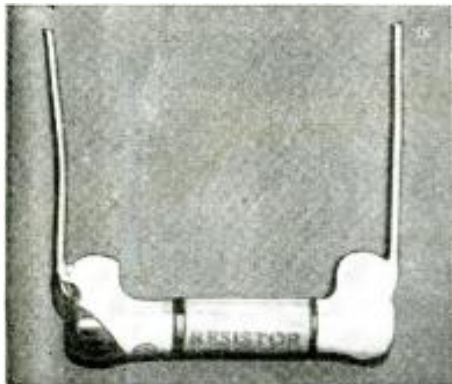
It is mounted on high grade ceramic material and the plates are of spring metal. Single or double assemblies in any practical range; the lowest 10 to 80 mmf. and the largest 700 to 1000 mmf.

Note that both resonant circuits of an I.F. transformer may be tuned from one side of the unit.



Trimming Condenser (No. 136)

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

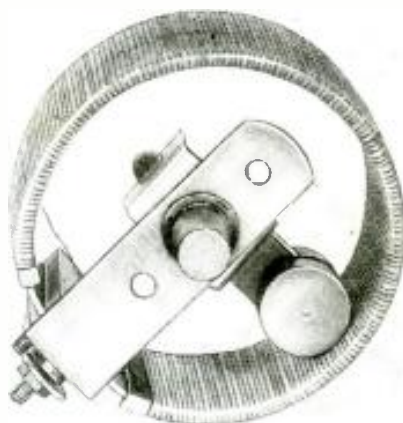


Wire-Wound Resistors (No. 137). These resistors are covered with an insulating material. They are color-coded and stamped with the resistance value.

1-WATT WIRE-WOUND RESISTORS

ONE of a new series of 1 W. wire-wound resistors of small size is shown above. They are available in sizes of 100 to 25,000 ohms and are provided with 1½ in. soldering leads.

In the construction of these resistors, the resistance wire is wound over a core of special insulation, and the ends then locked and brazed to the terminals.

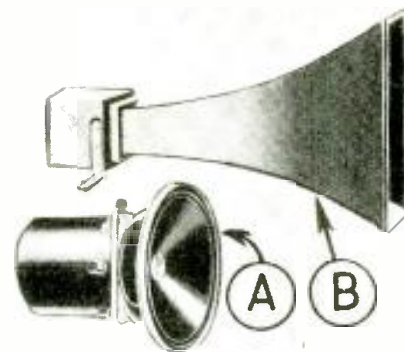


Variable Resistor (No. 140)

WIRE-WOUND VARIABLE RESISTORS

THIS resistor was designed with the idea of dissipating the greatest possible amount of heat, and providing a positive contact without wear on the resistance element. It will be noticed that this element is open to the air.

Various sizes are obtainable from 25 to 150 watts.



P. A. Speaker (No. 142). The horn, with its small internal baffle, is equivalent to a straight baffle of approximately double the size.

A NOVEL P. A. SPEAKER

THE new speaker shown above consists of a dynamic driver combined with an exponential horn. The field of the driver is energized from a 6 V., D.C. source. The diaphragm is 6 ins. in diameter and is made from fibrous pulp. The voice coil will carry 15 W. continuously. Horn is 3½ ft. long; bell, 28x28 ins.



Fuse Retainer (No. 138)

A CABLE FUSE MOUNTING

THE fuse retainer shown above was developed for manufacturers of auto and battery sets desiring a fuse mounting that would not take up space and still be accessible for renewals.

It is hung in the line between the battery and the radio power supply. A tension spring assures a good contact to the fuse at all times.



Coin-Slot Machine (No. 141)

RADIO COIN-SLOT MACHINE

HERE is a novel little timing device which may be installed on any radio set, or equivalent device, in order to make it a commercial vending machine. It may be installed in practically any position and is designed to accommodate nickels, dimes and quarters. The small dial (upper right corner) tells the time of duration. Operates on A.C., D.C., or batteries. Finish is two-tone Italian bronze.

The Service Man and dealer will no doubt appreciate the possibilities of this device. It may be installed in candy and soda stores; railroad stations, hotels, and in fact, any public place. The income from the installation should be worth while.



Dynamic Mike (No. 143)

A DYNAMIC MICROPHONE

THIS unit has many advantages over the carbon type and is more desirable than the condenser "mike."

It is designed for an output impedance of 50 ohms with a sensitivity of 40 db. No polarizing voltage is needed. It will pick up sound over a 180 degree swing, 90 degrees on either side of normal. Finished in either nickel or black.



Line Attenuator (No. 139)

A NEW LINE ATTENUATOR

THIS attenuator, shown above, has a 30 step, ladder-type network, and is designed for extremely low noise level. Standard impedances of 50, 200, 250 and 500 ohms are available, but any other practical value can be furnished.

The size including the metal shield is 2¾ x 2 1/16 ins. deep.



Dial Lights (No. 144)

DIAL LIGHT ASSEMBLIES

ABOVE are shown a new jewel—, and a few of many dial-light assemblies made for various manufactured receivers. The manufacturer of these items makes a specialty of supplying these items to set manufacturers, at their specifications.

The difference in design and the quality of manufacture are apparent.

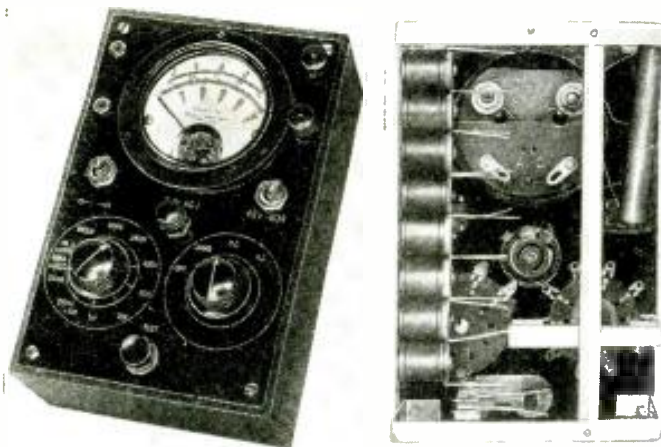


Fig. A, left; Fig. B, center; Fig. 1, right

At A is shown the front panel of a new meter, available in kit form, which permits voltage, current, continuity, capacity, resistance, output and impedance tests to be made. A rear view of the instrument, ready to be wired, is Fig. B. The schematic circuit is A, in Fig. 1; wiring diagram, B. (No. 145).

A MULTI-PURPOSE TEST INSTRUMENT

IN the illustrations above is shown a new test instrument which will appeal to every Service Man and radio experimenter; the circuit used in this device is also given. It is one of three units designed to comprise a service instrument of extreme versatility; and which may be built in sections, one at a time, at the convenience of the radio man. The other two units, not shown, are a service oscillator and an analyzer.

The services and ranges of the illustrated instrument, called the model 90 Tester, are as follows: voltage, A.C. or D.C., 0-5-10-50-100-250-500-1000 V.; current, D.C., 0-1-10-25-100 ma.; current, A.C., 0-1 ma.; resistance, 0-1000-10,000 ohms-0.1-meg.; it is also suited to making impedance, capacity, continuity and output tests.

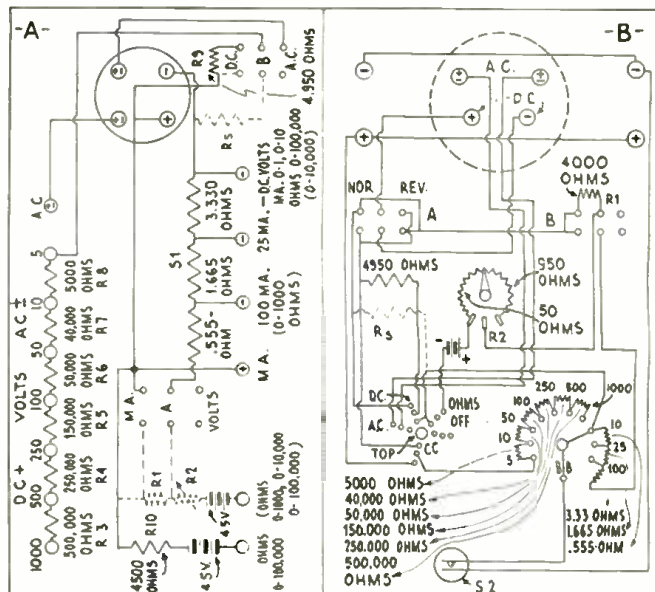
TESTING BY "SELECTIVE ANALYSIS"

THE latest development in radio test equipment is the "selective analyzer" illustrated at the lower right. It not only tests all present-day tubes, but also provides for all forthcoming types.

This year's tubes have completely upset all preconceived ideas as to standards of connection and we now have tapped heaters with the requirement for measuring filament voltage to other than the normal heater pins. The cathode wanders around among the other pins and may take any position. It has also multiplied itself and we may have two or possibly three cathodes to which certain voltages must be measured. We have two complete tubes in one envelope and there seems to be no end to the possibilities of multiplying the number of electrodes brought out on a single base.

As a concrete example of the requirements, assume a 7-prong tube with a top cap. This gives us 8 electrodes. We may be required to measure voltage from any electrode to any other electrode and with 8 electrodes this gives us 28 possible pairs. If we have 10 voltage ranges to cover all possibilities, and we must measure direct or reversed on any range and on any pair of electrodes, we have a total of 560 possible combinations of polarity, range and position. And to measure current, we are required to go into each circuit with the exception of the filament circuit and this means that we will make measurements in any of 6 electrodes, and if we assume 9 possible ranges and also the possibility of either polarity, we have 108 more possible combinations.

The total is 668 possible D.C. measurements. If we add the possible A.C. measurements of filament and rectifier supply voltages we reach a grand total of something like 700 possibilities and to follow the matter through in the old way, we would require a 700 point switch if we were to proceed with a single switch. To be sure, we can break



Low resistance values are easily read, the first major division on the 1000 ohm scale being ten ohms. The meter used has an accuracy of 2% on D.C. and 5% on A.C. The resistors used are of precision type and have an accuracy rating of 1%. The kit of parts includes the meter, a black crystalline-finish cast-aluminum case, and all necessary resistors, switches, tip-jacks, etc. The "C" battery must be supplied by the constructor. The cast-aluminum case measures 7 1/4 x 4 3/4 x 2 3/4 ins. high.

Referring to A, in Fig. 1, switch A should be in the "volt" position when reading volts, 1 ma., and 0 to 0.1-meg. This switch should be shifted to the "ma." position to read the ma. ranges of 0-10-25-100 ma. When using the optional ohmmeter circuit, shown dotted, switch A should be in the

(Continued on page 245)

this up into a group of switches and reduce the number of possibilities but the total still remains a formidable figure.

Also, we are likely to see more and more pins on a base as the tendency is consistently to get more elements into a single tube and the requirement of extreme flexibility of a system is still paramount.

The new method of "selective analysis," exemplified in the test instrument illustrated, is a method of making voltage, current and resistance readings in a radio set through the medium of a standard analyzer plug which brings out all

(Continued on page 238)



The "Selective Analyzer," a new test instrument for the Service Man (No. 146).

AND NOW—THE "SHOE-BUTTON" TUBE

LAST SPRING, IN OUR MAY ISSUE—

—we thought to perpetrate a hoax on our readers in the form of an April Fool joke. At that time we introduced the Vest-Pocket, 7-Tube Superhetero-Ultradyne, as well as the "APR 1" tube. This tube was described as being 1 in. by $\frac{3}{8}$ -in. in diameter.

The joke, within four months, has become a grim reality, and we now have the SHOE-BUTTON tube which, being only half an inch high, is a 50% improvement over our April Fool idea.

The new tube is a product of the Research and Development Laboratory of the R. C. A. Radiotron Co. While the present tube is only made for use in ULTRA-SHORT waves, there is no doubt in our mind that sooner or later the tube will become available as a regular, standard tube for broadcast requirements.

THIS TUBE IS STILL IN THE EXPERIMENTAL STAGE. IT IS NOT AS YET ON THE MARKET. R. C. A. RADIOTRON COMPANY WISHES US TO PARTICULARLY EMPHASIZE THIS POINT, AS THEY ARE NOT IN POSITION AS YET TO FILL ORDERS. When the tube is released, an announcement to this effect will be made in RADIO-CRAFT.

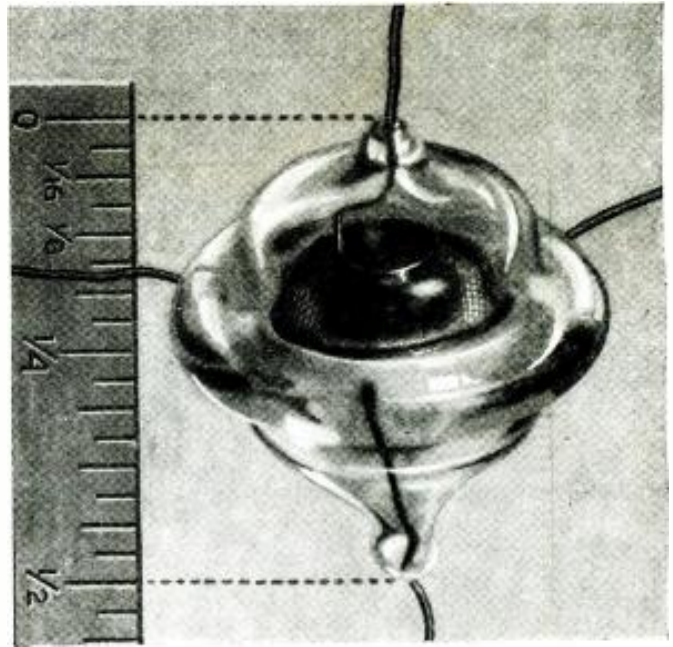


Fig. A

The extremely small size of the "Shoe-button" tube is shown by the ruler.

FOR transmission and reception at wavelengths down to about 5 meters conventional types of tubes and circuits have been found satisfactory. At these wavelengths feed-back oscillators and T. R. F. amplifiers may be constructed, using standard receiving tubes. However, at wavelengths of less than 1 meter, such tubes and circuits have been found entirely unsuitable because of the large inter-electrode capacitances and lead inductances of the tubes, and recourse has been had to the Barkhausen-Kurz type of oscillator, in which the wavelength depends upon the time of transit of the electrons across the space in the tube. These oscillators have been used both for transmission and reception, operating in receivers as super-regenerative detectors or as heterodyne detectors. By means of these tubes much important study of the properties of these waves has been made possible. From the standpoint of practical use, however, the receivers are

entirely unsatisfactory, since they are in-sensitive, non-selective, unstable and noisy in general. In addition they require considerable power supply, and radiate energy from the receiving antenna.

In an attempt to produce more satisfactory receiving methods at these wavelengths an investigation has been carried out by B. J. Thompson and G. M. Rose, Jr., in the Research and Development Laboratory of the RCA Radiotron Co., of the properties of extremely small tubes operating on the conventional principles. Triodes and screen-grid tubes representing approximately a ten-fold reduction in dimension, as compared with conventional receiving tubes, have been made; an experimental, laboratory model is illustrated in Fig. A. The maximum overall dimension of these tubes is less than $\frac{3}{4}$ in. It is found that these tubes approximate closely in all electrical characteristics the conventional size tubes, except that the inter-electrode capacitances and lead inductances are reduced to about $\frac{1}{10}$ those of the larger tubes.

These tubes have been operated in a T. R. F. receiver at a wavelength of 1 meter. This receiver consisted of two stages of T. R. F. amplification using the screen-grids, and a grid-leak detector and 1 stage of A. F. amplification, using the small triodes. The set was enclosed in a shielded box less than 7 in. long and 3 in. high. The amplification was found to be approximately 4 per stage. The operation was in every way similar to that of conventional sets designed for much longer wavelengths.

The triodes have been operated as oscillators in a simple feed-back circuit at wavelengths as short as 30 cm. At this short wavelength the plate supply was 112 V. and the plate current 3 ma.

It appears from these results that these small tubes should make reception possible at wavelengths well below 1 meter in the conventional circuits used for much longer wavelengths. Due to the small size of these tubes they are not very suitable for transmitters, as the power output is very low.

This work was carried out, in the laboratory, as part of a program of research on short waves. These tubes are not available commercially, and no attempt is being made to manufacture them at the present time.

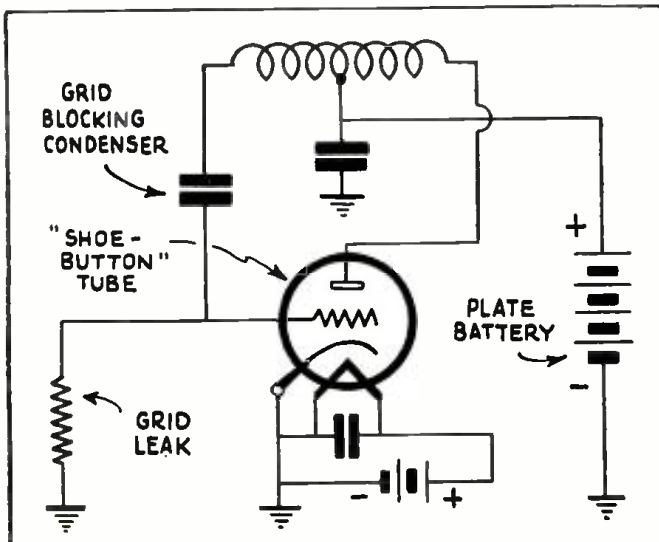


Fig. 1

An ultra-short-wave circuit devised for use with the new experimental tube.

THE NEW CATHODE-RAY

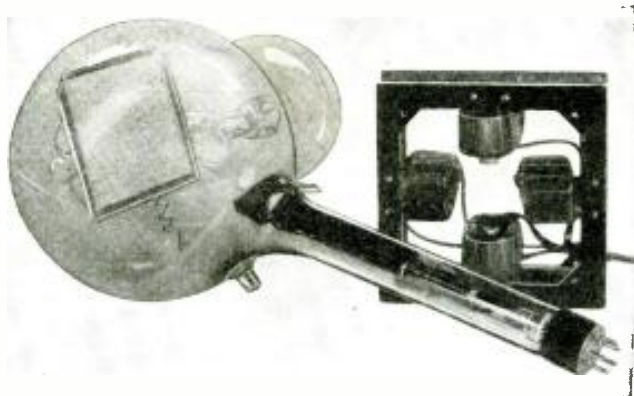


Fig. A

The new photoelectric "Iconoscope" cathode-ray television transmitting tube.

The "missing link" in the cathode ray system of television, a weightless-beam pick-up device for use at the transmitter, has at last been achieved in the "Iconoscope" described in this article. Its companion at the receiver, the "Kinescope," has been described in previous articles in the press. This system of television, unlike previous methods, has no moving parts!

R. D.

SINCE television will form the basis of the next real "wave" of public interest in radio, the following description of the "last word" in television technique has been compiled.

The picture mosaic for a great number of years—since 1875, in fact, when Carey proposed the use of a multitude of selenium cells in imitation of the construction of the human eye—has been the ideal of scientists who have been trying to evolve a practical method of transmission and reception involving a system of television more nearly perfect in theory than that of the now out-moded "scanning disc."

Coupled with the idea of a "mosaic" system of television there has been the hope that moving parts could be eliminated—in other words that a "weightless-beam" could be used to supplant other methods of segregating the object view into its component elements, and, at a remote point, re-combining them. The weightless-beam principle of operation was demonstrated to be practicable in the receiving unit of a mosaic television system when the "Kinescope" (kine, motion; and scope, observe) was demonstrated to the radio fraternity several years ago. In this arrangement a cathode ray plays over the surface of a plate covered with a fluorescent material, such as willamite, which has been made slightly conductive to permit the electron charge set up by the cathode ray beam to leak off.

The final link in the system, a pick-up device termed an "Iconoscope" (icon, image; and scope, observe), for use at the transmitter, has at last been developed by a pioneer in the field, Dr. Vladimir K. Zworykin of the research laboratories of RCA Victor Co.

The operation depends upon the use of a plate which is essentially a mosaic of minute, light-sensitive cells onto which the picture is projected by means of a lens system. These cells develop minute voltages in the condensers formed by the capacitance between these cells and adjacent conductive surfaces. The weightless-beam or cathode ray scanning these condenser units discharges them into the input circuit of a vacuum tube amplifying system. From this point the usual procedure of modulating the transmitter, radiation, and reception takes place. (A wavelength of 6 meters is particularly suitable for this system.)

The Iconoscope Pick-Up Tube

In Fig. A is illustrated the new pick-up tube. It supplies the missing link in a theoretically perfect system of television. The schematic circuit illustrating the principle of operation is shown at A in Fig. 1; the manner in which it connects into a transmitter set-up is shown at B in the same figure.

The cathodes of the iconoscope tube are in the shape

of a photosensitive mosaic on the surface of a "signal plate" and insulated from it; the anode is common and consists of the usual silvered portion on the inside of the glass bulb.

The capacity of each individual element with respect to the signal plate is determined by the thickness and dielectric constant of the insulating layer between the elements and the signal plate. The discharge of the positive charge of the individual elements is accomplished by a weightless electron beam originating from what is essentially an "electron gun," located opposite the mosaic and inclined at 30°-to-the-normal passing through the middle of the mosaic. Both mosaic and electron gun are enclosed in the same, highly-evacuated glass bulb. (The inclined position of the gun is merely a compromise in the construction in order to allow the projection of the picture on the surface of the mosaic.)

In practice, the number of individual photo elements in the mosaic is many times greater than the number of picture elements, which is determined entirely by the size of the scanning spot. Further, it has been found that all the elements of the mosaic should be of equal size and photo-sensitivity, and equal in capacity with respect to the signal plate. The fact that the exploring spot is much larger than the element modifies and simplifies this requirement so that the average distribution, surface sensitivity and capacity of elements over an area of the mosaic should be uniform.

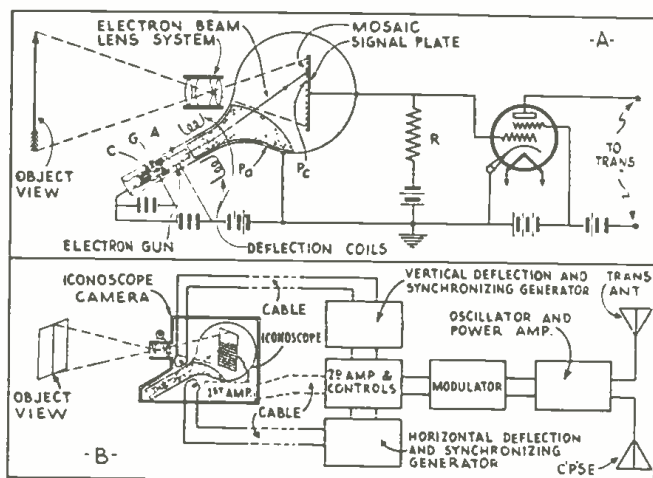


Fig. 1

In A, above, are shown structural details of the new cathode-ray television tube. At B is illustrated the manner in which this new tube is connected.

TELEVISION TUBES

SOME OF THE POINTS OF INTEREST

- (1) No moving parts;
- (2) More sensitive than the human eye and extends into the infra-red and ultra-violet regions;
- (3) More detail than the finest "half-tone";
- (4) Accurate and speedy as the ordinary motion picture camera;
- (5) Suitable as an ultra-violet microscope;
- (6) Tubes plug into sockets like ordinary radio tubes;
- (7) The most compact television system yet devised;
- (8) Both the picture pick-up and the reproduction may take place in ordinary daylight;
- (9) "Streaks" do not exist in the reproduction;
- (10) Makes color television practicable.

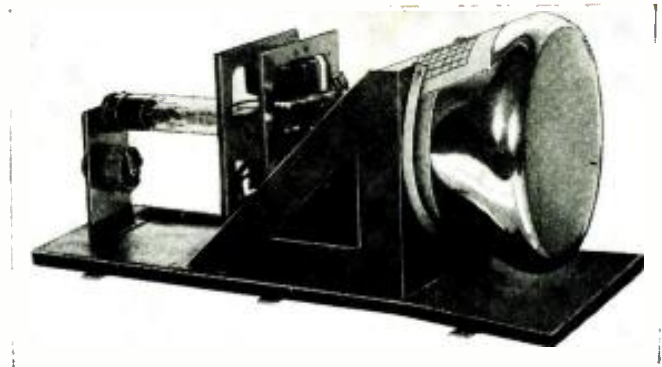


Fig. B

Above, the receiving tube which completes the cathode ray system of television. Electrical and optical lag at transmitter and receiver aid fidelity.

WASHBURNE

Construction of the "Mosaic"

The difficult problem of uniformity is solved by the help of natural phenomena. It is known that mica can be split into a thin sheet of practically ideal uniform thickness and it therefore serves as a perfect insulating material for the mosaic. The signal plate is formed by a metallic coating on one side of the mica sheet. The simplest method of producing the mosaic is by direct evaporation of the photoelectric metal onto the mica in a vacuum. When the evaporated film is very thin it is not continuous but consists of a conglomeration of minute spots or globules quite uniformly distributed and isolated each from the other. (Another possible method is that of ruling the mosaic from a continuous metallic film by a ruling machine.) The mosaic which is used at present is composed of a very large number of minute silver globules, each of which is photosensitized with caesium by a special process.

Since the charges are very minute the insulating property and dielectric losses should be as small as possible. Mica of good quality satisfies this requirement admirably. However, other insulators can also be used and thin films made of vitreous enamels have been proved to be entirely satisfactory. The insulation is made as thin as possible. Thus, the capacity to the signal plate of one square centimeter of mosaic is usually of the order of 250 to 300 mmf.

The sensitivity is of the same order as that of corresponding, high-vacuum caesium oxide photocells. The same

relative efficiency is true also of the color response. (There is a cut-off at the blue part of the spectrum but it is due only to the absorption by the glass envelope.)

The "Electron Gun"

The electron gun producing the beam is quite an important factor in the performance of the iconoscope. Since the resolution or "definition" is determined by the size of the spot, the gun should be designed to supply *exactly* the size of spot corresponding to the number of picture elements for which the iconoscope is designed. For the examination of 70,000 picture elements on a mosaic plate about 4 in. high, the distance between two successive lines is about .016-in.; the diameter of the cathode-ray spot is approximately one-half of this size. This imposes quite a serious problem in the design of the gun.

The electron gun used for this purpose is seen by reference to A in Fig. 1 to be quite similar to the one used for the cathode-ray tube for television reception or the kinescope shown at A in Fig. 2, and which has already been described in several papers. This "gun" consists of an indirectly-heated cathode, shown at C in Fig. 1A, with the emitting area located at the tip of the cathode sleeve. The cathode is mounted in front of the aperture O of the controlling element G. The anode A consists of a long cylinder with three apertures aligned on the same axis with cathode and control element. This gun structure is mounted in the long, narrow glass neck attached to the spherical bulb housing the mosaic screen. The inner surface of the neck as well as part of the sphere is metallized and serves as the second anode, Pa, for the gun and also as a collector for photo electrons from the mosaic. The first anode usually operates at a fraction of the voltage applied to the second anode, which is approximately 1000 volts.

The *focusing* of the electron beam is accomplished by the *electrostatic* field set up between the elements of the gun, and between the gun itself and the second anode. The theory of electrostatic focusing for this type of gun, briefly summarized, amounts to the fact that a correctly-shaped electrostatic field acts on moving electrons similarly to a lens on a beam of light. (The action of the field in the iconoscope gun is roughly equivalent to a composite lens consisting of four glasses—two positive and two negative.) The actual iconoscope illustrated has an overall length of 18 in.; the spherical diameter is 8 ins.

The *deflection* of the electron beam for scanning the mosaic is accomplished by two *magnetic* fields at a right-angle to each other. The four deflection coils are arranged in a yoke which slips over the neck of the iconoscope. (The

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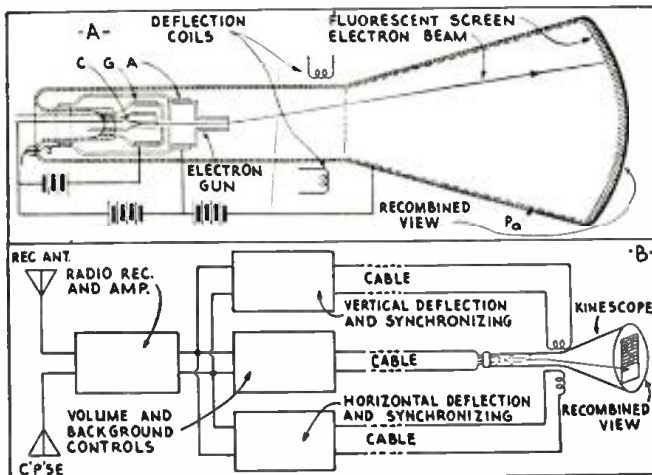


Fig. 2

Above, at A, the receiving tube described in previous magazine articles. Below, at B, the receiving tube is shown connected into the receiver circuit.

INTERNATIONAL RADIO REVIEW

SCOPHONY—A NEW SCANNING SYSTEM

WIRELESS MAGAZINE, London, England, has announced the introduction of a new commercial system for transmitting pictures by radio. While the system is not entirely new experimentally, having been associated for several years with the name of its originator, G. W. Walton, it is receiving its first commercial introduction by Ferranti, Ltd.

It might be of interest to note that the system is applicable to wave form analysis and study, as well as for television transmission and reception. From this view point, it is of interest to every advanced electrical and radio experimenter.

As originally conceived, Mr. Walton's scheme is based on the idea of using an arrangement of stationary mirrors, prisms or lenses which automatically and instantaneously convert the picture to be transmitted into a single "straight line" of equivalent light and shade value. See Fig. 1.

This is done without the use of any moving parts or mechanism. Once the original has been converted into an equivalent "line" picture, it is ready for scanning. It is this feature that forms the outstanding merit of the invention, because the scanning operation can now be performed by a simple vibrating mirror arranged to swing to and fro across the "line."

As each swing traverses the whole picture, a vibrating rate of fifteen cycles per second is sufficient to produce the kinematographic effect required for "living" pictures, in other words, fifteen cycles per second gives complete persistence of vision.

In transmission the picture, after being converted into its "line" equivalent is scanned by the vibrating mirror which throws the consecutive light-and-shade values in sequence across a photoelectric cell or "eye" so as to transform them into corresponding electric

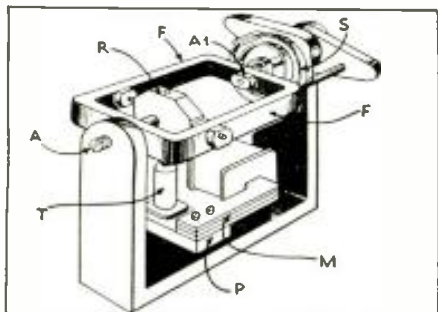


Fig. 1

The vibrating mirror of the scanner is fastened to the frame F and actuated by motor M.

HERE is what the radio experimenter has been wanting for a long time—a semi-technical review of the thousands of new ideas which are continually appearing in overseas publications. Each month there are received at the offices of RADIO-CRAFT hundreds of daily, weekly and monthly magazines originating from every point on the face of the globe.

SINCE the cost of subscribing to each of these would be prohibitive for most radio men, we have arranged with technical translators to prepare for our readers reviews of all the really important, new developments illustrated and described each month in these international radio periodicals.

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

currents. After suitable amplification, these are used to modulate the outgoing carrier wave from a transmitter.

In reception, the process is reversed. The light from a lamp is swept by a vibrating mirror across the face of a stationary "stepped" mirror, which automatically restores the picture to its original two-dimensional form. One method described by Mr. Walton for driving and synchronizing his vibrating mirror is shown in the illustration.

The mirror itself is omitted for the sake of clearness, but it is actually carried in a frame F, which is mounted in jewel bearings at A, and A1, so as to swing steadily about that axis under the control of a chronometer spring S. The drive control for synchronizing and for limiting the amplitude of swing to a steady value, is applied through a cross-pivoted rocker, R, which is coupled to a shaft, T, connected to the armature of a synchronous motor, M. The resultant motion of the mirror may be adjusted so as to compensate for the brighter edges of the "line" picture so as to ensure a uniform illumination.

The drive may be arranged so as to give a "saw-tooth" wave motion to a spot of light reflected by it from the lamp, thereby adapting the instrument to receive the standard type of picture transmission. The necessary phase-control required for perfect synchronization is obtained by rotating the platform, P, carrying the stator of the motor, M.

Two receiver models are being in-

troduced—a junior and a senior model. In the junior model the maximum size of picture is 8.26 ins. x 3.16 ins. and in the senior model 17.32 ins. x 6.32 ins. One of the most attractive points of these units is their size—either may be placed in a coat pocket. Compare this to the size of a Nipkow scanning system for the same size of picture!

A CLASS B, ADD-ON AMPLIFIER

BRITISH radio experimenters have become very enthusiastic over class B amplification, or "Quiescent Push-Pull" as they call it. A particularly interesting article on this subject appeared in a recent issue of AMATEUR WIRELESS, in which a separate class B amplifier was described to be used as an addition to existing sets.

As will be seen from the circuit, Fig. 2, which shows such an "add-on" unit, the internal wiring and also the interconnections to the existing receiver are quite simple. Little or no alterations to the set itself will be required, although some form of tone control must be provided in order to prevent over-accentuation of high notes. This control could be embodied in the class B unit, but it is perhaps more usual to include it in an earlier stage. As a rule, the simple plan of shunting the primary of the existing L.F. transformer (audio transformer) with a condenser of .01-mf. in series with a variable resistor of 20,000 ohms. or so. will be found satisfactory.

In addition, if there are any signs of instability, or if the quality is poor, it may be necessary to provide extra decoupling in the set. Occasionally this decoupling will be desirable in the driver circuit.

THE "EQUATOR" ALL-WAVE SUPER

A RECENT issue of WIRELESS WORLD, London, England, carried the circuit and description of an inter-

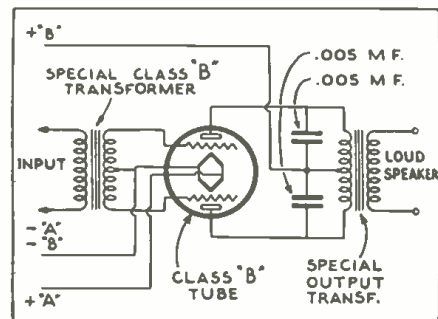


Fig. 2

The add-on class B unit may be connected to an existing set. Special transformers are required.

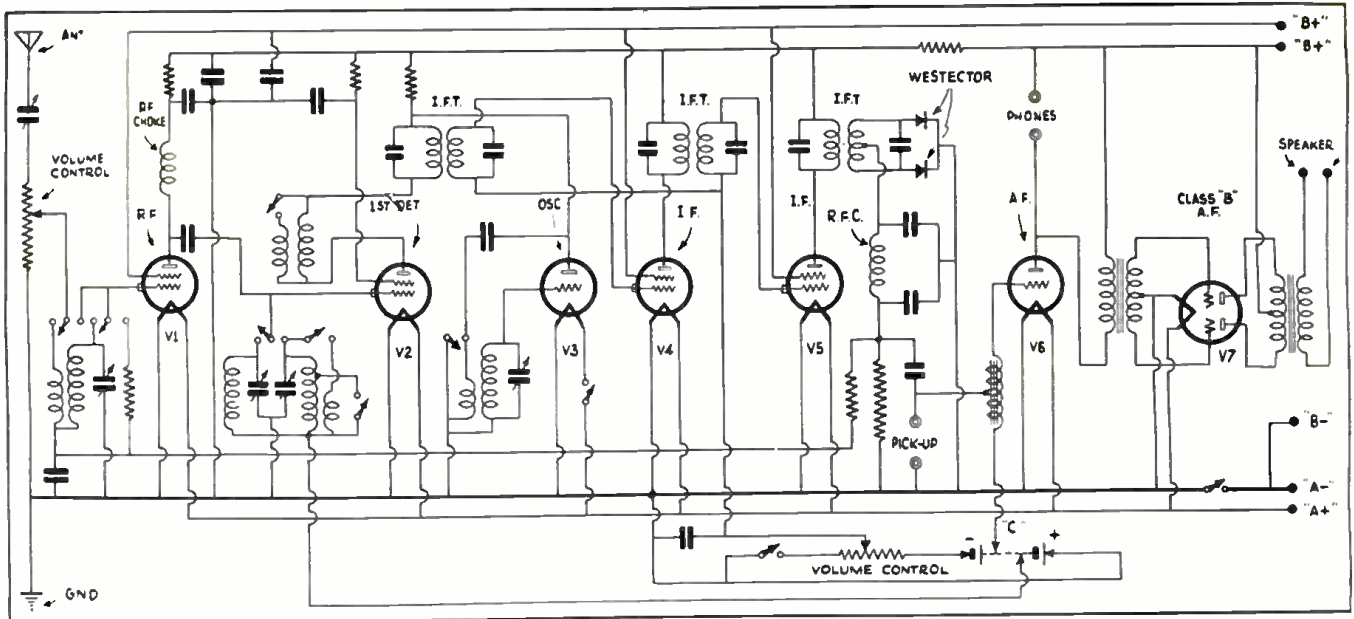


Fig. 3

This battery-operated commercial superhet. has many novel features, including automatic bandswitching, A. V. C., and full-wave dry-disc detector.

esting superheterodyne receiver using many items novel to American radio enthusiasts. The circuit is Fig. 3.

In view of the fact that short-wave receivers are in great demand in tropical countries where supply mains (lines) are not always available and where climatic conditions are severe, the makers have designed this set for battery operation, and housed it in a dust and insect proof cabinet.

The circuit is thoroughly up-to-date and contains many features of special interest from a technical point of view. There are, in all, 8 stages, with a Westector (a dry disc rectifier available in England) metal oxide rectifier taking the place of a valve (tube) in the second-detector stage. The set covers the following bands 220-550 meters; 80-55 meters; 60-28 meters; and 30-12 meters. All four ranges are controlled by a single switch; in addition to altering the wave range it also modifies the circuit in the earlier stages in the following manner:

On the broadcast band the aerial circuit includes a tuned input transformer and the signals after amplification at

R.F. by the first screen-grid variable-mu valve (tube) are heterodyned in the first-detector stage by a separate oscillator before passing on to the I.F. stages. On the short-wave ranges the detector, which is the second valve (tube) from the left in the circuit diagram functions on the autodyne principle and is self-oscillating, while the third valve—the broadcast wave separate oscillator—is put out of action by short-circuiting the reaction coil (regeneration coil) and opening the filament circuit. At the same time the tuned aerial circuit is replaced by a high resistance, and the tuned grid circuit preceding the detector is changed over to the short-wave coils and the special short-wave condenser coupled to the shaft of the broadcast wave triple-gang condenser. Only two sets of coils are used on short waves, and the three ranges are covered by short-circuiting or paralleling sections.

The two I.F. stages employ variable-mu screen-grid valves (tubes) tuned to 110 kc. The full-wave metal oxide rectifier is well suited to deal with the comparatively high output from the I.F. stages, and also provides a convenient means of obtaining A.V.C.; the D.C. component of the rectifier output is used to bias the R.F. tubes.

illustrated, by means of three lengths of rubber tubing; the central interstice provides room for the lead-in wire. Thus, capacitive and dielectric losses are greatly reduced.

TUNING I. F. AMPLIFIERS BY THE PERIDYNE METHOD

FUNKTECHNISCHE MONATSSHEFTE, Berlin, recently described a novel and effective method of aligning I.F. stages. See Fig. 5.

In the place of the usual trimming condenser there is used a "Peridyne plate," originally described in the article, "The A.C. Screen-grid Peridyne," by Hugo Gernsback, in the September, 1929, issue of RADIO-CRAFT.

The increased L/C ratio increases the effective Q of the circuit. This increases the selectivity and gain-percentage, and at the same time increases the selectivity. Also, since the setting of the Peridyne plate is controlled by a fine screw thread and not the usual spring action, changes in frequency due to shifting of the trimmer setting is eliminated; as also are the losses caused by the mica insulation, etc. The advantages of this system are apparent.

The Peridyne plate is arranged to approach or recede from the end of a trimmer winding in series with the regular winding of the transformer.

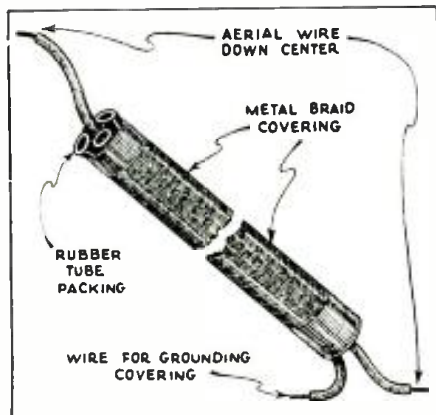


Fig. 4

Novel construction is the feature of this shielded lead-in. Rubber tubes form the insulation.

A SHIELDED LEAD-IN

IN A recent issue of WIRELESS MAGAZINE, London, England, was described a lead-in of interesting design. This device is a product of British Radiophone, Ltd., and is known as the Receptru. It is illustrated in Fig. 4.

Regardless of whether a matching transformer is used to obtain low-impedance characteristics in the lead-in system, it is essential that the capacity between the wire within the shield, and the shield, be kept to a minimum value. This is accomplished, in the lead-in

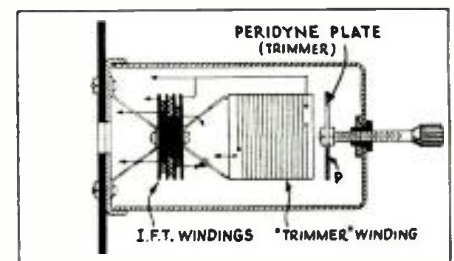


Fig. 5

The Peridyne principle is applicable to modern superhet. sets for aligning I. F. stages.

HOW TO MAKE AN ALL-CURRENT ULTRA-MIDGET RECEIVER

GEORGE DAY

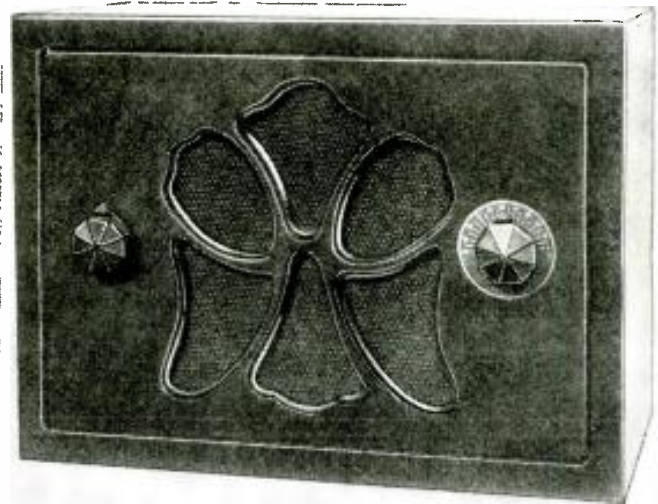


Fig. A
Front view of the ultra-midget set designed by Mr. George Day.

THE more desirable receiver today is one having flexibility of operation, reasonable cost, minimum power input, and small overall dimensions. The owner of a set that operates both on alternating current and direct current, in the home or in the car, does not have to worry whether he is living in an A.C. or D.C. district, in America or abroad, in Europe or in Asia; the set is *universal* in its current demands and can operate in any of the four corners of the globe. Such a receiver is illustrated in Figs. A, B and C. It was designed for a local manufacturer, and the requirements limited the engineer as to expense.

Schematic Circuit

The circuit that attains the requirements of high sensitivity and selectivity is shown schematically in Fig. 1. It utilizes only one stage of radio frequency amplification, one detector, one stage of audio frequency voltage amplification, and a stage of audio frequency power amplification.

In this design the most recent tubes, such as the 77 and the 6C6 are utilized in place of the usual 36 and 39 automobile tubes. The 6C6 tube is a recently developed R.F. pentode. With 250 V. on the plate and 100 V. on the screen, the plate current is 2 ma., while the screen current is 1 ma.; the minimum biasing resistor is in the order of 1,000 ohms. The amplification factor of this tube is 1,500 or over, thus simulating some of the characteristics of the 58 tube.

The R.F. stage has a band-selector coil L1 in its grid

circuit. The resonant sections of this coil are tuned by means of the two sections of the three-gang variable condenser, C; the coil L1, is designed to have a peak around 550 kc. The biasing resistor, R1, is shunted by a 5 mf. tubular electrolytic condenser, C3. The plate section of the R.F. stage comprises an interstage high-gain R.F. transformer which feeds into the type 77 detector, V2. This tube is self-biased by means of a 35,000 ohm resistor, R2, shunted by an 0.5-mf. paper condenser, C4. All the suppressors are strapped to the corresponding cathodes at the sockets except in the case of the 38 power tube where the suppressor is internally connected to the cathode. The closed-circuit phono. jack in the cathode circuit of V2 permits the use of headphones instead of the speaker if so desired. A 500 mmf., high-grade mica condenser, C5, is used in the plate circuit of the detector to bypass the R.F. currents.

The following stage is an A.F. stage utilizing the type 78 tube in a new function. It is coupled to the preceding detector through an 0.25-meg. resistor, R3. The grid resistor, R4, is 0.6-megohm which in conjunction with the coupling condenser C6, of .01-mf., affords a maximum input to the audio stage. The 78 audio tube is highly biased by means of a 25,000 ohm resistor, R5, shunted by an 0.1-mf. condenser, C7. The combination of the above values gives a flat response to the A.F. band, thus insuring good quality and no undue cutting of the side bands.

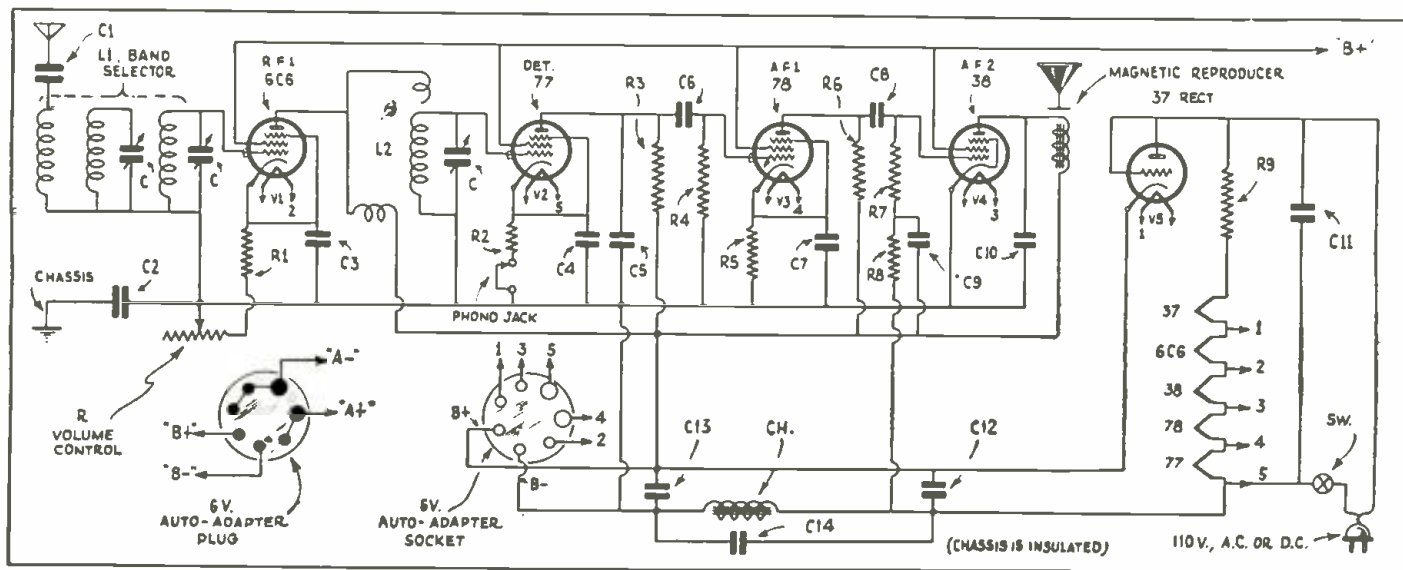


Fig. 1
Schematic circuit of a very sensitive and very selective ultra-midget broadcast and police-band radio receiver.

Numerous commercial types of ultra-midget receivers have been described in past issues of RADIO-CRAFT, but it has remained for Mr. Day to present constructional details of a model suitable for the "kitchen-table mechanic"; however, the set is designed for quantity production, if desired. A feature of this ultra-sensitive and exceptionally selective T.R.F. set is the use of new tube types.

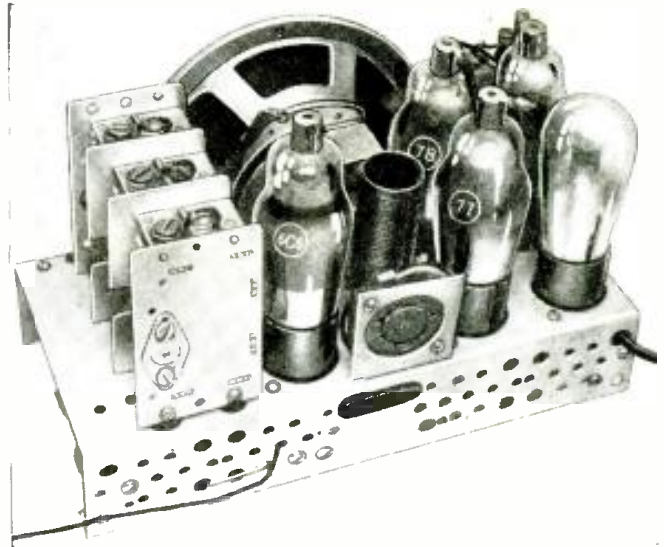


Fig. B

Rear-of-chassis view of the ultra-midget receiver. Ventilators keep R9 cool.

The power stage, which uses a 38 tube, is resistance coupled to the preceding stage. The grid coupling resistor has been sectionalized for filtering purposes; the junction of R7, of 1.0 megohm and R8, of 0.1-megohm, is connected to "B+" through a paper condenser, C9, of 0.5-mf. To obtain maximum voltage on the plate of the 38 power tube, the bias on its grid is obtained from the audio filter choke, L3.

The volume is controlled by changing the bias of V1. The use of a magnetic reproducer permits a type 37 tube to be utilized as a half-wave rectifier. For operation on light lines the heaters of the five tubes are connected in series and the line voltage reduced to the correct filament voltage value by means of R9. For auto use an adapter makes possible the connection of the heaters in parallel and the introduction of a separate "B" supply.

A pilot light has not been incorporated in this design, since the author is of the opinion that no pilot light on the market today can be used in circuits of this type without endangering the filament life of the pilot light. The power dissipation of such pilot lights is in the order of one watt. This causes them to heat up much faster than the two-watt filament, slow-heating pentodes, if connected in series with these tubes. Of course, the extra influx of current in the first few seconds does not endanger the pilot light. The danger zone lies between the normal heating time of the pilot light and the normal heating time of the tube. To limit the continuous flow of excess current through the pilot light some type of a device must be used. The best practical solution so far is to use a 6.3 V., 0.15-A pilot light (Tungsol) shunted by a 40 ohm carbon resistor. Carbon, due to its negative temperature coefficient, will tend to shunt the excess flow from the positive temperature coefficient pilot light.

In no universal A.C.-D.C. receivers have voltage regulators been employed to keep a constant voltage on the heaters. For the normal fluctuations of transmission line

voltages probably no hum troubles will arise. (Hygrade Sylvania claims that no hum is noticeable before the voltage on the heaters drops down to five volts, a voltage change in the order of 20%.) It may be desirable, however, to employ ballast lamps, such as an Amperite 3-80 or other type of voltage regulator, to check the upward rise of voltage on heaters which endangers the life of the tube and entails a servicing cost to manufacturers. (The normal design of line dropping resistors is for 115 V.)

How sensitive this set is may be appreciated from the fact that with only 25 ft. of indoor aerial and no ground connection, distant stations such as WTAM, Cleveland and WLW, Cincinnati, were received with good volume at a location in New York. In addition the receiver is exceptionally selective and is comparable in this respect to a super-heterodyne receiver. The receiver chassis is one of the smallest found on the market; its dimensions are 9 x 4 1/8 x 1 1/8 in. high.

Construction Data

A piece of 16 gauge aluminum 9 x 7 3/4 in. will suffice. Before bending the piece along a line 1 5/8 in. from both sides, it is necessary to cut with a cold chisel an opening for mounting the speaker.

The three-gang variable condenser C is placed at the extreme right; insulate it from the chassis by means of fiber washers placed on either side of the mounting holes in the chassis through which the condenser spade bolts pass.

Volume control R is located at the extreme left; an L-shaped bracket provides the necessary mounting. Insulate the shaft and case of the volume control from the terminals. In fact, everything is insulated from the chassis which connects to the set only capacitatively, through C2.

An L-shaped bracket having a large hole to fit a 7-prong socket makes a good mounting for the automobile adapter.

(Continued on page 234)

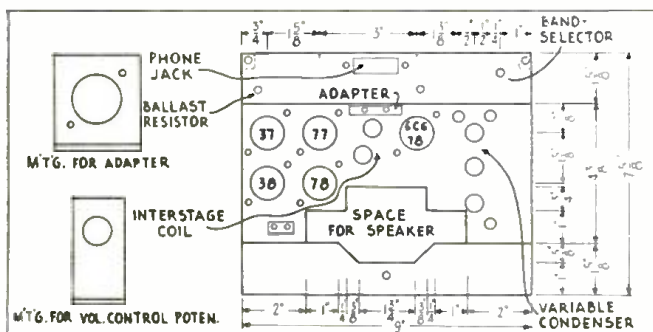


Fig. 2

Drilling layout for the chassis and two small mountings; note speaker cut-out.

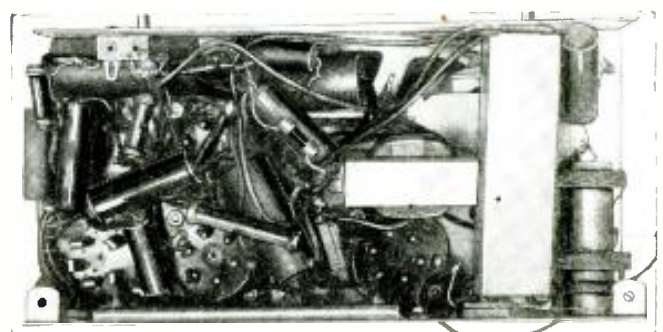


Fig. C

Note extremely compact arrangement of the under-chassis components.

THE BEGINNER'S "UNIT CHASSIS" CRYSTAL-AND-TUBE RADIO SET

Previous "Beginner's" articles in RADIO-CRAFT have been devoted almost exclusively to the design of "bread-board" radio receivers. In the following article the author discusses a "chassis-type" design which more closely follows the trend in standard radio set construction. The chassis has been designed to fit future set models.

FRANCIS R. HARRIS

WE HAVE been building, for several months now, various experimental "bread-board" hook-ups; we have learned, from the experience thus gained, a great deal of practical radio theory embracing almost all the fundamental types of receiving circuits; and we have acquired the "feel" of the work—we know how to make soldering irons, wire and sockets behave, and do what we want them to do.

But some of us may have had the experience of having some friend, more versed in the lore of radio than we, remark that our work was "old fashioned," that bread-boards were "out of date." So this month we are going to fool said friend; we're going high-hat and build a real modern chassis job so that his remark when he sees it will be not, "when did you build it?" but, "where did you buy it?"

The Circuit

First of all, before we go into the problem of building the chassis which is illustrated in Figs. A, B and C, let's get the circuit, Fig. 1, out of the way, since it embraces nothing startlingly new; the real "meat" of this month's work lies in the construction.

We are using a tuned circuit, Fig. 1, feeding a crystal

detector and a single type 33 tube operating as an audio amplifier. The only important departure from circuits we have previously built will be found to lie in the method of coupling the antenna. Here a three-circuit tuner is made use of with the regular primary and the tickler coil hooked in series and used as the antenna coupling coil. By rotating the tickler the sensitivity and selectivity of the circuit may be varied. This follows from the fact that the closer the antenna circuit is coupled to any input circuit the greater the sensitivity but the less the selectivity, or the broader the circuit tunes. Likewise, decreasing the coupling sharpens the tuning, or makes the set more selective, but decreases the sensitivity.

When the tickler coil is turned with its axis in line with that of the main coil and the current flowing in the same direction as that in the primary the coupling is closest, since the tickler and primary are working together and aiding each other. When the tickler is turned 180 degrees from this position the two coils are bucking each other and the coupling is loose. This is the theory of the effect; a little playing around will soon teach you the practical application of the theory.

A point about which there may be some question in the



Fig. A, above; Fig. C, right

The appearance of the panel and the interior of the set are shown above and to the right, respectively.

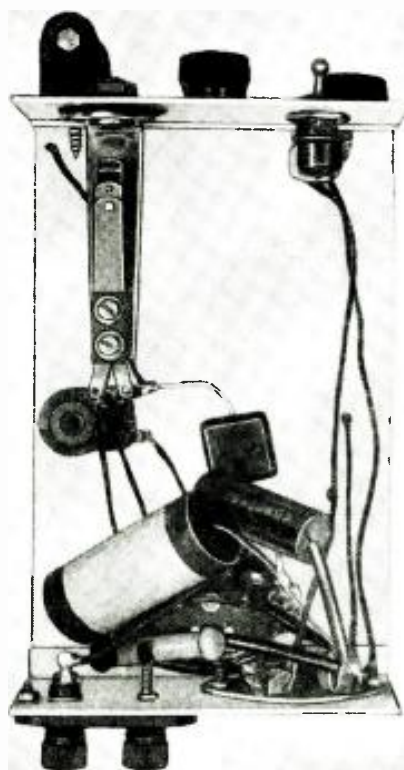
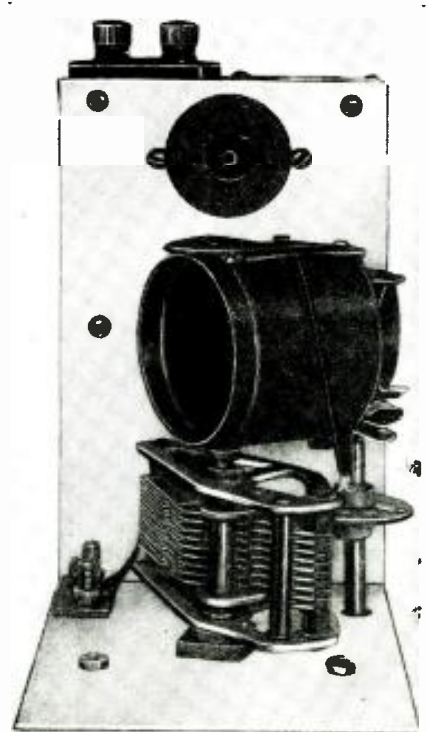


Fig. B

The top view of the aluminum sub-base.



mind of the beginner is the use of two condensers, one an electrolytic of 25 mf. capacity, C3, and the other a non-inductive paper condenser of .1-mf., C2, bypassing the bias resistor, R1.

The reason for this is that, due to its internal construction, an electrolytic condenser has considerable inductance as well as capacity. While this inductance is not enough to be important at audio frequencies, to bypass which the condenser is used in this circuit, it is sufficient to cause this type of condenser to act as a very effective choke at radio frequencies.

Hence, in any circuit in which both radio and audio frequencies must be bypassed it is necessary to use, in addition to the electrolytic which handles the audio, a non-inductive type of condenser to take care of the radio frequencies.

This particular point is very interesting, and sufficiently important to warrant spending enough time on it to thoroughly understand what it is all about.

Suppose, for instance, we should remove condenser C2 in this circuit. Then we would have, between the grounded end of the tuning condenser, C1 (which is the chassis) and the end of the tuning coil which should be directly grounded, not only the resistance of the 750 ohm bias resistor, R1, but also the inductance of the condenser, C3. The circuit would operate under these conditions, if at all, very inefficiently.

And while we are on the subject of electrolytic condensers we will repeat the warning about being sure to *correctly connect this condenser into the circuit or it will be ruined*. In general, in connecting this type of condenser into any circuit the negative end goes to the grid return point and the positive to the filament or cathode of the tube.

Construction

Now that we have that out of the way let's begin on the actual construction. We are going to build an aluminum, sub-panel, unit type of chassis which has been so designed as to be used not only for this particular set but also for other sets in the future, and also is so designed that the addition of other units of the same type will allow of the piecemeal construction of large sets, having each unit available for use while collecting the parts for the next.

Don't get scared just because we are talking of metal construction. Aluminum is a very soft and easy metal to work, and it allows of a type of construction which looks really professional when finished.

Aluminum can be sawed, cut and planed just like wood; and with woodworking tools. And it will not harm the

tools. One must remember only that it is somewhat more tenacious than wood and therefore requires a lighter cut. When straightening the edge of a panel, for instance, set your plane blade for a very light cut and go to it. You will have a beautifully smooth, clean edge when you are done.

In cutting out the large holes for the sockets you may proceed in either of two ways. If you have a circle cutter use that; if not, lay out the desired hole and drill a series of small holes around the inside of the line, then cut through the partitions between them with a chisel and clean up the work with a half-round, rather coarse file. It is well to drill the screw holes for the mounting of the socket before cutting out the large hole since they come so close to it as to make the drilling difficult.

In laying out holes which must be accurate the procedure is to mark the position of the hole with a center-punch, then drill part way through the metal with a small drill, say 1/16-in., follow up with a drill of the correct size. The reason for this recommendation is that a small drill will hold its position much better than a large one and will make a guide hole that the larger drill must follow.

Only part of the holes required are shown on the chassis layout drawing, Fig. 2, for the reason that each experimenter will have on hand parts of his own which he will wish to use, and the mounting holes must be made to fit the available parts. Items such as sockets are practically standard, hence these mounting holes can be shown. The mounting for the crystal is also shown because the type of detector specified is the only one we know of that can be mounted on the front of the panel as this is shown.

The best procedure to follow in layout is to cut two pieces of paper of the exact size given for the panels, then arrange the parts on this paper and mark out the exact position of the required holes. Finally, lay the paper on the metal panel—being sure to have it on the same side of the panel on which the parts mount or you will have all the holes backwards—and mark through with a center-punch.

After all the holes are laid out and drilled you can proceed with the bending. For this you will require a vice with jaws as wide as the length of the bend to be made or, preferably, two pieces of angle-iron about 1 x 2 x 1/4 in. thick, and a foot long.

Place the piece to be bent between the two angles with the dotted "bend line" exactly even with the edge of the angle and clamp them tightly. Then gently and evenly press the metal over in the direction of the marked side along this line as far as possible. After this is accomplished complete the bend, making it nice and sharp, with quick, light strokes of a hammer, working evenly back and forth across the width to be bent.

Remember always, in laying out panels to be bent, that the length from the bend to the edge of the panel, measured along the inside of the bend will be less than that measured along the outside by an amount equal to the thickness of the metal.

For instance, the overall length of the sub-panel shown, when bent, will be 6 1/2 in. but the distance between the bend lines is 6 3/8 in. less by twice the thickness of the metal since there are two bends.

(Continued on page 235)

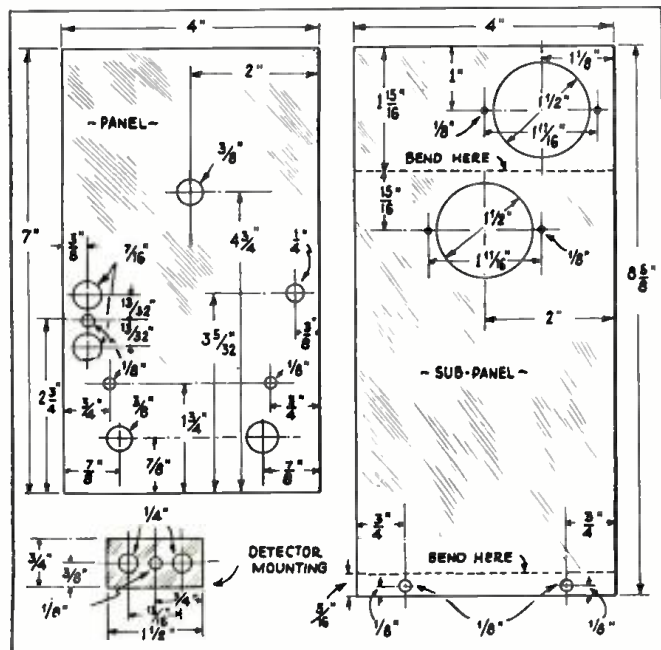


Fig. 2

This shows the size of the aluminum panel, sub-panel and detector mounting.

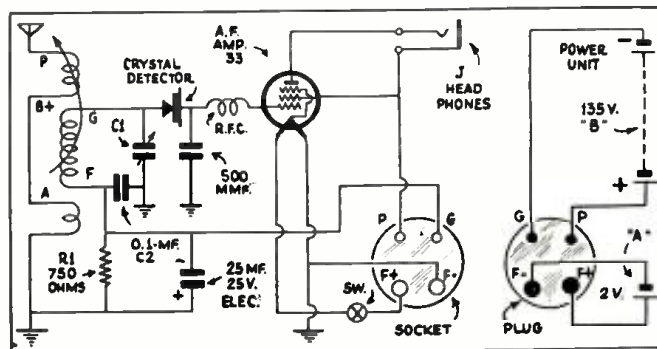


Fig. 1

The circuit diagram of the Beginner's set; including battery connections.



Fig. A

A 3 1/2 W. power amplifier of exceptionally high gain and small proportions.

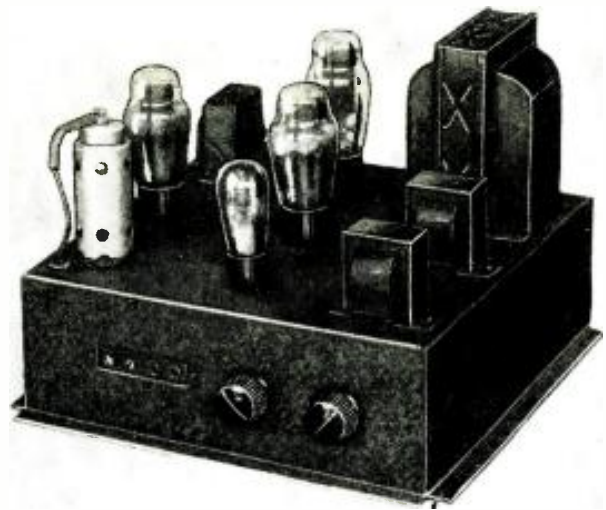


Fig. B

A 6 W., 3-stage power amplifier capable of driving up to six dynamic reproducers.

HOW TO MAKE FOUR NEW AMPLIFIERS

F. LESTER*

THE development of power amplifiers to their present high degree of efficiency has followed closely the introduction of new and better vacuum tubes. There has been a marked trend towards simplification accompanied by constant lowering in price. Consequently, powerful public address amplifiers are now available at prices which would have seemed ridiculously low several years ago.

A Midget, 3 1/2 W. Amplifier

An enormous demand has arisen for an inexpensive, very small, high-gain amplifier suitable for use in small sound systems and capable of operating three or four dynamic speakers.

*Engineer, Wholesale Radio Service Company.

Such an amplifier has been recently developed. The actual amplifier is illustrated in Fig. A; its schematic circuit is shown in Fig. 1.

This compact amplifier finds many uses in public address work because of its high efficiency and low price. It is ideally suited for sound systems in small meeting halls, for beer gardens, restaurants, markets, small theatres, etc. It can also be used to replace old-style amplifiers in radio receivers having good tuners; to electrify old-style horn-type phonographs; for hearing aids and for numerous other useful purposes.

A glance at the schematic diagram, Fig. 1, reveals the fact that only two tubes are employed, exclusive of

the rectifier. These are of the new type and actually do the work which formerly required four of the older model tubes. The amplifier has an undistorted power output of 3 1/2 W. and is available either with or without provision for exciting the field of a 2500 ohm dynamic speaker.

The first stage employs a 57 pentode tube, resistance-coupled to a 2A5 power output pentode. This combination attains the remarkably high gain level of 95 db. The new 5Z3 full-wave rectifier is used, assuring excellent regulation and yielding a relatively large amount of rectified D. C.

An important feature, not to be overlooked in these days, is the fact that this amplifier costs less than ten

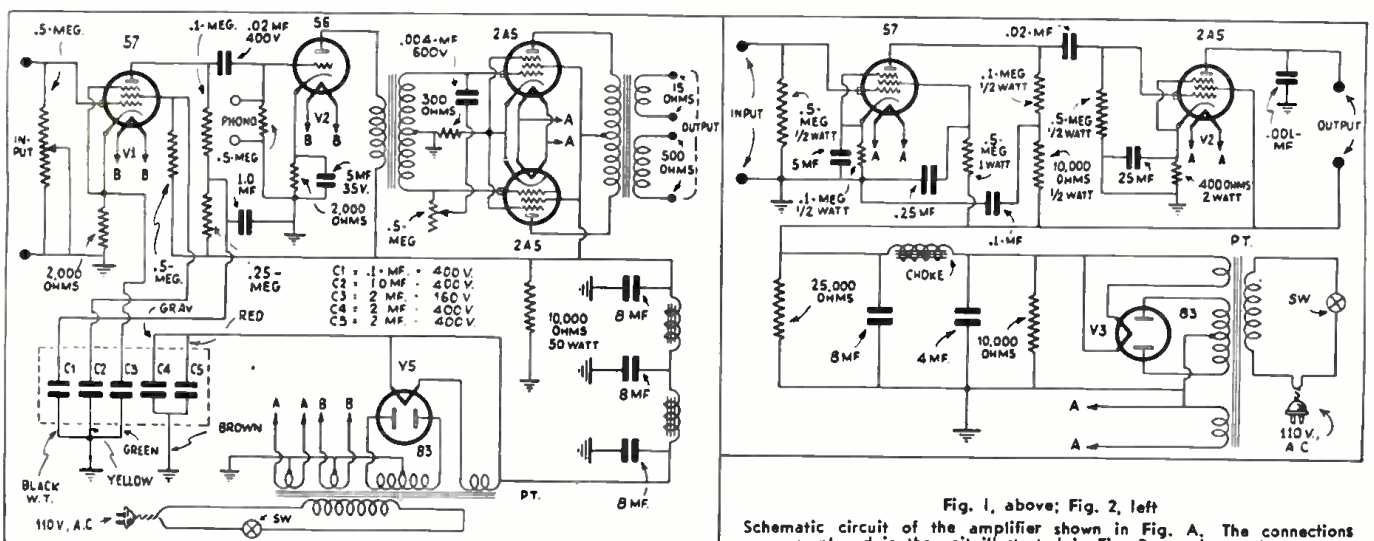


Fig. 1, above; Fig. 2, left
Schematic circuit of the amplifier shown in Fig. A. The connections employed in the unit illustrated in Fig. B are shown above.



Fig. C, left; Fig. D, above.
A 10 W., direct-coupled power amplifier with nearly flat response (left).
A 28 W., direct-coupled power amplifier having fine output quality (above).

Four amplifier designs are discussed by the author. Each circuit is designed for a particular service, ranging from a power-output demand of 3½ watts, to 28 watts. The last two units are direct coupled.

dollars, exclusive of tubes and speakers. The amplifier measures only 8¼ x 6 x 5½ ins. high, and is known as the Lafayette model P-15790.

A 6 W. P. A. Amplifier

While the "midget" type amplifier described above has thousands of applications, it is subject to limitations imposed by its power output and this in turn limits the number of speakers it can handle. Hence, amplifier engineers have produced a three-stage amplifier costing only a few dollars more, but having output sufficient to operate five or six dynamic speakers, and with an undistorted power output of 6 W. This amplifier is illustrated in Fig. B.

The schematic diagram, Fig. 2, shows a 57 pentode in the first stage, resistance-coupled to a general purpose 56 tube in the second stage. This in turn is transformer-coupled to an output stage, consisting of two 2A5 pentodes in push-pull. The required plate current is supplied by an 83-type mercury vapor full-wave rectifier. Filtering is more than adequate; the hum is not noticeable.

The overall amplification of this amplifier is so high that the phonograph input connections are provided at the *second* stage, instead of the first. Referring to Fig. 2, it will be noted that an 0.5-meg. gain control is connected between the control grid of the 57 tube and ground. A tone control is also used. This is connected across the secondary of the push-pull input transformer and consists of an 0.5-meg. rheostat in series with a .004-mf. fixed condenser. This amplifier is designed solely for use with A. C. speakers, or with D. C. speakers employing external field supply. It cannot be used to furnish speaker field excitation. The gain of this amplifier exceeds 100 db. Incidentally, the amplifier is only 12x12x9½ ins. high.

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A 10 W. Direct-Coupled Amplifier

In comparing the amplifier shown in Fig. C with that illustrated in Fig. B, it is hard to believe that the former is capable of (Continued on page 236)

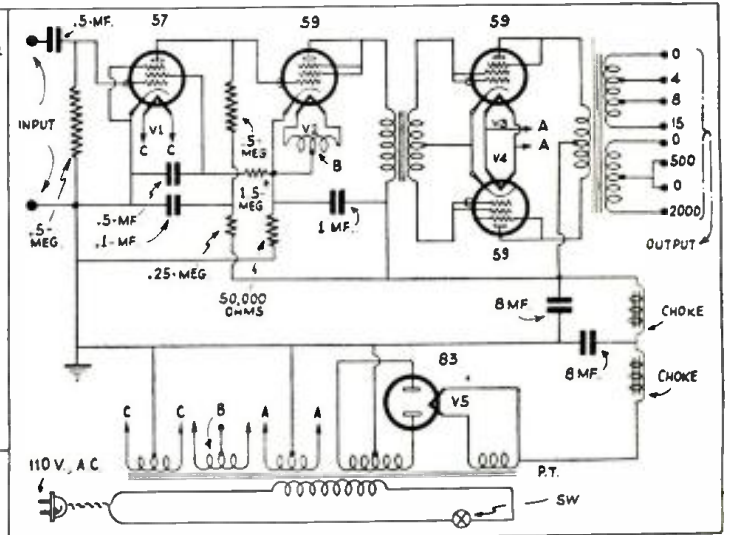
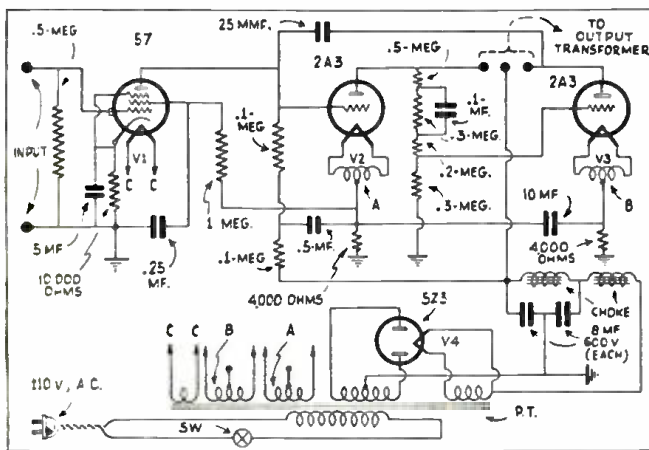


Fig. 3, above; Fig. 4, right
A diagram of the circuit used in the unit pictures in Fig. C. The instrument illustrated in Fig. D is connected as shown at the right.

CONSTRUCTING A COMPLETE 26-WATT, DUAL-CHANNEL P. A. SYSTEM

Part II

SYSTEM

Construction details for a "superheterodyne tuner" to be used with the 26 W. amplifier described in the preceding issue of RADIO-CRAFT. The tuner operates on either 110 V., A.C., or on batteries.

LOUIS GANCHER*

EVERY public address system, regardless of its size or nature, materially increases its effectiveness and value by being able to pick up and amplify radio broadcasts on limited antenna systems. A highly-selective and sensitive superheterodyne tuner of the type incorporated in the system partially described in the preceding issue of RADIO-CRAFT, should not only be looked upon as an essential auxiliary, but should also be considered as a profitable adjunct. For it not only furnishes the owner with regular broadcast programs during "idle" periods, but it also affords the added advantage of being able to amplify important broadcasts, for rental purposes, particularly those involving championship boxing bouts, baseball games, national affairs, important local announcements, etc. One should not overlook the fact that popular broadcast dance music is regularly available through the national

broadcasting systems and furnishes the finest available "fill-in" programs for all forms of P. A. work. If for no other reason, this "fill-in" feature makes it a worth while investment to complete the "interlocking P. A. system" with the specially designed, completely self-contained 6 V. storage battery and 110 V., A.C. operated "super-het" tuner. A front view of the tuner and power supply is Fig. D; an underside view is Fig. E. The schematic circuit of the tuner is Fig. 4.

By referring to the block layout of the components, Fig. 5, it will be noted that although the complete tuner is mounted upon one chassis, it consists essentially of three parts, the tuner proper, the 110 V., A.C. power supply, and the 6 V. storage battery operated motor-generator.

If it is desired to operate the tuner exclusively from a 6 V. storage battery the 110 V., A.C. pack and its components need not be purchased or built, for space will always be available upon the chassis for such a pack

if it is ever desired. On the other hand, if exclusive 110 V., A.C. operation is contemplated, the motor-generator need not be purchased, for this, too, may be added at a later date if 6 V. storage battery operation is required. (This universal operating feature does not add materially to the cost of the tuner. The only additional parts required are a 5-prong plug, two 5-prong sockets, and two ft. of 4-wire cable.)

The value of this universal operating feature should not be overlooked for it assures maximum satisfaction and use of the entire system regardless of conditions or localities. Any ordinary 110 V., A.C. P.A. system would be useless in rural territories (or on boats, in autos, etc.) where commercial power lines are not available and where 6 V. storage battery operation is essential. In order to overcome this obstacle, two alternatives were generally resorted to: one was the use of a fan-belt-driven 110 V., A.C. generator which involved a large initial outlay and presupposed the ownership

*President, Coast-to-Coast Radio Corp.

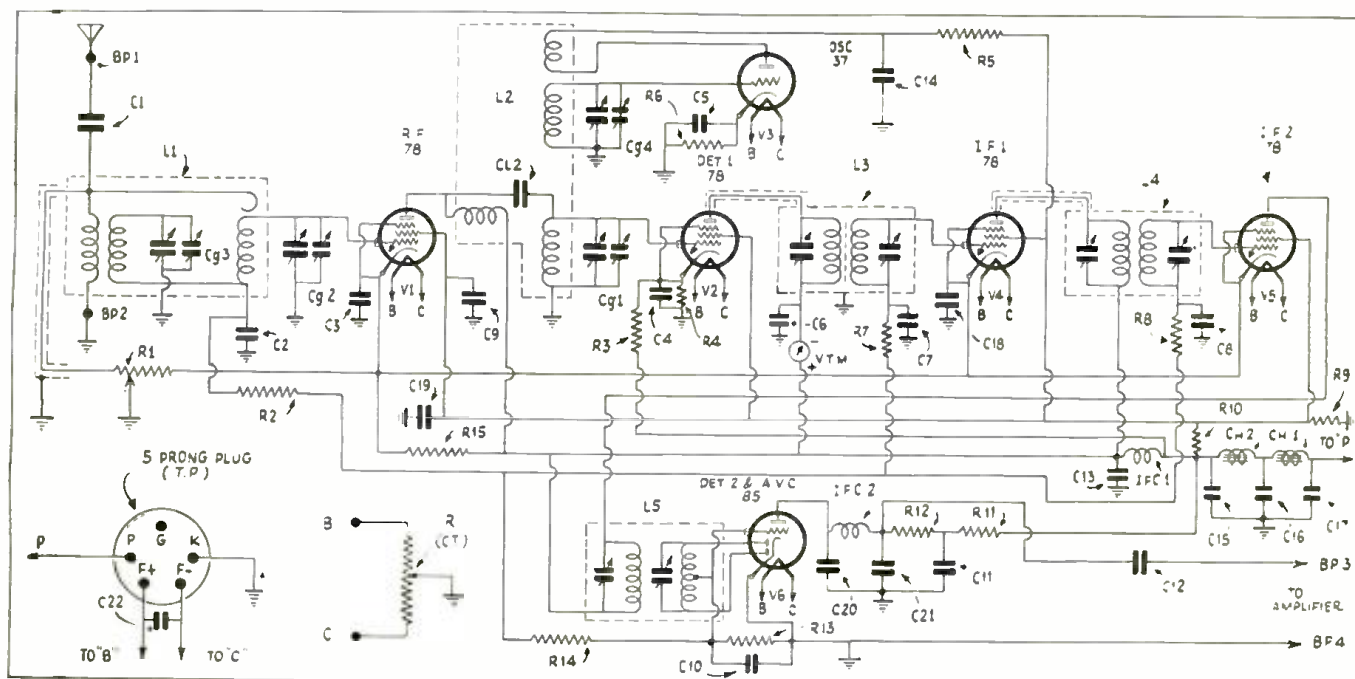


Fig. 4

Schematic circuit of the "universal"-current superheterodyne tuner designed for use with the "universal"-current P. A. amplifier described in the September, 1933, issue of RADIO-CRAFT. The completed "system" may be operated not only where A.C. lines are available, but also in other localities.

of an automobile or gasoline engine; the other alternative was to use a 6- or 12-V. rotary converter delivering 110 V., A.C.—a unit which is not only costly, but which imposes a considerable drain on the storage battery.

In order to do away with all of the undesirable features of both these methods of universal operation, special attention was given to the selection of the tubes and design of the superhet. tuner employed in the system.

By referring to Fig. 4 it will be noted that all of the tubes employed in the tuner are of the 6.3 volt heater type. These tubes were selected for the following three reasons: (1) They are exceptionally sturdy and rigidly constructed, having been originally designed for automobile receivers; (2) they operate equally well from 6.3 V., A.C. or D.C.; (3) they do away with the necessity of either replacing tubes or using special adapters when changing from 110 V., A.C. to storage battery operation. In fact, the only changes involved in "switching" the tuner from 110 V., A.C. to 6 V., D.C., or vice-versa, is to remove the tuner plug TP, shown in Fig. 5, from power supply socket S1 (for 110 V., A.C. operation) and insert it into power supply socket S2 (for storage battery use); there are no additional changes required. The writer believes that this method of instantaneous change-over for "universally"-powered systems will shortly be incorporated into every worthwhile receiver or amplifier.

Circuit Features

The tuner and its associated power supplies are thoroughly shielded and filtered to prevent any extraneous pick-up. A single tuning dial, volume control, R1 (combined with A.C. on-off switch Sw.1), and on-off battery switch Sw.2 complete the manual controls. A band-selector coil, L1, is tuned by sections CG3 and CG2 in the 4-gang oscillator tracking tuning condenser. The tuned signal is then fed into the first type 78 R.F. tube, V1, the output of which is coupled through L2 into the first-detector employing an additional

(Continued on page 245)

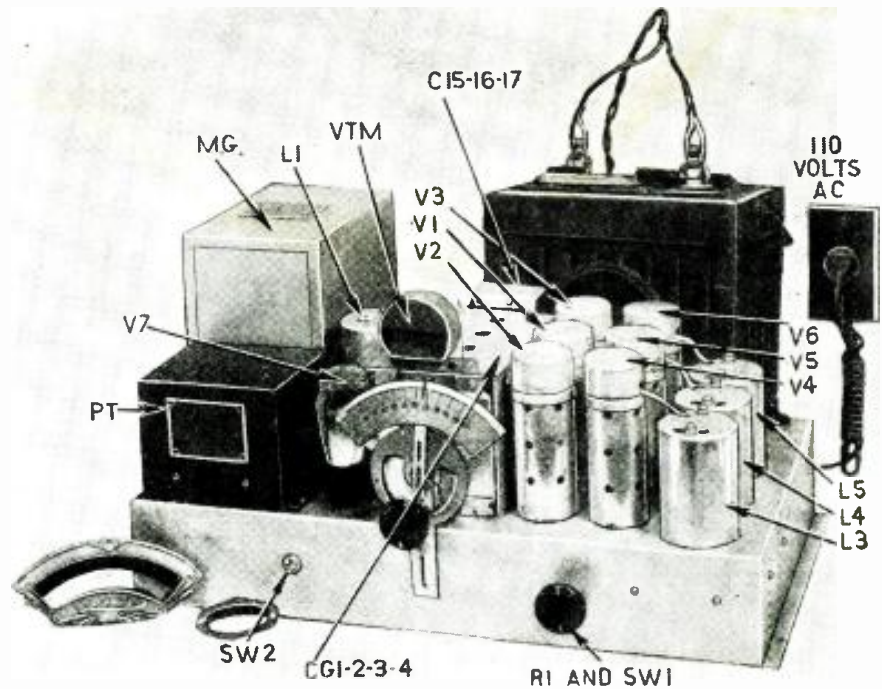


Fig. D
A view of the superheterodyne tuner and its power supply units. A motor-generator is used to supply the high voltages required by the tuner, when battery operation is desired.

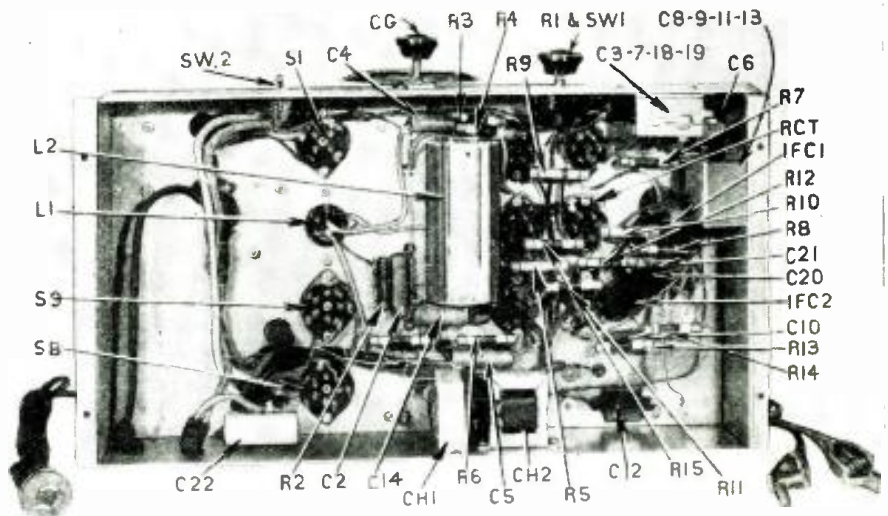


Fig. E
An underside view of the tuner. From this illustration the constructor is enabled to obtain an idea of the manner in which most of the under-chassis components are mounted.

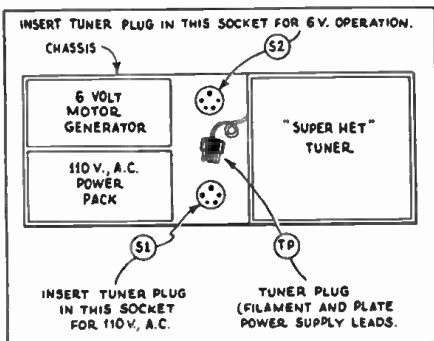


Fig. 5
A block illustration of the manner in which the superheterodyne tuner is connected into circuit.

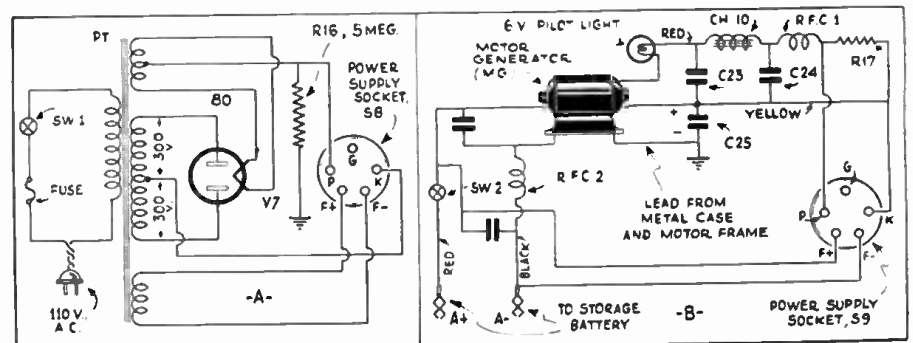


Fig. 6
Circuit connections of the power packs designed for the superheterodyne tuner. At A is shown the 110 V., A.C. unit; and at B, the 6 V. battery unit. Plug-in connections permit either circuit.

HOW TO BRING YOUR RADIO-CRAFT UNIVERSAL ANALYZER UP-TO-DATE

Circuit revisions of the test instrument described in the article, "The RADIO-CRAFT Universal Analyzer," which appeared in the September, 1932, issue, permit all the new sets and tubes to be checked. All tube manufacturers concede that the number system which this instrument first introduced to the radio field is the most satisfactory method of designating tube elements.

THE
ENGINEERING STAFF
OF
RADIO-CRAFT

IN ANSWER to the hundreds of letters for more information regarding the changes necessary to bring this popular tester up-to-date, a special article has been prepared by the engineering department, covering the details of necessary changes. The "re-vamped" instrument is illustrated in Figs. A and B.

An examination of the circuit diagram, Fig. 1, shows that the fundamental method used in the first design is still applicable with a few minor

additions. It will be noticed in regard to the changes, that they are few in number and low in cost.

One word before going ahead with the story—tube manufacturers will not produce tubes with more than seven prongs for a long time to come, and the RMA committee has not issued a bulletin covering the basing of tubes using more than seven prongs. This is a piece of good news and is authentic.

In the latest data sheets from the tube manufacturers it will be noted

that the terminals have been assigned numbers. *This method of identifying the various elements of the vacuum tube was first proposed and used in the RADIO-CRAFT Universal Analyzer, long before the tube manufacturers thought it would be the correct answer to the problem of element identification!*

A striking example of tube element connections with respect to the more or less accepted method of prong connections will be found in the 25Z5 tube. Here, a cathode connection is made to

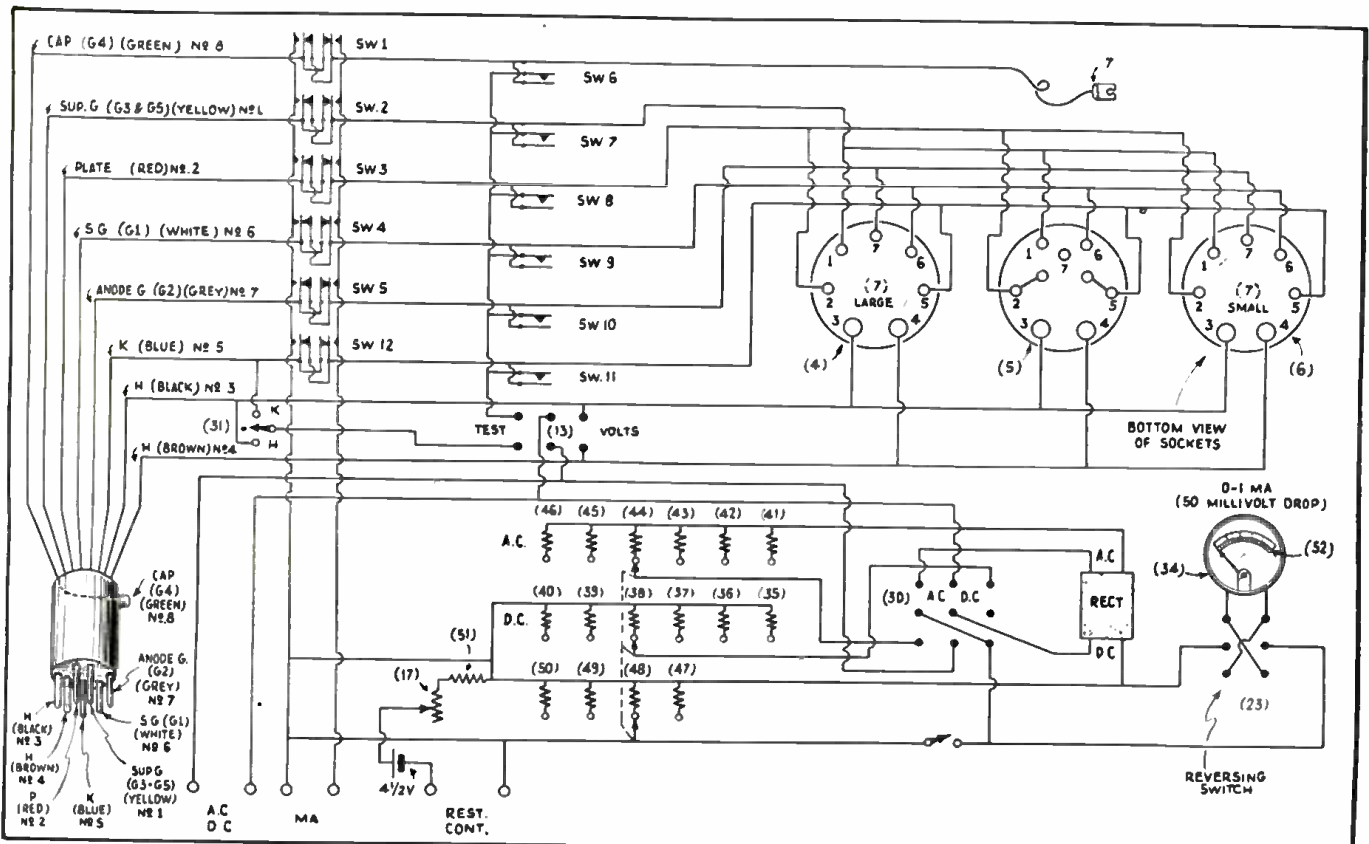


Fig. 1

Schematic circuit of the revised RADIO-CRAFT Universal Analyzer. Note that the resistance of individual copper-oxide rectifiers greatly influences accuracy.

the prong that in the ordinary sense would be the plate terminal, and the two plate terminals of the 25Z5 are connected to the prongs commonly identified as suppressor- and screen-grid terminals. Thus it is seen that the system set forth over a year ago is still useful today, and in fact, is the *only* way to analyze tubes and receivers with a minimum of complicated switches and push-buttons.

Another feature of the Analyzer is the fact that the instrument is "dead front." That is, it is impossible to get a shock from any of the metallic, exposed parts of the unit. It is interesting to note that a fundamentally sound design is always capable of modification at a reasonable cost without destroying the efficiency.

Important Changes

One of the most important points to be noted is the relation between the

output resistance of the copper-oxide rectifiers to the values of resistance employed in the A.C. multiplier circuit. This holds for the A.C. voltage ranges only, of course.

The following resistor values, non-inductive and non-capacitative can be used in copper-oxide rectifiers having an output resistance of approximately 1000 ohms, with a reverse reading of 60,000 ohms at 70 degrees Fahrenheit. Tests were made on the D.C. output or meter side (with a Taussig rectifier) calibrated at half scale, 1 mil.—50 millivolt, Weston Model 301 meter. Ranges of 50 volts and up are read on the regular linear D.C. scale; for voltage ranges of 10 and 5 volts, use the correction markings of the A.C. scale on the Van No. 4 dial. A slight error would occur if a 27 millivolt meter were used instead of the 50 millivolt meter.

	Ohms
5 volts*	3,200
10 volts*	7,500
100 volts**	84,000
250 volts**	212,000
500 volts**	425,000
1000 volts**	425,000

*To be read on the offset scale of Van No. 4 dial.

**To be read on regular D.C. scale.

The last two resistors, viz., the 425,000 ohm units are connected in series so as to increase the accuracy of the readings, preventing any possibility whatsoever of overload due to the presence of more current flowing in the circuit than that required by the rectifier. (This affects the 1000 volt scale only.)

The following resistors are for the 600 ohm output rectifier which was used in the first model of the Universal Analyzer:

	Ohms
5 volts	3,900
10 volts	8,100
100 volts	88,000
250 volts	220,000
500 volts	450,000
1000 volts	900,000

It is important to note that with the newer type rectifier there has been an increase in the output resistance from 600 ohms to 1000 ohms, thus necessitating the changes in the values of the A.C. multiplying resistors. Some of the builders of the analyzer had trouble along that line, and *most of it could be traced to differences in output resistances of the rectifier.* It will be noted that all of the rectifiers available today are supplied with a tabulating slip, but the given output resistance can be checked in the proper range and value of resistors used.

The following changes have been
(Continued on page 240)



Fig. A

The panel of the revised RADIO-CRAFT Universal Analyzer. The markings correspond with Fig. 1.

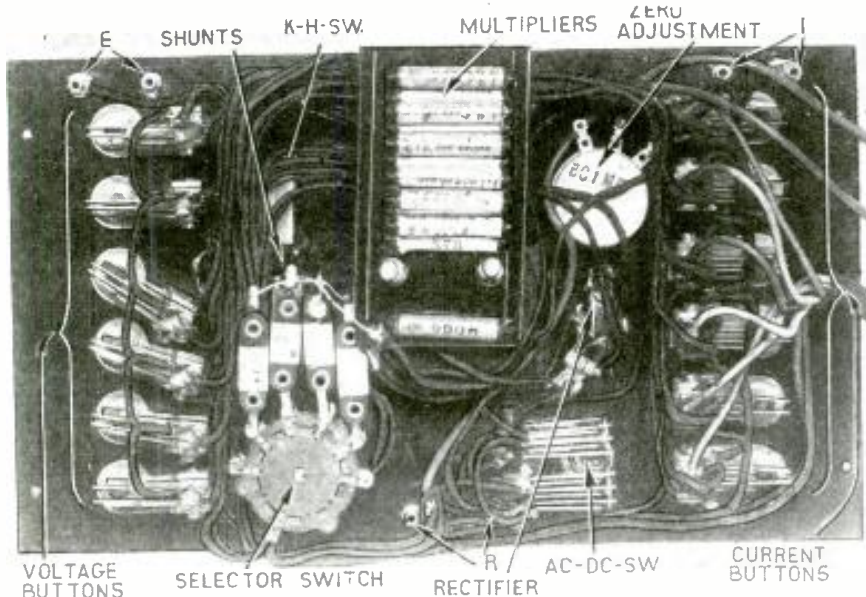


Fig. B

Rear view of the RADIO-CRAFT Universal Analyzer. A close inspection will reveal many changes.

EXPERIMENTAL RADIO

Not every Service Man has sufficient foresight to see that there is more to radio than just replacing an off-value resistor, or a shorted condenser in Mr. Jones' Super-Bloopadyne; and that the New Deal is going to thrust forward a great number of marvelous devices, each of which will, when marketed in commercial quantities, require the services of an expert technician. Consequently, RADIO-CRAFT has dedicated itself to the task of presenting in easily understandable terms the most up-to-the-minute information on developments in Experimental Radio. (See "An Experimental Radio-Phone," in this issue.)

HOW TO MAKE THE NEW "ANALYZER UNIT"

MILTON REINER*

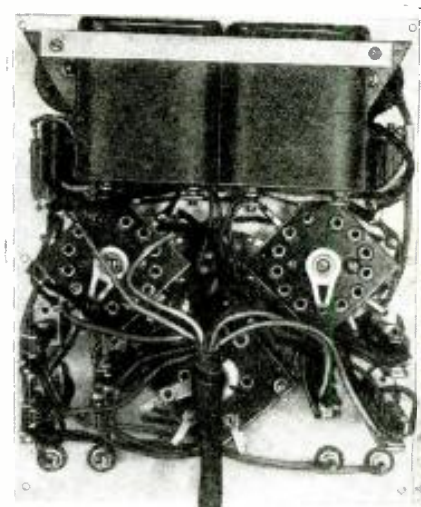


Fig. A, above; Fig. B, right
Exterior and interior views, respectively, of the new "analyzer unit." Panel markings are shown in Fig. 2.

REGARDLESS of the immediate condition of the radio industry, it behooves every radio mechanic to apply the by-words of a famous politician, "Let's look at the record." And the record, when it comes to test equipment, shows that the great majority of Service Men and dealers are inadequately equipped for testing sets and tubes, and modern accessories and parts. The sad part of it is that most of these men have paid out a hundred dollars or more for what is now practically obsolete apparatus.

Naturally, "hindsight" is more convenient than foresight, but it is now time to review the situation so that we do not make the same mistake too often. *It is possible to build test equipment into inexpensive units, and design each unit to be sufficiently comprehensive to provide for future developments.*

"Unit" Test Instruments

With this idea in mind, the device illustrated in Fig. A has been designed; it is classed as a "set analyzer unit." This instrument is a very compact companion unit for the "multitester" described in May, 1933, issue of RADIO-CRAFT, but may be readily used with any voltmeter, milliammeter, ohmmeter or combination meter. The limitations of the set analyzer unit will depend only upon the limitations of the meter used with it. Many obsolete analyzers have a meter with combination ranges in volts, ohms and milliamperes which may be used to excellent advantage.

This new unit provides for flexible point-to-point resistance and voltage analyses, as well as comprehensive, conventional current-voltage analyses. The resistance or voltage between any two elements at any socket may be quickly determined by the voltage-resistor selectors. There is no limitation to the point of reference so that any element or chassis ground may be used as the base or reference point. This is a decided advantage in resistance testing. The elements are clearly indicated and are etched into the panel at the sockets and at all switches. Guesswork is eliminated and complete flexibility is at the command of the operator.

Flexibility of Design

The panel contains sockets not only for the 4-, 5-, 6-, and 7-prong tubes, but also for the 8- and 9-prong tubes, which takes care of the future for some time to come. Note that provision is made for the grids of multi-element tubes of the future; connections are already made for G1, G2, G3, G4, G5 and external control grids, as shown in Fig. 1. Moreover, there are spare points available on the switches, and spare wires in the analyzer cable for possible future additions. An interior view of the device is Fig. B.

Current readings may be obtained by operating the current selector switch. Momentary switches protect the meter and permit current to pass through the meter only

WHAT THIS "ANALYZER UNIT" WILL DO—

- (1) Combines all features of point-to-point analyzer and conventional current-voltage analyzer;
- (2) Ample capacity for future changes and developments;
- (3) May be completely constructed at a cost not exceeding eleven dollars;
- (4) Any tube element or the chassis may be used as a reference point;
- (5) All circuit switching is automatic;
- (6) Provides for 8- and 9-prong tubes;
- (7) Simple to operate; reference charts or instructions are not necessary.

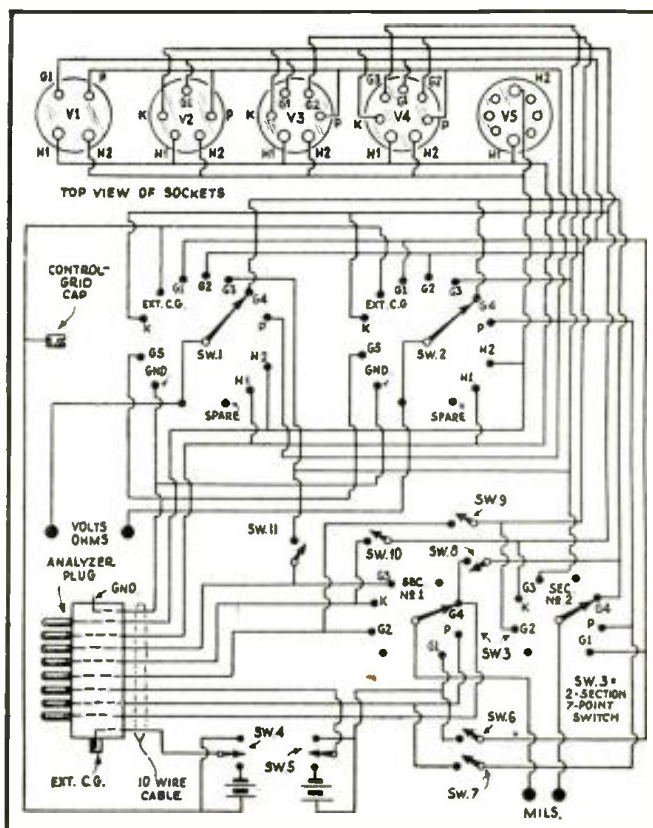


Fig. 1
The schematic circuit of the analyzer.

*Chief Engineer, Radio City Products Co.
(Continued on page 247)

CLIFFORD
E.
DENTON*

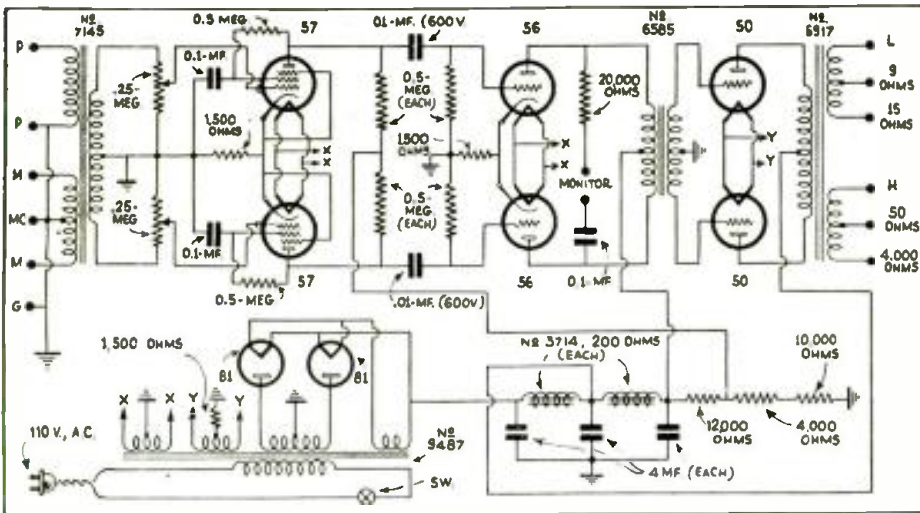


Fig. 1
Schematic circuit of the auditorium model 125-P. A. amplifier.

? AND ANSWERS ABOUT

P.A. SOUND SYSTEMS

Questions on the problem of "breaking into" the field of P.A. work are given direct answers in this interesting article.

Q *QUESTION:* How much experience do I need to install an auditorium sound system?

Answer: None. Any radio man can install a sound system without previous experience, merely by following the given directions.

Question: What will a complete sound system cost me?

Answer: About one hundred and thirty dollars, including amplifier, speakers, tubes, microphone, wire and all necessary equipment.

Question: How large a crowd could be handled with a system costing about one hundred dollars?

Answer: The system described below with two speakers is a real power job capable of handling a crowd of 5,000; or, the amplifier could be used with up to 25 speakers to handle a crowd of 10,000 people and to cover a space of over three square city blocks.

Question: How long would it take to install such a system?

Answer: It would take one man about an hour and a half to make an average permanent installation.

Question: How much profit could I expect to make from such a job?

Answer: A charge of two hundred fifty dollars would be very reasonable. This would mean a gross profit of one hundred twenty dollars. Not bad for 1½ hours work.

Question: Where would I look for prospects for an auditorium sound system?

Answer: They exist everywhere. The town hall, the high school auditorium, the opera house, dance halls, swimming

pools, club rooms, lodge halls—in fact every place where crowds congregate for amusement or instruction.

Question: How much initial investment would be required to land an order?

Answer: No investment whatsoever; merely the time required to make a sales talk to the prospect.

Question: How can I finance an order for a complete sound system after I land it?

Answer: It should not be difficult to obtain from one-third to one-half of the agreed upon price upon closing the deal with your prospect. This is common practice.

Question: Will you give a list of equipment needed for a comprehensive sound system?

Answer: A complete list of parts for an auditorium sound system follows: one, Push-pull power amplifier with

tubes; one, condenser microphone complete with tubes; one, condenser microphone supply; two, theatre dynamic speakers; one, speaker field exciter; two, studio speaker cabinets; 100 ft. silk-covered parallel wire.

Question: Describe an amplifier that you recommend.

Answer: The auditorium No. 125 is a satisfactory, powerful 30 W. amplifier of the type known as double class A prime. It uses a triple push-pull circuit with type 57 high gain pentodes in the first stage, type 56 general purpose tubes in the second stage, and type 50 tubes in the output stage. Among its many features are monitor speaker output, attenuator control, 90 db. gain, built-in microphone pre-amplifier, etc.

Question: Is this amplifier available assembled, wired and ready for use, or do I have to wire it?

Answer: The amplifier is available completely wired and ready for use.

Question: Is it necessary for me to know the wiring details of the amplifier in order to install it?

Answer: No. The schematic wiring diagram is given, however, in Fig. 1, merely so that you will have this information available if your prospect is interested in details of this nature.

Question: Can I use this amplifier for other purposes besides the ones mentioned above?

Answer: Yes, it can be used for hundreds of other purposes. Just to mention a few, it is particularly well adapted for aeroplane advertising, sound trucks, stadiums, broadcast transmitters, for multi-speaker installations in hotels, wired radio systems,

(Continued on page 237)

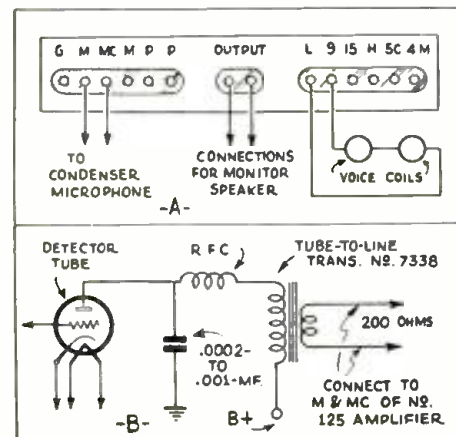


Fig. 2

At A, terminal-strip connections; B, set connections.

*Sound System Engineer. Federated Purchaser, Inc.

THE ANALYSIS OF RADIO RECEIVER SYMPTOMS

OPERATING NOTES

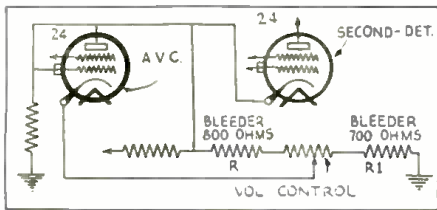


Fig. 1
Replacing the volume control in A. K. 82 and 82F.

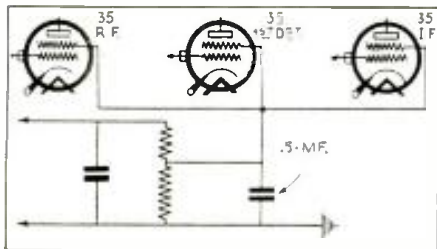


Fig. 2
A vulnerable point in Zenith models 91 and 92 sets.

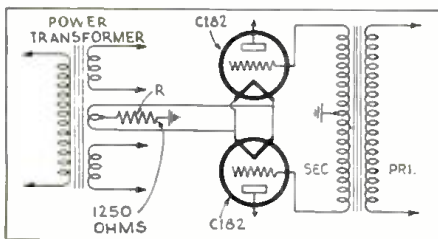


Fig. 3
An open bias resistor results in no plate voltage.

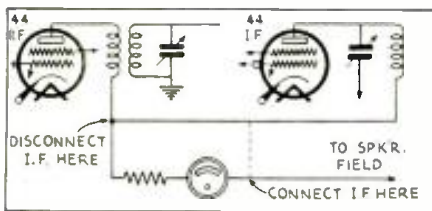


Fig. 4
The tuning meter is improved by this change.

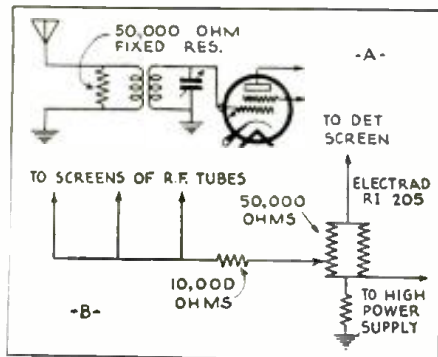


Fig. 5
A change to improve the volume control.

ATWATER KENT MODELS 82 AND 82F

One of these sets was brought in for repairs in which the combination switch and volume control had been replaced with a replacement unit, the switch having given out. The set would not play with the A.V.C. tube in the set. In looking over the circuit, shown in Fig. 1, we find a bleeder resistor from the volume control to ground. Also another bleeder, R1, from the other end of the volume control to the screen-grid of the A.V.C. tube socket. As these resistors are concealed in the leads to the volume control, they had been cut away when the replacement unit was installed and replaced with wire leads. Replacing these resistors remedied the trouble.

ZENITH MODELS 91 AND 92

Fading in these models is generally due to a poor A.V.C. tube, a type 24. Intermittent squealing in these sets has been traced in several cases to a defective condenser which bypasses the screens of the R.F. and I.F. tubes, as shown in Fig. 2. The test for this defect is to substitute a condenser, of .5-mf. capacity, which is known to be good. Frequently a complaint comes in of noise in the set that resembles telegraph interference. The trouble is usually due to a defective 27A second-detector, or a first A.F. tube. The only method of checking these tubes is to substitute one which is known to be good as these tubes will test perfectly in tube testers and analyzers.

SPARTON SERIES 931

No plate voltage on the power tubes in these sets can most often be traced to an open 1250 ohm bias resistor. This is R, in Fig. 3. Replacement should always be made with a resistor of 5 watt rating to insure against a repetition of this trouble.

PHILCO MODEL 91

The shadow tuning on these sets has been a frequent source of trouble. The

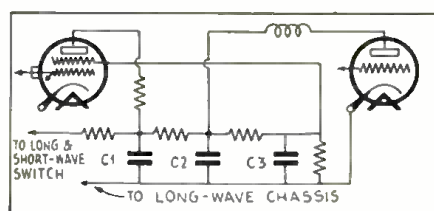


Fig. 6
Trouble is caused by condenser C1, C2 or C3. Marconi model 27 receiver.

complaint of the device working on the more powerful stations or the device being completely inoperative, has been drawn to our attention. In the latter case the trouble usually was remedied by dropping a little solder on the base of the pilot lamp which did not make good contact with the socket. In the former case the trouble usually lies in the type 44 R.F. and I.F. tubes in that they do not pass enough current in the plate circuit to operate the meter on weak signals. This may be remedied by trying several different tubes; but a more satisfactory remedy is to disconnect the meter from the I.F. circuit and operate it on only the R.F., as shown in Fig. 4. In most cases this change makes the set work better than did the original circuit.

WESTINGHOUSE MODEL 71

These models are constantly causing complaints of defective volume controls. It seems that the control becomes erratic in a short period of time. The trouble lies in the control itself and if replaced with a similar control will usually give out again in a few months. In one set we had to replace at least six controls until we finally changed to a single-type 50,000 ohm wire-wound control, such as the Electrad type RI 205 unit which we wired into the screen circuit as shown at A, in Fig. 5. We then completed the antenna circuit by inserting a 50,000 ohm fixed resistor in place of the volume control, as shown at B in the same figure. Since making this change we have had no further trouble.

KING 7-TUBE T.R.F. SCREEN-GRID SET

Low voltage on all tubes in several cases has been found due to a defective input A.F. transformer, there being a high-resistance short from the primary to the secondary windings. A Philco input transformer fits this set perfectly as a replacement unit.

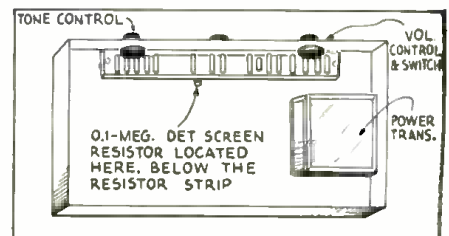


Fig. 7
Weak volume is caused by the .01-meg. resistor.

MARCONI MODEL 27 SHORT- AND LONG-WAVE

Low plate voltage, or an entire lack of it on the tubes in the converter of this model is usually due to one or more shorted .1-mf. bypass condensers, C1, C2, C3, in Fig. 6. A condenser with a high working voltage should be used as a replacement, as this is a frequent cause of trouble in these sets.

BOSCH MODEL 60

No pep, or intermittent reception, in these models has been traced to an open 1 meg. resistor in the detector screen circuit. As there is only a 7 V. screen reading on this tube, it is easy to overlook this defect. Replacing this resistor with one of 2 megohms greatly increases the pep and volume of these sets.

SONORA MODEL 30

Weak reception, when everything else seemingly checks O.K. is often due to an open 0.1-meg. detector screen resistor. As this unit will give little or no reading on most ohmmeters, it is very easy to overlook this. The resistor is located, as shown in Fig. 7, below the resistor strip and out of sight, and is very hard to find unless one knows this set very well.

STEWART-WARNER SHORT-WAVE CONVERTER

Little or no plate voltage on the two tubes in this converter are most probably due to a defective 2 mf. bypass condenser located directly below the gang condenser. A good replacement is the dry electrolytic tubular type which is compact and possesses a high peak voltage insuring against future breakdowns. Care must be exercised in installing these condensers as they are polarized and must be connected with the negative to ground; otherwise, they will act as rectifiers.

CHARLES WACKID,
157 Gloucester St.,
Ottawa, Ont., Can.

MAJESTIC MODELS 90 AND 100

One of the most frequent service calls in the writer's experience on Majestic models 90 and 100 receivers has been a shorted (or leaky) filter condenser on the detector plate supply. Several treatments are obvious—ranging from replacement of the entire condenser bank on down to the one indicated in Fig. 8, which recommends

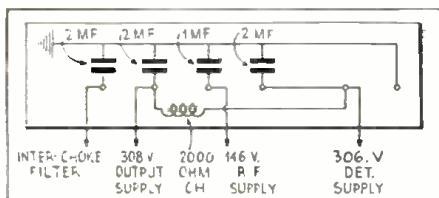


Fig. 8

Shorted or leaky filter condensers in Majestic 90. Many odd effects can be traced to the 2 mf. detector filtering condenser.

itself for three very good reasons: (1) it requires a minimum of time and hence can be performed "on location" without removing either speaker or chassis; (2) it requires no material because it is a substitution of the filter section which was originally on the R. F. system supply; and (3) it produces results on a par with any other method because there is no change whatsoever in hum level, power distribution, or overall performance.

The procedure is very simple. First clip the jumper on face of condenser bank between second and third lugs from the top which removes faulty condenser from the system. This will restore operation but quality and volume will both be insufficient. Next, clip wire to R.F. system (4th lug from top) and dead-end same. This causes no disturbance inasmuch as the R.F. system is sufficiently bypassed and filtered in the chassis proper (with apologies, of course, to Messrs. Grigsby-Grunow). In clipping R.F. feeder, leave enough wire on the condenser lug to swing upward and tie to detector system which completes the substitution—having introduced no extra material, yet restoring normal operation in every particular.

QUINCY GIBBON,
232 Main St.,
Greenville, Miss.

HUM IN A. K. 40

A very interesting, yet perplexing, problem in hum-hunting presented itself in an Atwater-Kent model 40. Upon arriving at the customer's home I turned on the set; only a slight hum could be heard. However, I was told that it would take about thirty minutes before the *real* hum would begin. Finally it started—with a low hum which gradually increased in strength until it reached a point where the music was almost drowned out. All the usual testing methods for abnormal hum were tried but the cause of the hum could not be located. The set and the speaker was then brought to our shop for a rigid test.

Close inspection finally disclosed that by pressing down one of the corners of the bakelite terminal plates, in the power pack, or by forcing up the opposite corner it was possible to regulate the amount of hum heard; in fact, by this method the hum could be caused to come and go at will. A bare stranded wire stub projecting about

(Continued on page 242)

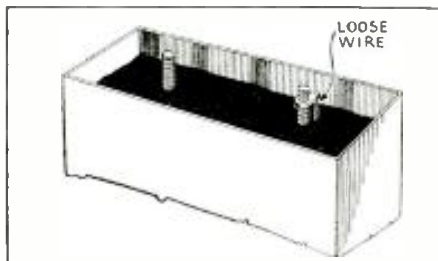


Fig. 9

Hum in A. K. 40 may be due to imperfect contact.

OPERATING NOTES

—save time and money. How many of them do you know? We are "in the market" for Operating Notes which have never before been published. Write for directions in preparing magazine articles; the data is gratis.

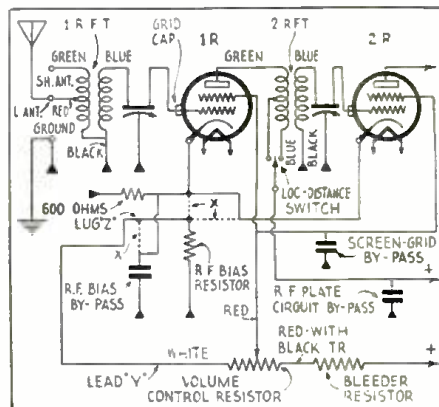


Fig. 10

Changes at X improve A. K. model 55 receiver.

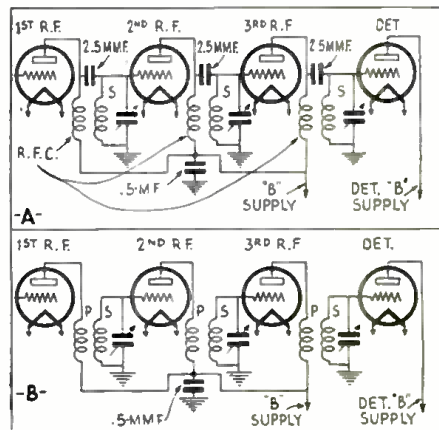


Fig. 11

Inductive R. F. coupling improves Brunswick sets.

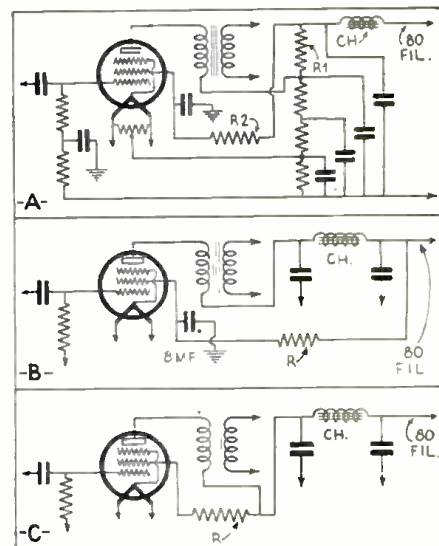


Fig. 12

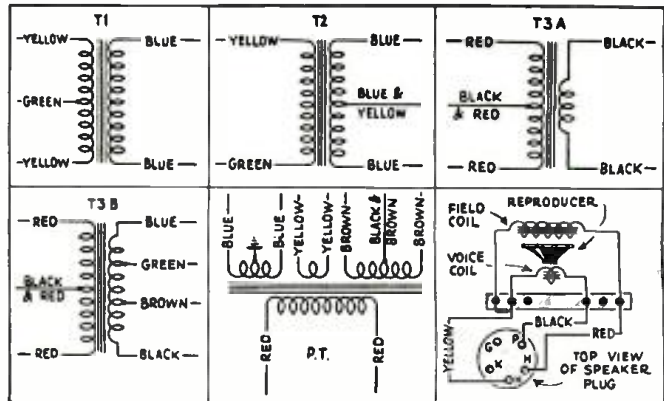
Power pentode circuits sometimes oscillate.

RCA VICTOR TYPE PG-63 "3-TUBE" PORTABLE SOUND AMPLIFIER SYSTEM

(Two models are available: type PB-100A1, for companion reproducer; and type PB-100B1, for remote reproducer having externally-excited field. Class B output; self-contained; provision for phonograph operation; moderate power output.)



Above, view of RCA type PG-63 amplifier; right, parts connections.



This equipment is designed for use as a sound reinforcing system in small auditoriums, theatres, churches or for outdoor gatherings. It is especially suitable for store window advertising use where the reproducer is placed outdoors while the person speaking remains in view through a window. The equipment is entirely A.C. operated. The maximum undistorted power output of 6 W. is sufficient to meet the average requirements of sound reinforcement in auditoriums with a capacity up to 600 seats.

Following are the characteristics and features of the equipment. Power supply, 110 V., 60 cycles; power consumption, 55 W.; maximum undistorted power output, 6 W.; overall gain, 75 db. The equipment is designed to supply one reproducer. As shown in the accompanying view, a compartment is provided (in the upper right-hand corner of the amplifier carrying case) for the microphone and its cable.

The diagram of the type PB-100A1 unit, which is the complete portable system, with removable reproducer (field resistance, 10,000 ohms) and microphone, is shown at A in the schematic circuit;

the diagram of the type PB-100B1 instrument, which is only the amplifier (and which requires a microphone, and a separately-excited reproducer), is shown at B in the same illustration.

Socket meter readings for both amplifiers, at a line potential of 115 V., A.C., and no signal input, are as follows:

Tube Type	Cath. Volts	S.-G. Volts	Fil. Volts	Plate Volts
V1	1.4	53	2.5	65
V2	13.5	2.5	240
V3	2.5	275

The controls consist of power control switch Sw. 1, speech clarifying switch Sw. 2, and the knob on volume control potentiometer R1.

Never apply power to these amplifiers unless all the tubes and the reproducer are in position. Looking at the front of the chassis, the tubes range from left to right in the numerical order indicated in the schematic circuit. It is necessary to vary the position of the microphone with respect to the reproducer in order to find a point at which acoustic feed back is eliminated.

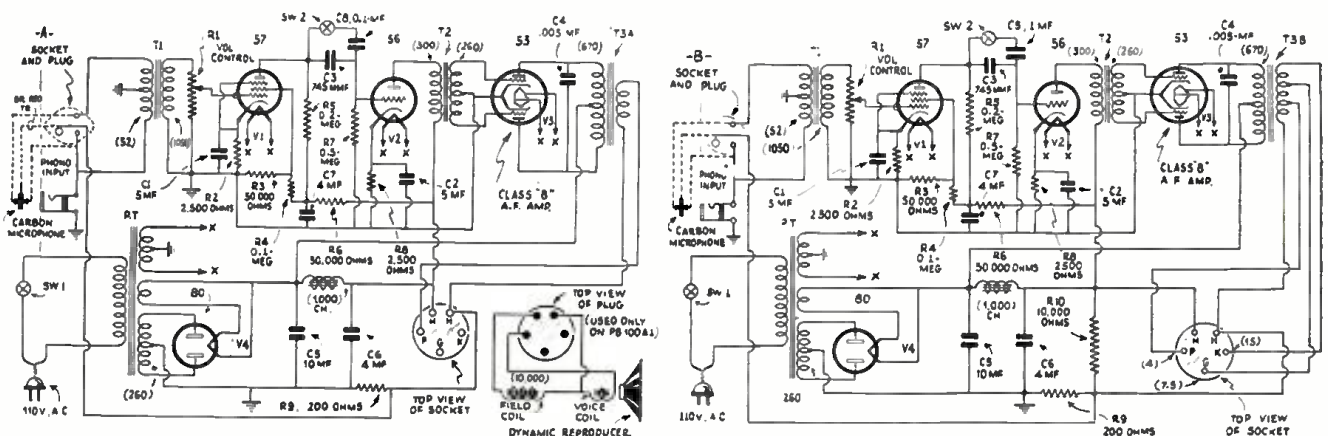
The amplifier chassis, the type PB-100B1 unit, is designed for use with a remote reproducer having a

voice-coil impedance of either 4, 7½ or 15 ohms. Equip field current with its own source of power.

For convenience in servicing by the resistance measurement method, the D.C. resistance values of the inductances in the diagrams are given in parentheses. The link circuit between the microphone and the input transformer has an impedance of 400 ohms. Resistor R1 in the diagrams is the usual volume control potentiometer, having a value of 10,000 ohms. The output impedance of T3A is 4 ohms.

The field coil of the dynamic reproducer used in the type PB-100A chassis functions as the bleeder resistance across the output of the power supply system. In the type PB-100B1 chassis the field coil is replaced by a porcelain-type 10,000 ohm resistor.

Both the PB-100A1 and the PB-100B1 units are made to operate with either a microphone, or a phonograph pickup. When a mike is used, it should not be located directly in front or at the rear of the reproducer as acoustic feedback will result. The two button mike is plugged into the three contact jack; the phono. pickup into the two contact jack.



Above, left, the circuit diagram of the type PB-100A1 amplifier, showing the plug connections for the attached dynamic speaker. The jacks for the mike and phono. pickup are at the left. The type PB-100B1 amplifier diagram appears at the right.

STROMBERG-CARLSON NOS. 48, 49, and 50, and 51 PHONO-RADIO SETS

(These chassis incorporate the following features: Meter tuning; A.V.C.; push-pull A.F. inter-stage; push-pull A.F. power stage; three stages of phono. A.F. amplification; class A power output; tone controls; antenna alignment; equalized phono. pickup circuit; and I.F. Circuits factory-aligned with an oscillograph.)

In this receiver have been incorporated a great number of technical improvements, which will be discussed for the benefit of those who wish to know the "why" of new circuits. The values of the components of this chassis are as follows:

Resistors R1, R3, R6, R9, R11, R20, 0.1-meg.; R2, R4, R16, R17, R23, 600 ohms; R5, 15,000 ohms; R7, R12, .25-meg.; R8, R31, 1. meg.; R10, 2 meg.; R13, R14, R24, 2,000 ohms; R15, 1,200 ohms; R18, 10,000 ohms; R19, 4,000 ohms; R21, 0.5-meg.; R22, 6,500 ohms; R25, 150 ohms; R26, 4,400 ohms; R27, 175 ohms; R28, 425 ohms; R29, 1.0 meg. Potentiometer; R30, 3 megs., variable; R32, 0.25-meg. potentiometer; R33, 400 ohm potentiometer.

Condensers C1, C2, .04-mf.; C3, 0.6-mf.; C4, C7, C8, C29, 0.3-mf.; C5, C10, C12, C13, C15, C18, C23, C27, .04-mf.; C6, .004-mf.; C9, 250 mmf.; C11, C22, 50 mmf.; C14, C24, .001-mf.; C16, C-17, .05-mf.; C19, C26, 1 mf.; C20, 0.2-mf.; C21, C30, C31, C35, 4 mf.; C24, C25, 0.5-mf.; C32&33, 6 mf.; C34, 5 mf.; C36, C37, .01-mf.

The operating voltages are measured at a line potential of 120 V. Note that the figures given are for the meter scales specified. Adjust the tuning dial to about 1000 kc.; set the S.T.C. switch in the "up" position so that the S.T.C. circuit is not functioning. The D.C. meter scale figures are shown in parentheses; only the filament voltages are read on an A.C. scale.

Tube Type	Cath. Volts	S.-G. Volts	Fil. Volts	Plate Volts
V1	4 (10)	95 (250)	2.5 (4)	200 (250)
V2	8 (10)	95 (250)	2.5 (4)	200 (250)
V3	25 (250)	—	2.5 (4)	95 (250)
V4	4 (10)	95 (250)	2.5 (4)	200 (250)
V5	8 (250)	—	2.5 (4)	170 (250)
V6	12 (250)	—	2.5 (4)	250 (250)
V7	12 (250)	—	2.5 (4)	250 (250)
V8	60 (250)	—	2.5 (4)	345 (750)
V9	60 (250)	—	2.5 (4)	345 (750)
V10	—	—	2.5 (4)	—
V11	—	—	5.0 (8)	380 V.

Three type 58 tubes are used as R.F., mixer and I.F. amplifiers. A 57 is used as S.T.C. One, type 56 tube is used as the oscillator, and the other two as the push-pull

first A.F. amplifiers. A type 55 tube is used as the demodulator. Two, type 2A3 tubes are used in the push-pull power output stage. The rectifier is a type 5Z3.

The resistor unit of the volume control potentiometer forms part of the load of the "audio" diode of the type 55 tube, and the A.F. voltage is applied to the triode section of this tube through the movable contact of this potentiometer. The potentiometer is double, the rear unit being used in the low-level tone compensation circuit, which increases the response to bass frequencies and high frequencies in correct amount as the volume level is reduced. The output of the triode section of the type 55 tube is fed through a transformer to the push-pull first A.F. stage. The "bass control" circuit apparatus is connected across the primary of this transformer. The "bass control" switch is provided to remove the bass compensation by opening this circuit when it is desired to secure extremely high levels of sound output for dancing, etc. The A.V.C. voltage is obtained from the other diode section of the type 55 tube, and is fed back to the first two tubes through a suitable filter.

From the push-pull first A.F. stage the signal is transformer-coupled to the push-pull power output stage. The "adjustable treble control" circuit apparatus is connected across the primary of this coupling transformer to enable the user to adjust the proportion of high frequencies in the reproduction as he desires. Used in conjunction with the "bass control" a wide range of variation in the response characteristics can be obtained.

The off-on switch, Sw.1, is turned to the "on" position by clockwise rotation. Further rotation in this direction gradually reduces the response to the high audio or treble frequencies. When in full clockwise position the minimum response to the "highs" is obtained. The full A.F. range is again obtained by turning the knob counter-clockwise until just before Sw.1 turns the set off.

The volume control is operated in the usual manner, turning clockwise for higher volume levels. Operated simultaneously with this volume control is the low-level tone compen-

sation circuit, which increases the relative response to low and high audio frequencies as the volume level is reduced. This gives the effect of "constant fidelity" to the ear.

When the phonograph switch and "bass control" knob is turned counter-clockwise from the normal position, the input of the A.F. system is switched to the phonograph circuits, in such a manner that the volume control knob is used for controlling the level of reproduction of phonograph recordings. When turned clockwise from the normal position, this control reduces the response at the low A.F. or bass frequencies. This position is used when it is desired to obtain extremely high sound levels from the receiver without over-loading.

The S.T.C. or "Q" switch is located at the rear of the chassis; the circuit is operating when the lever is in the "down" position.

The hum balancing potentiometer is located on the rear of the chassis, with means for adjusting by a screwdriver. It should be adjusted only when the volume control is at minimum and the "Q" switch is in the "up" position.

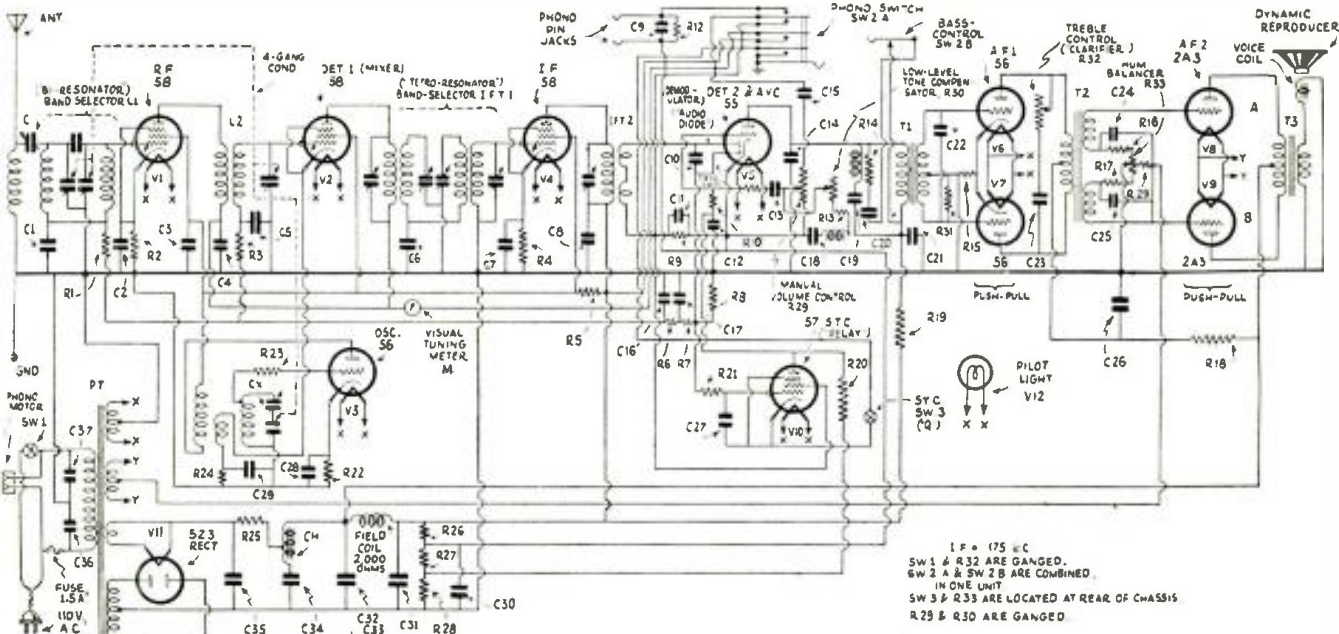
Do not align the R.F. and oscillator circuits unless absolutely necessary. The procedure is as follows:

To avoid apparent broadness of adjustment, due to the A.V.C. action, use a low value of service oscillator input. If broadcast station signals are used, moderately strong signals should swing the meter pointer about one-half the distance toward the "off" position.

Align the antenna, R.F. and oscillator trimmers at 1,400 kc. Next, turn the set dial to 600 kc., and adjust oscillator padding Cx only, for maximum background noise. Then, check the setting of the oscillator trimmer condenser at 1,400 kc., using the same dial setting as previously. The receiver should be turned on for about 15 minutes before aligning.

Since the I.F. circuits must be accurately aligned with an oscillograph, at the factory, to obtain correct flat-top resonance, it is not recommended that the Service Man align these circuits.

The power consumption is 160 W.



IF = 175 kc
 SW 1 & R32 ARE GANGED.
 SW 2 A & SW 2 B ARE COMBINED
 IN ONE UNIT
 SW 3 & R33 ARE LOCATED AT REAR OF CHASSIS
 R29 & R30 ARE GANGED

AN A. V. C. CIRCUIT FOR A. F. AMPLIFIERS

You all know about A.V.C. in R.F. amplifiers, now read about them in A.F. amplifiers. The circuit recommended by Mr. Metz may be used wherever a constant audio output is wanted.

HENRY I. METZ*

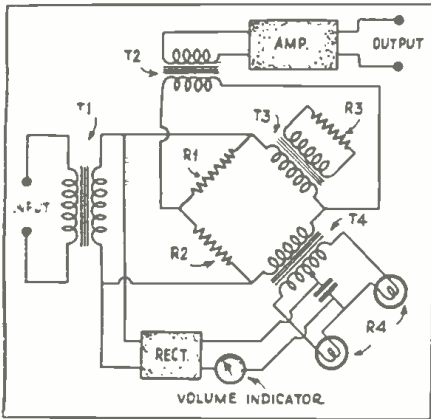


Fig. 1
The diagram of the A.V.C. bridge for amplifiers.

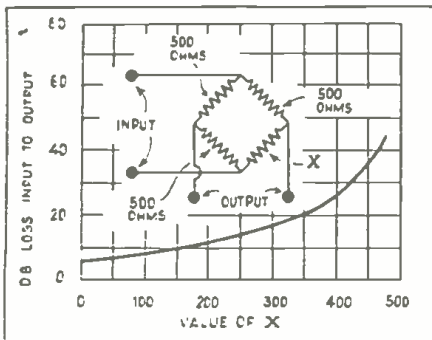


Fig. 2
The effect, on the attenuation, of varying resistor X.

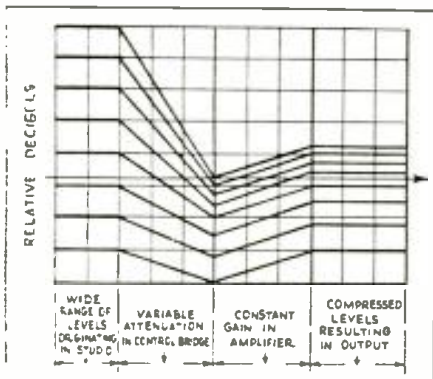


Fig. 3
Compressing the "peaks" levels the output.

The A.F. A.V.C.—

Although designed with particular reference to its use in transmitters, to maintain the audio output at an even level, the automatic volume control described in this article may be used in connection with home-recording set-ups, home and commercial talkies, and to maintain constant output from oscillators or devices delivering test signals. Additional services for this circuit will present themselves to the radio man.

AS THE art of broadcasting has progressed since its inception there has been a continual increase in the refinement of material and methods. One of the most remarkable of these noted particularly in well-organized broadcasting, is the unflinching uniformity of sound levels presented on successive programs. It is interesting to know how this is now accomplished and what changes might be made to *automatically* adjust these levels.

First, let us review the present-day layout for broadcast programs. The artist, the microphone, the amplifier, the microphone mixer, the master attenuator, the line amplifier, the telephone line, the station amplifier and radio transmitter together constitute the fundamentals of the broadcasting end of radio entertainment. The receiving end consists of receiver, amplifier, and loudspeaker. Throughout the program, if it is properly handled, there are but two points at which volume is controlled; at the studio microphone mixer or master attenuator and at the radio receiver. Except for fading of the received signal, and the occasional requirement of low volume there is no need for controlling the volume at the radio receiver. Furthermore, recent advances in receiver design have provided automatic control of receiver volume to compensate for the effects of fading. These designs, in general, operate on carrier strength such that a strong carrier signal creates a change in certain bias voltages to reduce the gain in the radio amplifier. The use of these automatic volume controls on receivers places the full responsibility of program level monitoring on the studio operator.

The Need for Gain Control

It is desirable in broadcasting to maintain fixed gain and loss on all parts of the system so that the full effect of musical variations is conveyed to the listener, but such conditions are not permissible because of limitations in equipment, lines, etc. For example, the actual level occurring in a studio

during a broadcast may vary from 0 db. to about 100 db., or a total range of at least 100 db. The range of level permitted on present "ordinary" broadcast lines is 30 db., being limited in minimum level by line noises and cross-talk from adjacent circuits and in maximum level by overloading of amplifier tubes in line repeaters and by induction of cross-talk into other circuits. To control a broadcast then it is necessary either to provide an operator to adjust the net gain of the microphone system to accommodate the levels occurring in the studio, or to restrict the artist or symphony to a generation of a given range of levels. Although this latter method has been attempted it is almost general and universal practice to manually adjust the gain of the system.

This adjustment of net gain is done by a "control operator" who has rehearsed the program and is in full view of the operations in the studio. He attempts to maintain an average level of a predetermined value by introducing more loss to the loud passages and less loss to the weaker passages. These changes must be inserted in a manner so as to not destroy the effects of musical variations intended by the artist.

The control operator is given both visual and aural indications of the program level being transmitted. The aural device, the loudspeaker, is used mostly to detect discontinuity and to assist in mixing microphones to obtain correct blending, but the visual device, the volume indicator is used exclusively for level observation. This volume indicator is a meter device in which the scale deflection is proportional to the volume of the signal which is being transmitted to the telephone lines or radio station. By observing the deflections of this meter the operator is able to maintain an average level suitable for transmission with minimum distortion and consistent average loudness in the listener's ear.

To replace this studio operator with an automatic device is physically possible except for the feature of anticipation. It was mentioned above that the operator usually rehearses the program in advance and knows the relative gain

(Continued on page 244)

*Radio Division, Westinghouse Elec. & Mfg. Co.

READERS' DEPARTMENT

A department in which the reader may convey his thoughts to other readers. Included in this department are letters, kinks, short cuts, and experiments. Send in your ideas.

INCORRECT METER READINGS

Editor, RADIO-CRAFT:

I note question No. 192 on page 676 of the May, 1933 issue. If Mr. White's meter has an iron case, that is probably the cause of the incorrect readings. To check this condition, remove the case from the meter, connect up the instrument with a suitable source of current to show about $\frac{3}{4}$ full-scale deflection. Then slowly bring the iron case over the instrument. The needle will fall back 20 to 30 per cent. Demagnetization does not seem to help. It needs either a brass or bakelite case.

I have three high-priced Jewell meters in this condition. Does anyone know a remedy?

THOS. C. WILLIAMS,
Baltimore, Md.

ANENT THE WESTINGHOUSE VEST-POCKET SET

Editor, RADIO-CRAFT:

I have decided to write to you and detail some of the difficulties I have experienced in constructing the vest-pocket radio described in the May issue. Also, I am somewhat astonished at the reception afforded by a set of this character and desire an explanation, as I am sure the designer must have had somewhat similar results with the early models of the set.

My first act of course in constructing this set was to obtain the tubes, an accomplishment which entitles me to a rating with Thurston, or worse. Obstacles were numerous; correspondence with the Westinghouse people disclosed that the designing (Huh? Editor) engineer had been confined in a generously upholstered room in an exclusive institution, and his supply of tubes had inadvertently been mistaken for capsules of evaporated fire water by the janitor who swallowed the entire 8,000 manufactured before the blueprint wore out. Of course I had to construct my own tubes after that, a really simple task compared to those which were to follow.

I experienced the greatest difficulty in securing the 6201 mf. condenser in the antenna circuit, but finally solved the problem by folding together, into a compact bundle 38x48x60 ins. long, 120 sheets of 28 gauge galvanized roofing which gave me a capacity of 6201.35 mf. I thought this was close enough for a start. The 55 mf. condenser I made of $\frac{1}{2}$ -mile of tinfoil, 2 ins. wide.

The coil, L3, was wound as directed but would not work until I reversed the

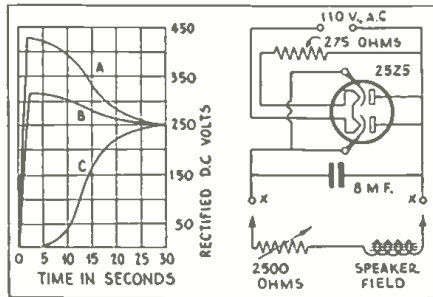


Fig. 1
Power supply for D. C. dynamic reproducers

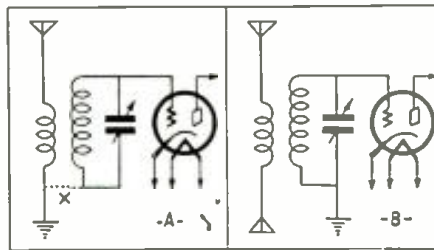


Fig. 2
Connections for a counterpoise "antenna."

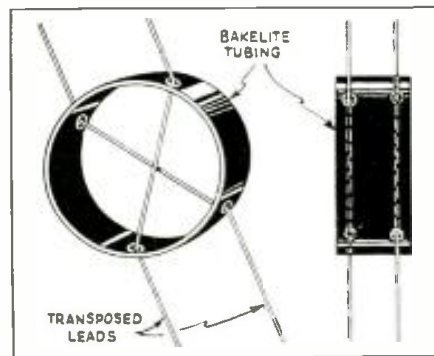


Fig. 3
A neat, simple and light transposition insulator.

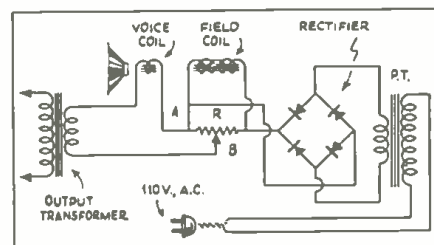


Fig. 4
Resistor R, introduces a hum-bucking voltage into the reproducer field coil.

leads. *The results were astonishing!* The first sound as I turned the set on after connecting it to our 110 V., 60 cycle D.C. line was, "Vas you dere Sharlie?" It has been repeating this statement every three minutes since and I am wondering if I made some error in

construction. Perhaps it was a mistake to build it after all, as I can't get it into my vest pocket, or even into the house. When I turned the set on, it was 6:30 A. M. Saturday night and I figured that probably the set was working on the 201st harmonic on its 420th trip around the world.

Can you suggest some alteration in the circuit to make it say "Get off the air" for a change? My other radio says "Vas you dere, Sharlie?" well enough. Any help you may give me will be promptly returned, after use, in as good condition as received.

C. W. SNYDER,
R. M. & C. W. Snyder Sporting and
Electrical Supplies,

Elkland, Penna.

(Can any of our readers suggest a remedy? This, of course, is a mechanical detail. Since the set works perfectly, it is quite evident that a very serious error has been made.—*Technical Editor.*)

CONVERTING D. C. DYNAMICS FOR A. C.

Editor, RADIO-CRAFT:

Here is a wrinkle that will be of great use to public address enthusiasts and others who use A.C. dynamic reproducers.

As shown in the diagram, Fig. 1. a D.C. speaker can easily be converted to A.C. at the cost of a 275-ohm, 25 W. resistor, a type 25Z5 tube, an 8 mf. condenser (rated at twice the line voltage), and a 2,500 ohm, 10 W. variable resistor. Connect the 25Z5 as a half-wave rectifier, with the 275 ohm resistor in series with the heater across the 110 V. A.C. line. Then connect the speaker field in series with the 2,500 ohm resistor across the output, at points X. If the D.C. resistance of the speaker field is high (5000 ohms or more), the 2,500 ohm fixed resistor may be reduced in value or entirely eliminated. This is an easy and economical way of replacing the burnt out rectifiers on RCA type 106 A.C. dynamic reproducers.

If it is desirable to energize two or more speakers of 2,500 ohms or more field resistance, I would recommend that they be connected in parallel; otherwise, they may be hooked up in series. The variable resistor can be adjusted to deliver whatever current is desired. Under normal operating conditions the circuit may work with the 2,500 variable resistor in the off

(Continued on page 249)

RADIO-CRAFT'S INFORMATION BUREAU

SPECIAL NOTICE TO CORRESPONDENTS: Ask as many questions as you like, but please observe these rules:

Furnish sufficient information, and draw a careful diagram when needed, to explain your meaning; use only one side of the paper. List each question.
Those questions which are found to represent the greatest general interest will be published here, to the extent that space permits. At least five weeks must elapse between the receipt of a question

and the appearance of its answer here.
Replies, magazines, etc., cannot be sent C. O. D.
Inquiries can be answered by mail only when accompanied by 25 cents (stamps) for each separate question.
Other inquiries should be marked "For Publication," to avoid misunderstanding.

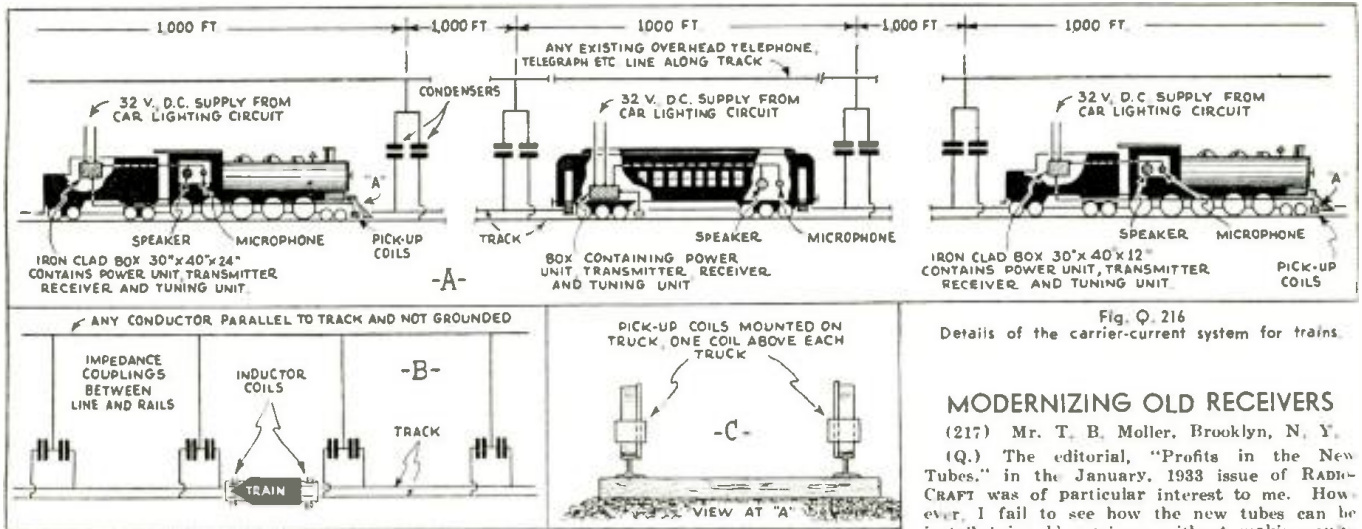


Fig. Q. 216
Details of the carrier-current system for trains.

RAILROAD 65-KC. TELEPHONY

(216) Mr. Hubert Brown, Oakland, Calif.

(Q.) Recent newspaper accounts have described an inter-communication system which operates between the cab and caboose of a train. How is this system, which seems to operate on "radio" principles, "worked"? What is the frequency or wavelength used?

(A.) It is probable that the system to which our inquirer makes reference is the carrier-current telephone system illustrated in Fig. Q. 216. The following information is furnished through courtesy of the General Electric Co.

A three-tube transmitter and five-tube receiver are employed. Automatic volume control of the loudspeaker compensates for varying distance of transmission. A transmitting frequency of the order of 65 kc. is used. The power requirements are 160 W. at each end of the train, with an output of 5 W. to the inductor coils. Less than a watt is required for satisfactory operation, however. The train control or headlight generator can supply the current for the equipment on the locomotive; and a battery and axle-driven generator the power for the caboose set.

Simplex operation, employing minimum equipment, is used, with the sets running continuously for reception of signals. It is then only necessary for either the conductor or engine man to speak into his transmitter to establish contact with the other end of the train.

The conductor in the caboose of a very long freight train can carry on a conversation with the engine man in the cab; conductors, or enginemen, of nearby trains can communicate with each other; and reports or instructions can be exchanged between trains and wayside stations. Work done by General Electric engineers has resulted in a new type of communication system—not radio. Superposed carrier current, or direct telephony in principle. Ear-phones are not required; with 5 W. or less input into the inductor coils, loudspeaker reception of ample volume to overcome train noises is received over a rail distance of 5 miles or more.

The rails are used as the medium for the transmission and pick-up of the signals, which are put into and taken out of the rails by inductor coils suspended from the caboose and locomotive at minimum clearance distance above the rails. These inductor coils are directly connected to the transmitting and receiving equipments.

The system consists of wave propagation on an exclusive channel which follows the rail. In some respects the method resembles carrier current communication, which is used extensively in telephony and over power lines, but differs in certain essential respects. Carrier current, for instance, is a natural wave propagation over a pair of wires, and the wavelength of the propagation is determined in accordance with the natural inductance and capacitance of the wires. In the new system one of the wires is replaced by the rail itself, whereas the other wire is any convenient conductor along the track.

The wave propagation in the double circuit of the rail and wire does not depend entirely upon the natural capacity. Instead, the principal portion of the electrostatic energy of the wave appears in a series of loading condensers connected between the rail and the wire. The result of this arrangement is that the rail is in every point carrying the current of the traveling wave, and therefore it is possible at any point to pick up energy from the traveling wave by induction in the inductor coil.

Although the rail itself is very inefficient for wave propagation, since the rails are not effectively insulated either from each other or the ground, it has been found that the wave propagation between the wire and the rail is very efficient because of the high quality of the electrostatic medium that carries the wave.

The loading condensers are spaced approximately 1000 ft. apart, but the distances vary with local conditions. A separate condenser is used for each rail, so arranged as not to shunt the signal track circuit. Provision is also made for the protection of automatic block signal and other circuits. There is no interference with operation of such signals or adjacent telegraph and telephone lines. Thus advantage may be taken of wires normally used for automatic block signal, telephone, telegraph, power or other circuits already paralleling the tracks. The receiver cannot be used for broadcast reception; and the transmitter causes no interference with radio receivers, however near the tracks they may be.

The general arrangement of the transmitter and receiver units is shown at A in Fig. Q. 216. The schematic circuit of the impedance couplings and the inductor coils is shown at B in the figure. At C are shown two of the four inductor coils of a car installation; each coil hangs in a frame suspended over one track or the other.

MODERNIZING OLD RECEIVERS

(217) Mr. T. B. Moller, Brooklyn, N. Y.

(Q.) The editorial, "Profits in the New Tubes," in the January, 1933 issue of RADIO-CRAFT was of particular interest to me. However, I fail to see how the new tubes can be installed in old receivers without making quite extensive changes, and replacement of the power transformer. To cite a specific example: a T.R.F. set now employing three type 24 R.F. tubes, a type 24 detector, a type 27 A.F. amplifier, two type 45 tubes in push-pull and a type 80 rectifier has a power pack giving 90 ma. at 350 V., according to the manufacturer's rating. Now, replacing the three 24's with type 58's causes an increase in drain of 18.6 ma., which means overloading the power transformer 20%. I don't think any transformer can stand this continuously. And as for replacing the 80 with an 82, the RCA manual states: "The 82 is not interchangeable with any other rectifier type." Is this not true?

(A.) A power transformer of reasonably good design will stand a load increase of 18.6 ma.; if your transformer comes within this rating it will not be necessary to replace it. The procedure in installing the type 82 tube has been described in past issues of RADIO-CRAFT merely connect a .75-ohm resistor in one filament leg.

A LONG- AND BROADCAST-WAVE BAND-SELECTOR UNIT

(218) Mr. Morris Block, Brooklyn, N. Y.

(Q.) Although several types of band-selectors have been shown in past issues of RADIO-CRAFT, the writer is a bit puzzled by advertisements in certain English magazines which state that the band-selector they are sponsoring may be used either on the broadcast band, or on their higher, 800 to 2,000 meter band. A switch is used. Do you know how this circuit is arranged?

(A.) The instrument to which our inquirer refers is a British General product, the circuit of which is shown in Fig. Q.218.

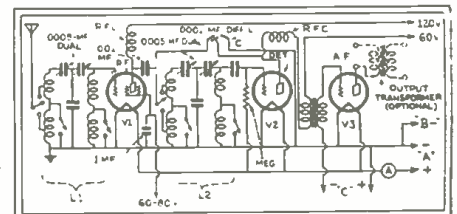


Fig. Q. 218
A switch facilitates reception on two wave bands.

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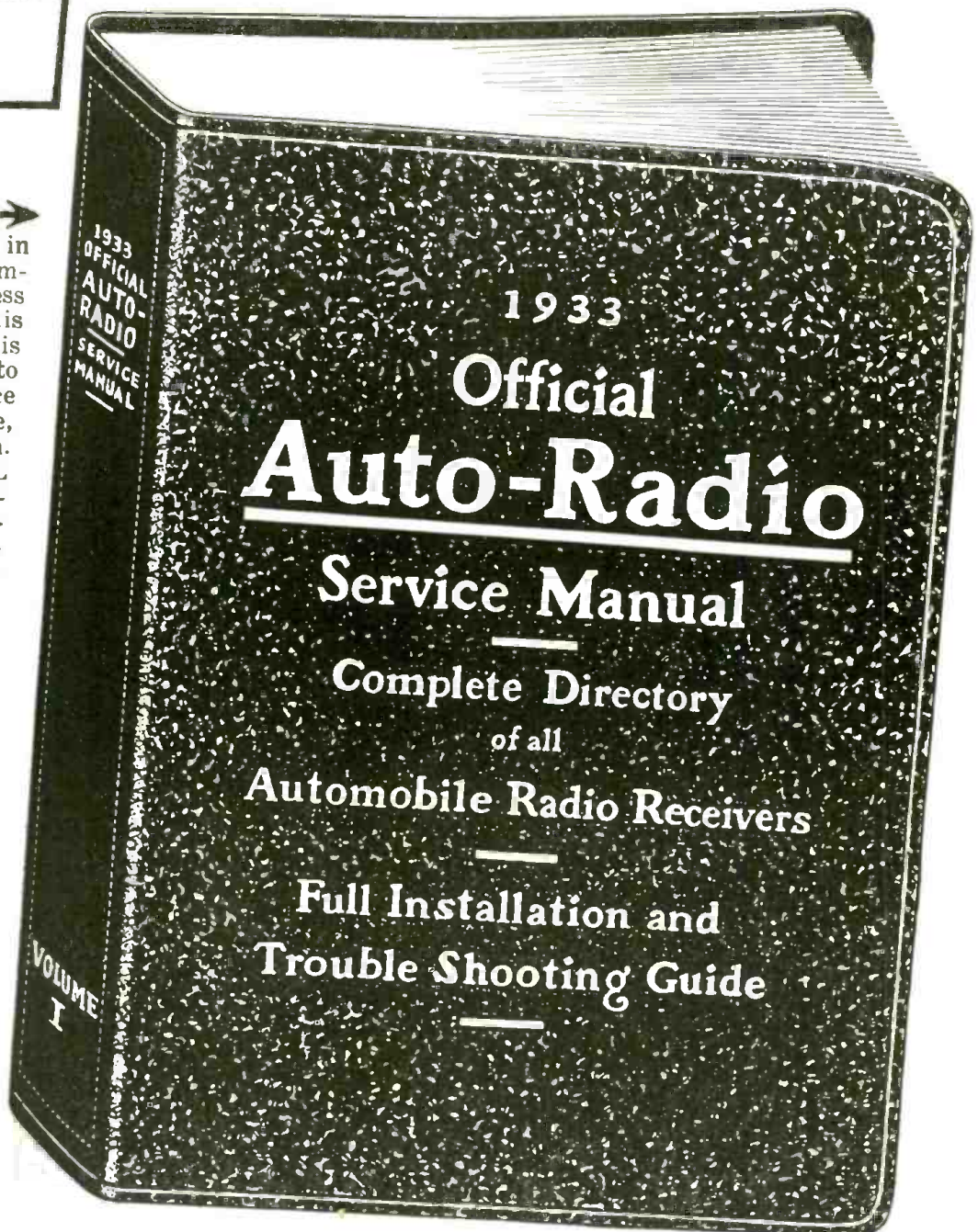
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This band-selector may be connected into the receiver's input or inter-stage circuits to obtain the selectivity of which band-selector systems are capable. The complete instrument is illustrated in Fig. Q.218. The ganged tuning condensers in the diagram are not a part of the band-selector unit, which is known as the British General Band-Pass 10 kc. Tuning Unit. Either or both units (Aerial Model L1, or Anode Model L2) may be used in a circuit.

This band-selector incorporates switches which make available dual ranges of 230 to 550 meters and 800 to 2,000 meters.

The device is manufactured by an English concern, the British General Manufacturing Co., Ltd.

INDUCTANCE TABLE—AUTOMOTIVE-SET SENSITIVITY

(219) Mr. Reginald Burns, Hollywood, Calif.

(Q. 1.) Is there available in tabular form any material which would make it convenient to determine requisite tuning capacities for a given inductance, or vice versa, to tune over a particular wavelength band?

(A. 1.) The only table available at the present time particularly concerns figures relating to honeycomb-type inductances; the table is Fig. Q. 219. However, this material is generally applicable in connection with other types of coils, allowance being made for the difference in distributed inductance and capacity, as determined by the individual coil construction.

(This table was prepared especially for the Patent Electric Company and relates to their "duolateral" type of coil winding, a design which results in a particularly low-loss coil; the advantages of this construction become especially evident at the longer wavelengths, such as 10,000 to 20,000 meters.)

To obtain maximum wavelength with a given coil and condenser, lay a ruler from the point on the chart occupied by the coil value in the inductance scale, to the upper limit of the condenser on the capacity scale. The ruler will cross the middle of the scale at the required wavelength. Example: using a 100 turn honeycomb coil and a 500 mmf. variable condenser the ruler crosses the line at 990 meters.

Minimum wavelength is obtained in a similar manner, except that the minimum capacity of the condenser should be increased by adding to it the distributed capacity of the coil. This capacity (in mmf.) is given by the small figure directly under the coil numbers. Example: using the same coil and condenser, we add 24 (the distributed capacity of the coil, in mmf.) to 75 (the allowance usually necessary to make up for the capacity of the circuit wiring, and including the minimum capacity of the condenser), obtaining 99 mmf.; and according to the straight-edge we obtain a wavelength figure of 440 meters. (With smaller condensers, just consider the minimum of the condenser without allowing for any accessories.)

The following tabulation of wavelength ranges for standard honeycomb coils shunted by either a 350 or 500 mmf. variable condenser is available. It is a very handy reference. The minimum capacity given for both condensers includes the parasitic capacity of the wiring of the circuit.

No. of Turns	Wavelength	Range
	50-350	
25	80-220	100-260
50	160-430	200-510
75	240-620	290-750
100	310-830	380-990
150	480-1360	590-1500
200	650-1690	780-2000
249	810-2150	990-2700
300	980-2600	1200-3100
400	1300-3500	1600-4120
500	1700-4400	2000-5300
600	2000-5200	2400-6200
750	2500-6500	3020-7800
1000	3400-8800	4100-11,500
1250	4400-10,400	5300-13,500
1500	6400-14,000	6500-16,500

(Q. 2.) What is the sensitivity of an automotive receiver, such as the Majestic model 116? The I.F. is 116 kc.

(A. 2.) The sensitivity of this set is approximately 10 microvolts-per-meter. Some receivers of this general type have a sensitivity of about 1.0 to 0.1-microvolt-per-meter.

THE "GRAND ISLAND" MULTI-VIBRATOR

(220) Mr. Albert Woolsey, Kingston, N. Y.

(Q.) In the February and March, 1932

issues of RADIO-CRAFT appeared an article entitled, "Grand Island' Monitor Station." The article in question discussed a "multi-vibrator." Do you have any more information available on the design and use of this instrument? Although described as a commercial product, it has occurred to the writer that the idea could be adapted to home-built equipment.

(A.) The construction of a multi-vibrator is quite an involved project. Consequently, we expect to be able to present in a forthcoming issue of RADIO-CRAFT a good article on how to build one of these most interesting and useful laboratory instruments. Meanwhile, we are glad to be able to present the following data which was originally furnished in connection with the design of the Grand Island monitor station, but which, for lack of space, was not previously published.

The Primary Standard and Its Secondary Units

There are two standards at the Grand Island station; one is referred to as the "primary standard." The secondary standard and its associated equipment is divided into five distinct parts: first, the standard itself; second, a series of multi-vibrators controlled by the standard; third, an audio oscillator; fourth, a beat indicator; and, fifth, a heterodyne oscillator. The whole combination is mounted in a

temperature-controlled steel rack.

The primary standard itself is a 30-ke. quartz crystal, mounted in a temperature-controlled chamber, together with its oscillating circuit. The temperature gradient is as follows: the rack is controlled to approximately 2 degrees, the outside crystal chamber is controlled to 0.2-degree, and the crystal itself is held to approximately .05-degree, all Centigrade.

The temperature coefficient of frequency of the crystal is approximately eight parts per million per degree change of temperature, so that the usual frequency variation of the crystal, due to temperature change, is less than one part in one million. There are four multivibrators, 90kc., 10 kc., 1 kc., and 0.1 kc., respectively.

The control is as follows: the 90-ke. frequency locks in with the 3rd harmonic frequency of the crystal; the 3rd harmonic of the 10 locks in with the crystal's fundamental; the tenth harmonic of the 7 locks in with the fundamental of the 10, and the 10th harmonic of the 100 locks in with the 1. Thus, each multivibrator is controlled, either directly or indirectly by the crystal.

The audio oscillator is of the beat-frequency type with a fundamental frequency ranging

(Continued on page 247)

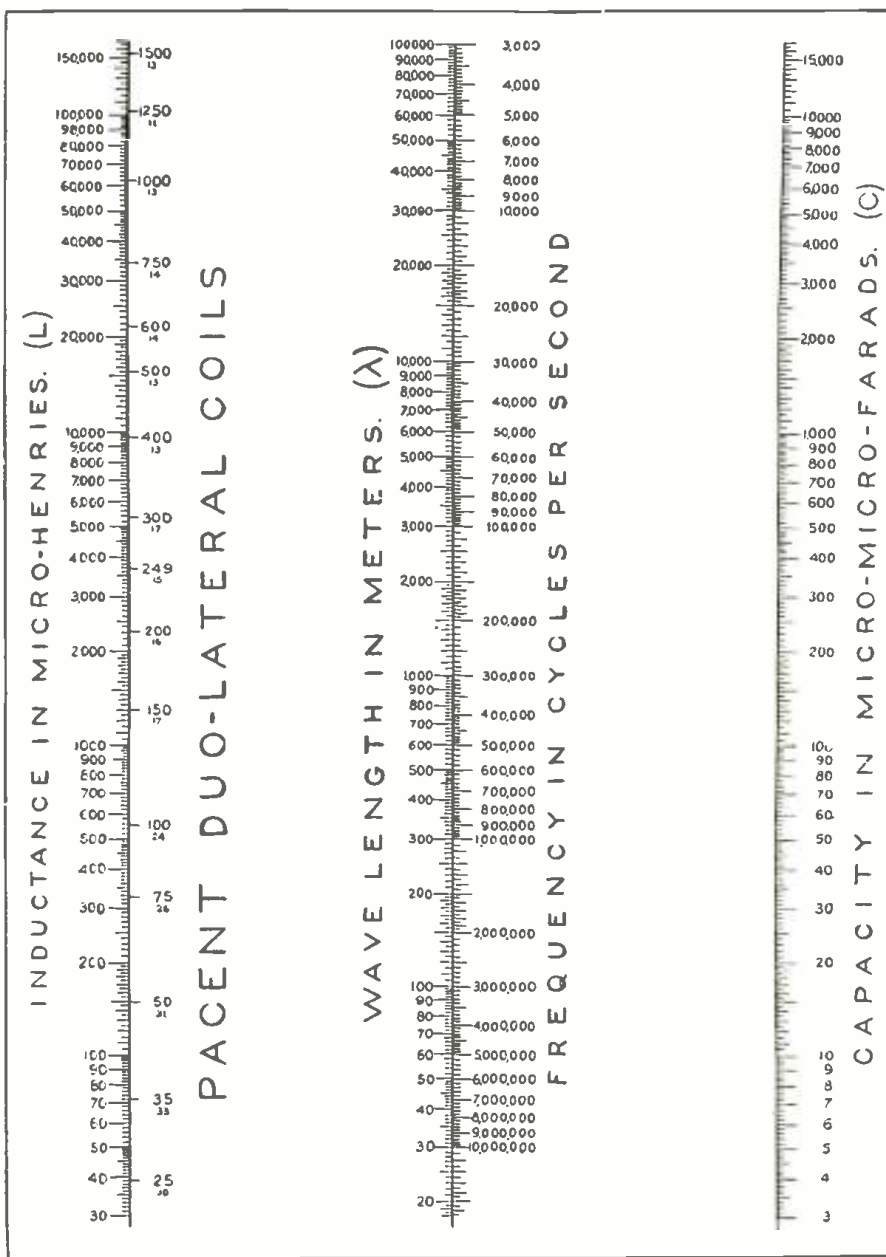


Fig. Q. 219

The correct condenser for a coil of given inductance can be read from this chart.

How to "Cash In" During
RADIO PROGRESS
WEEK
OCTOBER 2 to 7

On page 141 of the September issue of RADIO-CRAFT we announced the "New Deal in the Radio Industry," as a result of concentrated effort on the part of the radio industry under the guidance of the Radio Manufacturers Association during a Rebuild Radio Prosperity Campaign; this "battle" against existing business conditions is scheduled to reach its peak during a week of spectacular broadcasting—Oct. 2 to 7. In order that the entire radio industry, from manufacturer to Service Man may take full advantage of this opportunity, we publish the following recommendations from R. M. A. Campaign Headquarters. The material has been especially prepared for the use of: (a), radio dealers and Service Men, and; (b), local campaign committees.

Radio Dealers and Service Men

1. Study the campaign plan and figure out how you can take advantage of it to increase your sales this fall.

2. Get in touch with the distributors you buy from and find out what they are going to do in this campaign and how your manufacturers are tying into it. See what dealer cooperation they are planning and how you can benefit.

3. Find out if a local committee has been set up in your town to organize a local campaign to Rebuild Radio Prosperity. Go see the chairman. See what local plans are brewing and how you can cash in on them. If there is to be no local committee in your town, tie in with the local committee at the nearest radio distributing point. They will serve your town also.

4. Hold a meeting of your salesmen, Service Men, bookkeeper—all your people—and tell them about this coming campaign to bring back prosperity to everybody in the radio business. Get them enthusiastic about Radio Progress Week and ready to work together to go over the top in the September Sales Drive. Offer a commission to non-selling employees on sales from leads they bring in. Offer some prizes for the best selling idea, the best display in your window, the best advertisement, the biggest sale, etc. Get them working for quick deliveries, lower costs and better service to boost your profits and their pay.

Get Yourself Ready for Selling

5. Put on your hat and walk up the street. Then stroll past your store and look it over. Is it working for you or against you? Ask yourself—

(a) Is the store front dingy? Will a new coat of paint help?

(b) Does your sign reach out for attention?

(c) Are your window displays interesting? Are the backgrounds good?

(d) Does your store interior appear inviting as you look in?

(e) Study your store arrangement, equipment and decoration—is it creating a good impression or a bad one?

(f) Ask a few good friends—men and women—to visit your store and telephone for information—and give you their frank impressions.

Make a list of the ideas that come out of this check-up, talk them over with your staff and take action before the September Sales Drive begins.

6. Get your prospect lists in shape early in August so you will know just where you want to direct your selling effort.

(a) Make an up-to-date list of worth while customers on your books. Those who purchased good sets from you more than four years ago and those who bought cheap models are your best prospects for modern receivers. The rest are prospects for new tubes and reconditioning.

(b) Revise your list of unsold prospects by asking your old customers for names of friends who might be interested. Offer them a small commission for new set sales made with the use of their names.

(c) Go to the leading automobile dealers and get from them lists of those to whom they have

(Continued on page 239)

AGAIN OBSOLESCENCE TAKES IT ON THE CHIN!

Announcing
A New WESTON TUBE CHECKER



NO LONGER is there any need for worrying about tube checker obsolescence. Again Weston has supplied the solution; providing a design with 18 sockets, 11 of which are wired to test all of the present tubes, some 90 in number. The remaining 7 sockets are spares, and can be quickly wired in to test some fifty-odd additional tubes, when and if these tubes appear on the market.

Weston Model 674 Tube Checker is an "English Reading" tester—and is outstanding in its simplicity of operation. All reference to or knowledge of tube characteristics is avoided. The operator simply follows the few concise steps indicated on the tube limit chart and correct indication is obtained in minimum time.

Moreover, by means of the cathode leakage button the testing of all cathode type tubes for leakage between cathode and heater is readily accomplished—and in the same socket used for regular tests on the tube. Independent checking of the second plate in all double plate tubes also is accomplished simply by throwing a toggle switch.

And there are many more outstanding features—a few of them listed on the right. They will explain why Weston Model 674 is the outstanding value in tube checkers today. The coupon will bring descriptive circular RA. Weston Electrical Instrument Corp., 599 Frelinghuysen Ave., Newark, N. J.

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4. Lowest obsolescence factor.
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6. Tests cathode leakage by simply pushing a button.
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9. No adapters required.



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Complete Stock Ready for Immediate Shipment

Order from this ad with order, balance C. O. D. All prices are F. O. B. FACTORY, Newark. Shipments go forward express or parcel post. No order for less than \$3.00 accepted.

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UX-201A	5.0	Detector Amplifier.....	\$.30
UY-221	1.5	Amplifier (A-C Filament).....	.30
UY-222	2.5	Detector Amplifier (A-C Heater).....	.30
UX-171	5.0	Power Amplifier 1/2 amp.....	.30
UX-171A	5.0	Power Amplifier 1/4 amp.....	.30
UX-240	5.0	Voltage amplifier detector.....	.40
UX-120	3.3	Power Amplifier.....	.40
UX-199	3.3	Detector amplifier.....	.40
UV-199	3.3	Detector amplifier short prong.....	.40
UV-199	3.3	With a standard 201A filament.....	.40
UX-112A	5.0	Amplifier detector 1/4 amp.....	.40
UX-112	5.0	Amplifier detector 1/2 amp.....	.40
UX-200A	5.0	Detector.....	.40
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UY-215	2.5	Power amplifier (A-C Filament).....	.40
UX-201B	5.0	Detector amplifier 1/2 amp.....	.40
UY-216	2.5	Dual Grid Power Amplifier (A-C Fil.).....	.60
UY-247	2.5	Power amplifier pentode (A-C Fil.).....	.60
UY-257	2.5	Power amplifier pentode (D-C Fil.).....	.85
WD-11	1.1	Detector amplifier.....	.60
WD-12	1.1	Detector amplifier.....	.60
UX-210	2.0	Detector amplifier.....	.60
UX-231	2.0	Power amplifier.....	.60
UX-232	2.0	Screen Grid radio frequency amplifier.....	.60
UY-233	2.0	Power amplifier pentode.....	.85
UX-234	2.0	Super-control R-F amplifier pentode.....	.85
UY-235	2.5	Super-control R-F Amp. (A-C Heater).....	.60
UY-236	1.3	Screen-Grid R-F Amp. (A-C Heater).....	.85
UY-237	3.3	Detector amplifier (A-C Heater).....	.85
UY-238	3.3	Power amplifier pentode (A-C Heater).....	.85
UY-239	3.3	R-F amplifier pentode (A-C Heater).....	.85
UY-551	2.5	Super-control R-F Amp. (A-C Heater).....	.60
2A3	2.5	Power amplifier triode (A-C Heater).....	1.10
2A7	2.5	Pentagrid converter (A-C Heater).....	1.10
2B7	2.5	Duplex-Diode Pentode (A-C Heater).....	1.10
6A7	6.3	Pentagrid Converter (A-C Heater).....	1.10
6B7	6.3	Duplex-Diode Pentode (A-C Heater).....	1.10
2A5	2.5	Power amplifier pentode (A-C Heater).....	.85
41	3.3	Power amplifier pentode (A-C Heater).....	.60
42	4.3	Power amplifier pentode (A-C Heater).....	.60
43	25.0	Power amplifier pentode (A-C Heater).....	.85
44	6.3	R-F amplifier pentode (A-C Heater).....	.85
48	39.0	Power amplifier Tetrode (D-C Heater).....	1.10
49	2.0	Dual Grid power amplifier.....	.85
55	2.5	Duplex-Diode Triode (A-C Heater).....	.60
56	2.5	Super-Trio de amplifier (A-C Heater).....	.60
57	2.5	Triode grid detector Amp. (A-C Heater).....	.60
58	2.5	Triple grid R-F amplifier (A-C Heater).....	.60
59	2.5	Triple grid power Amp. (A-C Heater).....	.60
75	4.3	Duplex-Diode Triode (A-C Heater).....	.85
77	4.3	Triple-grid detector (A-C Heater).....	.85
78	4.3	Triple-grid R-F amp. (A-C Heater).....	.85
79	4.3	Class B Twin amplifier (A-C Heater).....	.85
80	4.3	Duplex-Diode Triode (A-C Heater).....	.60
89	4.3	Triple grid power Amp. (A-C Heater).....	.60
257	2.5	Power amplifier pentode (A-C Heater).....	.85
UX-210	2.5	Power amplifier oscillator (A-C Fil.).....	1.10
UX-222	1.3	Screen grid radio frequency amplifier.....	1.10
UX-227A	7.5	Power amplifier (A-C Filament).....	1.10
UX-227B	2.5	Detector amplifier (quick heater).....	.60
UX-226A	2.5	Screen grid R-F amplifier (quick heater).....	.60
UY-182	3.0	Sparton type power Amp. (A-C Fil.).....	.85
UY-183	3.0	Sparton type power Amp. (A-C Fil.).....	.85
UY-184	3.0	Sparton type detector Amp. (A-C Heater).....	.85
UY-556	7.5	Sparton type power Amp. (A-C Fil.).....	2.10
UY-686	1.0	Spurt in type amplifier.....	.85
UX-401	1.0	Kellace type triode (A-C Heater).....	1.50
UX-403	3.0	Kellace type output triode (A-C Heater).....	2.00

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125 Mill. rectifier tube B.H. (Raytheon type).....	1.25		
1/2 amp. charger Bulb (Tungar type).....	2.00		
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5 and 6 Amp. charger Bulb (Tungar type).....	3.75		
15 Amp. charger Bulb (Tungar type).....	7.50		
UX-686	2.5	Half Wave Rectifier (mercury vapor).....	.85
UX-280M	5.0	Full Wave Rectifier (A-C Heater).....	1.10
UX-281M	5.0	Half Wave Mercury Vapor Rectifier.....	1.50
UX-871	2.5	Half Wave Mercury Vapor Rectifier.....	1.10
UX-280	5.0	Full Wave Rectifier.....	.40
UX-282	5.0	Heavy-Duty Full Wave Rectifier.....	.40
25Z5	25.0	Rectifier-doubler (Heater).....	.85
UX-281	5.0	Half Wave Rectifier.....	1.10
UX-282	5.0	Half Wave Rectifier.....	1.10
UX-283	5.0	Heavy duty full wave mercury vapor rectifier.....	.85
UX-216B	7.5	Half Wave Rectifier.....	.85
UX-213	5.0	Full Wave Rectifier.....	.40
UY-84	3.0	Full Wave Rectifier (Heater).....	.85
UX-872	7500	Volts Half Wave Mercury Vapor Rectifier.....	11.00

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ARCO TUBE COMPANY

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A "RADIOPHONE"

(Continued from page 201)

well, which are other desirable features. And to show just how sensitive the receiver really is, it is interesting to point out that several modulated code transmitters were picked up during the tests without any aerial or ground on the set!

The values of parts in the receiver are identical with those in the oscillator, except for the value of the grid leak, which is 0.1-meg. in the receiver. The values of all other parts are shown in the circuit diagram.

It is well to point out that the tubes in both the oscillator and receiver must be mounted in a vertical position as the filament of the type 30 tube is quite thin and is likely to sag if operated horizontally. The writer discovered this fact in testing the oscillator unit; the short-circuit resulting from the filament sagging ruined not only the tube but also a perfectly good "B" battery.

The connections for the receiver are quite simple and may be easily followed from the schematic. The connections to the coils are made as shown, with the grid and plate at the two remote ends. This applies to both the oscillator and the receiver coil connections.

Operation

In adjusting the receiver, the same point should be watched as that mentioned for the oscillator—i. e., the coils should be made so that very little tuning capacity is needed to tune to the desired frequency. However, since the coils and condensers for both oscillator and receiver are identical this should not present any difficulty.

The receiver is tuned like any short-wave superregenerative set. When the carrier wave from the oscillator is tuned in it will be found that two strong hissing sounds are heard in the headphones; on the dial these points are separated by a small distance. Between these is a narrow space with no hiss and very little background noise. At this point, the signals from the oscillator are loudest.

After this point is reached, it is only necessary to experiment with the length of the plate wire of the oscillator, to determine how short it can be made to give consistent results over the desired distance. It will be noticed that no aerial is used on the receiver. Over the short distances for which this communication system was designed, no aerial was found necessary.

The above description will supply all essential data to the experimenter. However, it must be understood that the units are not presented as ideal—there is plenty of room for improvement. For example, the ingenious experimenter will find duplex transmission and reception without any switches or other throw-over devices quite possible. In this way ordinary telephone conversations may be carried on over short distances, without connecting wires.

List of Parts

- Oscillator
 One oscillator coil (see text), L1;
 One Hammarlund variable condenser, 50 mmf., C1;
 One fixed condenser, 100 mmf., C2;
 One fixed condenser, .01-mf., C3;
 One resistor, 10,000 ohms, R1;
 One resistor, 17 ohms, R2;
 One Universal modulation transformer, T1;
 One Universal hand or lapel microphone;
 One 4-prong tube socket;
 One filament switch, Sw.1;
 One type 30 tube, V1;
 One "B" battery, 22 1/2 V., small size;
 One "C" battery, 4 1/2 V. (for "A" supply);
 One carrying case and aluminum panel to fit; wire; binding posts; etc.

Receiver

- One receiver coil (see text), L2;
 One Hammarlund variable condenser, 50 mmf., C4;
 One fixed condenser, 100 mmf., C5;
 One fixed condenser, .01-mf., C6;
 One resistor, 0.1-meg., R3;
 One resistor, 17 ohms, R4;
 One 4-prong tube socket;
 One filament switch, Sw.2;
 One type 30 tube, V2;
 One "B" battery, 22 1/2 V., small size;
 One "C" battery, 4 1/2 V. (for "A" supply);
 One pair headphones;
 One carrying case and aluminum panel to fit; wire; binding posts; etc.

Test All the NEW Tubes with This Improved and Modern Instrument The E 34 TUBE TESTER

Tests all 1, 5, 6 & 7 prong tubes including the new small 7 prong series, the 12-14 volt, the 25-30 volt, 2A7, 2B7, 6A7, 6B7, 2A3, 2A5, 5Z3, 5Y, 75, 81, 12Z3 and 25Z5. Provision made for future type tubes. Gives Short Test; Grid Change Test; Oscillation Test; Total Emission Test; Voltage regulation 90-130 Volts. Top with hand-operated TRIAL—MONEY REFUNDED IF NOT SATISFACTORY. E 34 WITH 3/4" D'Arsonval METER Net to Dealers & Service Men



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TELEVISION TUBES

(Continued from page 267)

assembled deflecting unit is shown besides that of the tube.) The scanning is linear in both vertical and horizontal directions and is caused by saw-tooth shaped electrical impulses passing through the deflecting coils and generated by special tube generators. (The circuits for these generators as well as methods of synchronizing have appeared in the Proceedings of the I. R. E.)

Since the iconoscope is practically a self-contained pickup unit, it is possible to design a very compact "camera," illustrated in Fig. C, containing the iconoscope and a pair of amplifier stages connected with the main amplifier and deflecting units by means of a long cable. Since the camera is portable, it can be taken to any point of interest for the transmission of a television picture.

The Kinescope Receiving Tube

The reception of images transmitted by the iconoscope is accomplished by means of the cathode ray receiving tube or "kinescope" (also described in past issues of the Proceedings of the I. R. E.) shown in Fig. B. Complete block diagrams of the circuits associated with the transmitting and receiving ends of the whole system are shown in Figs. 1B and 2B, respectively. The tube illustrated measures about 18 x 8 in. in diameter.

The main feature of this scheme is that in the whole system there are no mechanically moving parts and the transmission of the image is accomplished entirely by electrical means.

The color response characteristics of the iconoscope make it convenient not only for the transmission of pictures in visual light, but also pictures invisible to the eye in which the illumination is either by ultra-violet or infra-red light.

The present sensitivity of the iconoscope is approximately equal to that of a photographic film operating at the speed of a motion picture camera, with the same optical system! The inherent resolution or "definition" of the device is higher than required for 70,000 picture element transmission. Some of the actually constructed tubes are good up to 500 lines with a good margin for future improvement!

With the advent of an instrument of these capabilities, new prospects are opened for high-grade television transmission. In addition, wide possibilities appear in the application of such tubes in many fields as a substitute for the human eye, or for the observation of phenomena at present completely hidden from the eye, as in the case of the ultra-violet microscope.

We close this review of the iconoscope television tube with the comment to those who are in favor of overnight developments, that it has taken ten years for Dr. Zworykin to bring this equipment to the present state of laboratory perfection; finally, a reasonable amount of time must elapse before all the manufacturing "bugs" have been taken out of the design, and an inexpensive instrument made commercially available to you and me.

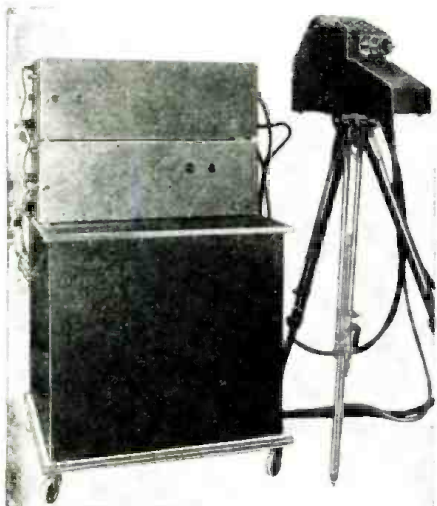
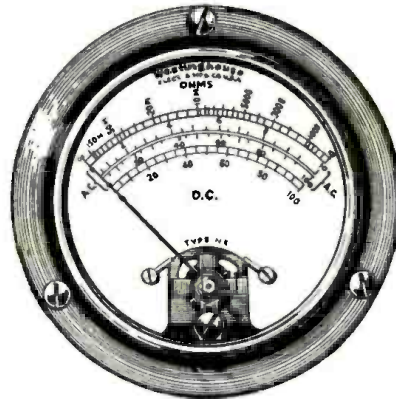


Fig. C.
A television "camera"



New Universal Rectox Instrument

measures

A-C. and D-C. Volts as well as Ohms

THIS new Westinghouse instrument was specially developed for the radio service man.

For panel mounting, it not only measures d-c. voltages from 0-100; but also a-c. voltages over a double-range, 0-10 and 0-100 volts; and resistances from 0-150,000 ohms.

For measuring a-c. volts, an external Rectox unit is supplied. It can be mounted on the panel with a suitable switch to facilitate connecting the instrument for a-c. measurements.

For special uses, external resistances are available to give other than standard ranges of volts and ohms. Modified scales to match these ranges can also be ordered specially.

Practically all voltage measurements needed to check receiving set operation can be made with this Universal Rectox Instrument. In addition, the ohmmeter is available for resistance measurements; for locating open circuits, short circuits and grounds; and for solving, in short order, many of the puzzling situations that so often seem to defy solution.

This is but one of a complete line of Westinghouse instruments, types MX and NX, which cover all the requirements of radio engineering, service and research. For prices and further information, see your local dealer. If he cannot supply you, simply mail the coupon.

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Be sure to turn to page 229 of this issue and read about the new 1933 OFFICIAL AUTO-RADIO SERVICE MANUAL which is now published.

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Simply plug into A.C. or D.C. power line—connect the shielded wire to aerial and ground posts of the radio set—adjust the tuning dial—turn on the switch—and presto you have a regular P.A. system. No need to use plug-in adapters or to remove any tubes or to tamper with the radio chassis in any way. The Modulator need not be disconnected to use the radio for regular broadcast reception. By turning off the switch of the Modulator, the radio is ready for use.

SPECIAL INTRODUCTORY OFFER

To introduce the RADIO MODULATOR to you, we offer it now, for a limited time, at this special reduced price. If your jobber does not have it, use the coupon below. Comes complete with three tubes, fifty feet of microphone cable, special Model 5N two-button microphone and stand. The Radio Modulator is portable and measures 8"x4"x5 1/2". Finished in grained walnut to harmonize with most radios.

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City _____ State _____

ULTRA-MIDGET SET

(Continued from page 211)

The high-gain, unshielded interstage coil L2 is mounted with another L-shaped bracket on top of the chassis between the type 6C6 R.F. tube and the 78 A.F. tube. The band-selector coil L1 is mounted at the bottom of the chassis directly underneath C; to insure short grid leads, the two rear sections of C are used to tune it.

A convenient place to mount the 20 hv. A.F. choke, Ch., is on the bottom of the chassis, between L1 and the socket of V3. The dual electrolytic condenser, C12, C13, fits between Ch. and L1.

The ballast resistor, R9, is mounted on the back of the chassis.

Considering the results obtained and the low construction expenses, this receiver may prove to be an additional source of income to custom set builders.

List of Parts

- One midget 3-gang variable condenser, counter-clockwise type, 365 mmf, C;
- One mica condenser, .001-mf., 200 V. peak, C1;
- Two tubular paper condensers, .05-mf., 125 V. peak, C2, C11;
- One electrolytic tubular condenser, 5 mf., 35 V. peak, C3;
- Three tubular paper condensers, .5-mf., 125 V. peak, C4, C9, C14;
- One mica condenser, 500 mmf., 200 V. peak, C5;
- Two tubular paper condensers, .01-mf., 200 V. peak, C6, C8;
- One tubular paper condenser, .01-mf., 200 V. peak, C7;
- One tubular paper condenser, .01-mf., 200 V. peak, C10;
- Two electrolytic condensers, dual 8-4 mf., 175 V. peak, C12, C13;
- One band-selector coil, L1;
- One high-gain interstage coupling coil, L2;
- One 20 hv. choke, 25 ma., Ch.;
- One Clarostat 50,000 ohm potentiometer with line switch, and with terminals insulated from shaft and case, R;
- One resistor, 1,000 ohms, 1/2 W., R1;
- One resistor, 25,000 ohms, 1/2-W., R2;
- One resistor, 250,000 ohms, 1/2-W., R3;
- One resistor, 0.6-meg., 1/2-W., R4;
- One resistor, 35,000 ohms, 1/2-W., R5;
- Two resistors, 100,000 ohms, 1/2-W., R6, R8;
- One resistor, 1 meg., 1/2-W., R7;
- One closed-circuit phono. jack;
- Three 6-prong sockets, medium size;
- Two 5-prong sockets, medium size;
- One 7-prong socket, for automobile adapter;
- One Clarostat ballast resistor, 250 ohms, 25 W., R9;
- One 6C6 tube, V1;
- One 77 tube, V2;
- One 78 tube, V3;
- One 88 tube, V4;
- One 37 tube, V5;
- One magnetic speaker, 5 ins. diameter, designed for type 38 tube;
- One aluminum chassis 9 ins. x 4 3/4 in. x 1 1/2 in. high;
- One cabinet;
- One tuning unit with pilot light socket and escutcheon;
- Two knobs, one for R and one for C;
- One line cord;
- One 7-prong plug with 8 ft. of 4-wire cable;
- Four screen-grid clips;
- One roll of solid hook-up wire.

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RADIO BEGINNER

(Continued from page 213)

After the sub-panel is bent it is assembled to the panel by two screws through the holes provided, and the various parts mounted thereon. The two pin-jacks for holding the crystal detector are first mounted on the piece of bakelite cut and drilled as shown in the detail, Fig. 2, marked "detector mounting" and the entire assembly then fastened to the panel, being sure that the pin-jacks do not make contact with the panel. If the holes have been drilled correctly they will not, otherwise you will have to get busy with a rat-tail file and clear them.

You must also either make or buy some sort of insulating washers for the jack "J" into which the phones are plugged as this jack, having the full "B" voltage applied to it, must not make contact with the chassis.

After the assembly is completed proceed with the wiring, marking out on the diagram, as mentioned in the previous articles, each wire as you put it in place. Due to the sub-panel construction of this job and the simplicity it should take only a few minutes to produce a neat, professional-looking job.

The circuit, as shown, is designed for use with a 2 V. storage cell for filament power. If two dry cells are used instead it will be necessary to put a fixed resistor of four ohms in the positive leg of the filament circuit.

The power cable is made very simply. Take an old tube with a 4-prong base and break off the bulb. (Better wrap it in cloth before breaking it, by the way, as the glass has a nasty habit of flying.) Then thoroughly scrape out the cement from the base and unsolder the wires from the prongs. Cut four wires with differently colored insulation and having sufficient length to reach the batteries, and solder one into each prong. Braid the wires together and pour insulating wax into the tube base.

Operation

After you are sure the job is all wired up correctly, plug in the detector, the tube, the phones and the power plug, then hitch on the "A" battery and the negative side of the "B" battery and test the filament circuit. Next flip the positive "B" wire across the post; if a moderately loud click results in the phones the circuit is presumably O.K. and the connection may be made permanently. Work the adjustment on the detector; a loud scratching in the phones indicates that this portion of the circuit is operating. If a buzzing noise is heard, it indicates that the little wire in the detector is not making contact; adjust the detector so that it is just making contact. Finally, hook on the antenna and ground and slowly turn the tuning condenser from one end of the dial to the other.

During this operation the "ex-tickler" coil should be turned with its axis parallel to the main coil. If no signal is heard on the first trip around, turn it through 180 degrees and try again. Patience will eventually be rewarded with a signal.

Just one final word. Build this chassis exactly according to the dimensions shown as we have quite a bit of use for it in the future and if you go changing it around you may find yourself "out of luck" on some subsequent layout.

Parts List

- One 3-circuit tuner for 350 mmf. condenser.
- One R.F. choke, 85 mh.
- One tuning condenser, 350 mmf.
- One mica fixed condenser, 500 mmf. (.0005)
- One non-inductive paper condenser, .1-mf.
- One electrolytic condenser, 25 mf., 25 V.
- One bias resistor, 750 ohms, 1 W.
- One Rotorit crystal detector
- One type 33 tube
- One 6-prong wafer socket
- One 4-prong wafer socket
- One open-circuit jack
- One panel mounting switch
- One antenna-ground binding post strip
- One power plug and four wire cable
- One Rechargit 2 V. storage cell, "A"
- Three battery blocks, 45 V. each, "B"
- One aluminum panel, 4x7x $\frac{1}{16}$ -in. thick
- One aluminum sub-panel, 4x8 $\frac{1}{2}$ x $\frac{1}{16}$ -in. thick
- One bakelite detector-mounting, 1 $\frac{1}{2}$ x $\frac{3}{4}$ x $\frac{1}{4}$ -in. or $\frac{1}{8}$ -in.
- Brass 6/32 machine screws, nuts and hook up wire.

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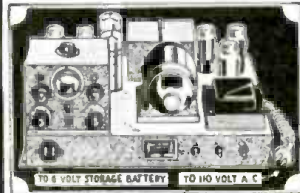
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Tubes Employed: 2-37, 2-89, 2-53, 1-83
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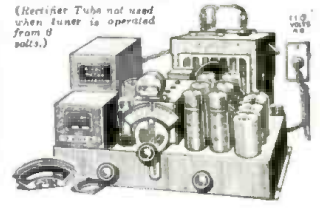


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- 6 Volt Storage Battery Operated Motor Generator **\$20.50**
- 110 Volt A. C. Power Pack Factory Wired, including Rectifiers 12-82 (or 1-83) **\$22.50**
- All Purpose Input "Mixer" Control Box **\$16.50**
- Dual Field 6 Volt D. C. and 2500 ohm D. C. Jensen 11 In. D-9 Dynamic Speaker **\$12.50**
- 110 Volt A. C. Speaker Exciter with 280 Tube **\$ 5.88**

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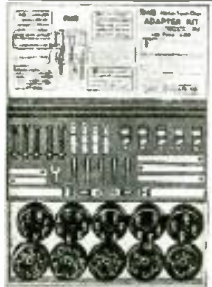
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- 907D 7 to 7-prong Core Adapter 1.00
- 907EN LIT Complete as shown \$4.50

Here is the set for those who want the lowest possible cost. Do not have means for locking the adapters to the plug but is viewable in every way, the wired adapters including the necessary small base for fitting shielded sockets. C. G. stud supplied.

- 907PN 7-prong Plain-Type Analyzer Plug \$3.50
- 907W 7 to 4-prong Wired Adapter35
- 907W 7 to 5-prong Wired Adapter35
- 907W 7 to 6-prong Wired Adapter35
- 907W 7 to 7-prong Wired Adapter35
- 907W KIT Complete as shown \$2.00

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ELECTRAD
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4 P.A. AMPLIFIERS

(Continued from page 215)

furnishing almost twice as much power output as the latter. Nevertheless, this compact amplifier, measuring only 12x7x7 1/4 ins. high and using only three effective tubes, can furnish an output of 10 W. of undistorted power. The circuit is Fig. 3.

This high efficiency is due to the use of the recently developed 2A3 class A triode in an improved Loftin-White direct-coupled circuit. The power applied to the plates is only 24 W., whereas old-style amplifiers of this classification formerly required 50 W. Other features of this amplifier are: non-critical load conditions; low mu; and high gain. Through the use of a 25 nmf. neutralizing condenser, the input capacity of the first 2A3 tube is neutralized, thus bringing the high frequency portion of the curve down so as to have a flat characteristic. As a result the amplifier has a flat frequency response over a very wide frequency range, with only 3 per cent harmonic content.

Referring to Fig. 3, the first stage employs a 57 pentode tube. This drives two 2A3 tubes arranged in a novel push-pull system which eliminates the usual push-pull input transformer. A 5Z3, high-vacuum full-wave rectifier supplies the required high voltage through an oversize transformer and filter system. Voltage is available for the field supply of four 2000 ohm speaker fields; two 4000 ohm, 7 W., fields; or two 2500 ohm fields. Naturally, this lowers the cost of the complete P. A. system. This amplifier has a gain of 80 db. Costing less than twenty-five dollars (exclusive of tubes and speakers), it supplies a quality of reproduction comparable with old-style amplifiers costing three and four times as much. (The properly designed Loftin-White amplifier is noted for its super-fine tone quality.) This amplifier, using a perfected and improved Loftin-White circuit and employing the new 2A3 tubes in push-pull, maintains superb tone quality, even when operated at maximum volume.

A 28 W. Direct-Coupled Class B Amplifier

In selecting an amplifier for a large auditorium or for any application where a great crowd must be reached over an extensive area, it would be preferable to employ a class B amplifier such as the Lafayette model P-15760, shown in Fig. D. Although this is a 28 W. deluxe amplifier, capable of operating 20 dynamic speakers, it employs only four tubes (exclusive of the rectifier); a novel, high-gain circuit is used, as shown in Fig. 4.

A 57 pentode tube is used in the first stage, direct-coupled in a modified Loftin-White arrangement, to a 59 pentode in the second stage. This in turn, is transformer-coupled so as to drive a pair of 59 tubes in class B push push arrangement in the output stage. An 83 type mercury vapor rectifier tube is used.

The output of this three-stage amplifier is conservatively rated at 28 W. of undistorted power. It is designed for an input impedance of 0.5-megohm. Through the use of tapped secondaries on the output transformer, it can be used to match output impedances of 4, 8, 15, 500 and 2000 ohms.

Because of the use of a direct-coupled driver, the higher frequencies are accentuated, compensating for their loss in the class "B" stage and resulting in a uniform response over the entire audible range, regardless of the level of the input signal. This improvement in design overcomes the chief objection to class "B" amplification, permitting the attainment of high power output without impairment of tone quality. A characteristic curve of this amplifier reveals a gain of 90 db. at 1000 cycles, 87 db. at 50 cycles and 92 db. at 5000 cycles.

This amplifier is 11 1/2 x 20 x 10 ins. high. Both mechanically and electrically, it is well fitted to handle the work for which it was designed. Both the power transformer and the choke assembly can carry twice the normal current to which they are subjected under full load. This powerful, class "B" amplifier, with eight times the power rating of the amplifier shown in Fig. 1, is available at a cost of less than fifty dollars, complete with tubes.

(Continued on page 217)

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FINEST RESISTORS FOR EVERY SERVICE NEED

P.A. "Q. AND A."

(Continued from page 221)

hospitals, convention halls, etc.

Question: I have in mind a particular application not mentioned by you. Could I get definite information about my particular problem from you and what would this cost me?

Answer: The writer will be glad to offer Service Men advice and to give them technical help on any problems pertaining to sound systems; this information will be supplied gratis.

Question: Do I need a special power supply line to furnish current to the amplifier, or can I connect this any place?

Answer: You can plug the No. 125 amplifier into any 110- to 125-V., 50 to 60 cycle, A.C. lighting line socket or outlet. Of course, in making a permanent installation and in installing additional wiring, it will be necessary for you to do this in accordance with the specifications of the Fire Underwriters.

Question: In a hall capable of seating 3000 people, having floor space dimensions of 100x200 ft., and a height of 20 ft., how many speakers would you recommend and where should they be installed?

Answer: I would recommend two dynamic model 548 theatre-type speakers used with baffles in a No. 755 studio cabinet, and would place these on the stage at either side.

Question: Where would you install the amplifier?

Answer: This should be placed in a control room, as near as possible to the stage.

Question: How are the speakers, microphone, and other equipment hooked up?

Answer: These should be connected as shown in Fig. 2A.

Question: Why do you recommend the condenser type of microphone for use with the sound system?

Answer: Condenser microphones are far superior to even a high-priced carbon-type microphone, because of their greater frequency response and also because of the complete absence of hiss common to carbon mikes. The condenser microphone has other important advantages. It is rugged and will withstand the general banging around which quickly ruins carbon microphones. Furthermore, the condenser microphone may be used in any position.

Question: What power will the No. 548 theatre-type speaker handle?

Answer: This speaker will handle up to 12 W. without cone vibration or distortion. It is equipped with hum-bucking coils.

Question: What other accessories could I recommend to a prospective customer for use with a sound system?

Answer: The owner of an auditorium sound system may want to use the equipment for radio or for phonograph, as well as for microphone input. In many cases, a good radio receiver can be used in connection with the sound system. Figure 2B shows how to connect a radio receiver to the auditorium No. 125 amplifier. A No. 7338 tube-to-line transformer is employed. This can be used in connection with any radio set employing a low impedance detector such as a 56, 27, 37, 01-A, 30, etc.; if a high-impedance detector is used, such as a 57 or a 21, a No. 2625 transformer is required, instead. The secondary of this transformer is connected to posts M & MC on the amplifier. The electric phonograph recommended for use with this sound system is the two-speed model "D" motor unit. When used with the long-playing phonograph records, this is operated at 33 1/3 r.p.m. When used with regular records, a speed change lever instantly brings the speed to 78 r.p.m.

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A COMPLETE Service Instrument
Weights Only 2 1/2 lbs.

Everything you would find in the most expensive meters—and more—IRC now offers in this new Volt-Ohmmeter at the lowest price: Automatic vacuum relay; four voltage and three resistance ranges; full Bakelite case; special rotary switch; one set of pin jacks for all readings; convenient compensation for battery variations on ohmmeter; IRC 1% Precision Wire Wound Resistors and compact size only 7" long, 3" deep and 4 1/2" wide.

With just this Volt-Ohmmeter and a tube checker you can do prompt, accurate servicing via the popular point-to-point method. Will last indefinitely—no meter or circuit burn-outs possible. What is more, it does not become obsolete with introduction of new radio tubes or circuits.

THE AUTOMATIC VACUUM RELAY DOES IT . . .

If you've ever experienced the inconvenience and expense of burnt out meters or resistors you'll appreciate this exclusive IRC volt-ohmmeter feature all the more inasmuch as it is specifically designed for positive protection against such accidents. No fuses to replace—no burn-outs possible even though you accidentally touch the test lead across a 300 volt section while working on the 0 to 3 or 30 volts scales. When overload occurs the vacuum relay automatically opens—then automatically closes when overload is removed.

USE IT WHEREVER ELECTRICAL MEASUREMENTS ARE MADE . . .

The high degree of accuracy of the IRC Volt-Ohmmeter coupled with its convenient size and burn-out protection make it unexcelled for use in schools, colleges, laboratories, electrical shops, etc. for experimental and practical purposes alike.

VOLTAGE RANGES 3, 30, 300 and 600	NET PRICE \$25.50
RESISTANCE RANGES 0 to 1,000—0 to 100,000 ohms—0 to 1 megohm	Complete with test leads (List \$42.50)

INTERNATIONAL RESISTANCE CO.
2100 Arch St., Philadelphia, Pa.

Enclosed find \$25.50 (check or M. O.) for one of the new IRC Volt-Ohmmeters. It is understood that I can return it (prepaid) for full credit if, within five days after receipt, I am not more than pleased.

Please send folder describing the IRC Volt-Ohmmeter in detail, and telling how it can be used for better point-to-point work.

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STREET _____
CITY _____
NAME OF YOUR JOBBER _____

... DO BETTER WORK WITH LESS EQUIPMENT!

String Back

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You'll be happy—the customer will be happy . . . and the set will "perk" again with renewed pep . . . that is if you insist (and who wouldn't) on using CENTRALAB FIXED RESISTORS, for ALL replacement jobs.

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Books and lectures on the marvelous accomplishments of the Photo-electric cell must inspire you, but only by experience with the actual device can you get the FEEL of a Photo-cell; only by owning and working with the tools of Photo-electricity (a complete kit) can this science become a powerful reality rather than the intriguing mystery that it must be to you now.

Years of experience manufacturing Photo-cells and allied instruments have placed us in a position to supply the most dependable apparatus known. The Kit we offer consists of only the highest quality merchandise; a Photo-electric cell, amplifying tube, magnetic relay, condenser, resistors, socket; everything that is essential for the ideal unit, though your problem is to control illumination, detect burglars, count articles in production, guard machinery or accomplish any of the innumerable feats which are practical for Photo-cell control.

Our price is an achievement in itself. \$8.00 the complete kit.

The Clark Instrument Company
Camden, N. J.

"SELECTIVE ANALYSIS"

(Continued from page 204)

of the terminals. But instead of bringing these terminals to the inside of a complex instrument, they are brought to a small, rectangular box carrying a tube socket and a group of pin jacks. This small socket unit or tube selector is arranged to fit mechanically on top of a multiple range combination instrument which in itself reads volts, milliamperes and ohms. Connections are made to the socket by means of small leads fitted with tips which fit into the pin jacks on the socket block and also into the instrument proper. In this way, by plugging into pin jacks as required, voltages may be taken from any terminal to any other terminal.

To measure current, two jacks are supplied for each line except the heater circuit, and when pins are plugged in both jacks, the circuit is opened by means of a simple switching mechanism which is taken care of automatically when the pins are plugged in. The current in the circuit is then diverted into the milliammeter. When resistance measurements are to be made from any terminal to any other, leads from the resistance jacks on the instrument are taken to the socket unit or tube selector and plugged in across the terminals in question. A pair of jacks are also supplied for a ground lead should it be found desirable to make measurements to the chassis itself.

In order to avoid the use of adapters, and to reduce the operations to utter simplicity, separate plug and tube selectors are furnished for the 4-, 5-, 6- and 7-prong tubes. The extra units cost but little more than a pair of adapters and avoid the complexity of an adapter system as well as the extra voltage drop in the filament connections. Indications on the face of the socket block are also much clearer when adapters are not required. Should tubes with more prongs be made available, such tube selectors will be produced and may be purchased at a relatively small figure so that only a small investment will take care of such new tube developments as may come out in ensuing years.

The unit itself is simply a combination tester with a large number of ranges. The voltage ranges supplied are 1000, 500, 250, 100, 50, 25, 10, 5, 2.5 and 1 volt, both A.C. and D.C., with a sensitivity of 1000 ohms per volt. The A.C. ranges are available by virtue of a copper-oxide bridge type rectifier. The current ranges obtainable are 500, 250, 100, 50, 25, 10, 5, 2.5 and 1 MA. D.C. only. Four resistance ranges are supplied running to 1 megohm with the lowest range indicating 1 ohm per division. With four scales a good coverage is obtained and practically all resistors used in radio sets will give good indications.

As an additional feature, the customary tube test can be made using the internal batteries which the instrument contains. By plugging from the outlets marked "grid test" in series with the grid, the battery is connected to the grid when the button is pressed and with the instrument connected into the plate circuit the corresponding change in plate current can be measured. As a matter of fact grid shifts of both 4.5 and 13.5 volts are available to take care of the audio amplifiers as well as the tubes with a lower transconductance.

It will be noted that the instrument itself is simply a combination voltmeter, milliammeter and ohmmeter with a very broad coverage of all ranges which may be required in the future. The device is basic because the instrument itself is not permanently connected to the socket circuit in any way. It is hardly conceivable that we shall go beyond the ranges of this instrument, states the manufacturer. The only requirements on the horizon which the instrument does not seem to cover are the high voltages which may be required for cathode-ray tubes; and such voltages will require a special instrument anyway because of the very low current which will be available.

Reverting to the tube selectors, one of which is shown in the insert, A, in the figure, the block is of moulded bakelite and carries on its top face the standard numbering system for the pins. White lines connect from the pin jacks to the corresponding pin holes in the socket and also to the cap. The use of this standard numbering system eliminates the use of such terms as "plate prong" for a 6-prong tube where this prong may actually be connected to something else. To tie in with the numbering system a

(Continued on page 247)

1 WINDS LIKE A WATCH

2 VISIBLE INK SUPPLY

1+2=

The Nozac*
(no sack).
You know when it's filled, when to refill it. Demand the quick, easy, positive mechanical Nozac filling action. See the Nozac before you buy . . . Compare . . . \$5 and more. Other Conklin \$2.75, \$3.50 and more. Pencils \$1.00 and more. . . Ask your dealer.

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RADIO PROGRESS WEEK

(Continued from page 251)

made sales within two years. Offer them a commission on sales of auto sets to these prospects.

(d) Make up lists of good prospects for battery sets among the farmers in the surrounding rural territory and hamlets not served by power lines. Send them advertising matter on home and auto models and cash in on the national promotion of the Campaign to the farm market.

Make sure that you are ready with good names to whom you can mail advertising matter and send salesmen with the minimum waste of postage and time.

7. Secure a set of the campaign display and advertising material—plan book, window display, posters, decalcomania window sign, model markers, direct mail folders, poster stamps—and be ready to feature Radio Progress Week in your store and windows during the September Sales Drive. (Study the dealer plan book and take advantage of every benefit the campaign offers you. Get these from your distributor or the local committee.)

8. Attend the meeting of local dealers that the local campaign committee holds in your town or at the nearest radio distributing point, in August. Make notes of the selling ideas that are suggested there and be ready to use them when the September selling comes.

9. Study the details of the Radio Progress Week broadcasting program as they come to you, during August and discuss them with your salesmen. Be sure they understand how to make the most of the popular appeal of this special broadcasting and use it as the urgent reason why the prospect should buy now. See that you receive the Radio Progress Week program broadside which will be ready early in September and display it prominently.

Schedule Your Activities in Advance

10. Put down on paper a sensible schedule of things to do during the September Sales Drive that will give you a well balanced program of selling. Make an effective combination of window and store display, newspaper advertising, direct mail advertising and active canvassing by salesmen sent to carefully selected prospects. Set up a calendar, with your whole program set down—just when you want to start each activity. Make somebody responsible for each part of the program so that each feature will be carried out.

11. Carry through the mechanical preparation of your September Sales Drive. Have envelopes ready to mail out the folders, advertising copy selected and cuts ready, salesmen equipped, instructed and ready to go and a schedule of window displays and store features for September and Radio Progress Week. Have plenty of manufacturers' advertising matter on hand to combine with the campaign display material.

12. Make up a list of novel ideas that may be used with dramatic effect to help you capture popular attention, create interest and attract people to your store. Select a set of selling stunts that will go well together and give you a full program of strong appeals—such as—

(a) Feature a "history" window, using traded-in models, showing the advance in radio design since early days. Give demonstrations of these sets, in your store, one after another, winding up with the latest receiver.

(b) Stage a comparative demonstration some evening between modern receivers and trade-in sets three or more years old, on the sidewalk in front of your store.

(c) Service and repair sets in the front window during the campaign.

(d) Run a door-to-door free tube testing campaign with the Service Man carrying impressive testing equipment.

(e) Demonstrate the methods used in broadcast stations to make "prop" noises during plays, right in the store window, using a public address system.

(f) Rig up the store with photoelectric cells to do all sorts of semi-scientific tricks. Advertise it as the "Magic Shop" During September. Make the cells turn radio receivers on and off. Add old radio equipment to give a "Radio Museum" effect, showing progress.

(g) Put police calls or short-wave foreign broadcasts on a front-door speaker for short per-

iods. Call attention to these unusual programs with appropriate signs and in your newspaper advertising.

(h) Run a trade-in campaign during September, offering some special inducement.

(i) Where you can't close sales to good prospects in September, secure permission to install sets on demonstration during Radio Progress Week. Close the sales during the special broadcasts.

(j) Hold an evening reception in your store to show the new models in your line. Invite artists from the local broadcasting stations to be your guests. Send out invitations. Serve light refreshments.

13. Your local committee has been provided with many suggestions for cooperative activities to create local publicity for radio in the interest of all dealers. If no committee has been organized by the radio distributors in your town, call a meeting of the local dealers and form a dealers committee to organize cooperative publicity. Write to Campaign Headquarters for a list of local publicity ideas.

Organize Your Canvassing—(Special, for the Service Man)

14. Plan your canvassing, with these two objectives clear—to sell new sets wherever possible, and when you can't sell new tubes and recondition the set in use. Write to all customers telling them about Radio Progress Week, offering to inspect their sets without charge and to provide new tubes or parts at special rates during September.

15. Study the dealer plan book and follow its suggestions on the best method of handling the sale when you reach the prospect's home, so that each call will give you a chance for either a new set or recondition sale.

16. Work up a route plan for your salesmen and Service Men, so that they will cover the residence districts in the shortest possible time. Secure a report on each call and follow up no-sale calls on the telephone in the evening, talking to the husband.

17. Give your Service Men a typed sheet listing the things to do in checking an old set for reconditioning, including—

(a) Test and match tubes. Substitute new, modern tubes giving better volume or better tone, or both, for older types, and make necessary circuit changes.

(b) Renovate the existing antenna system—solder connections, inspect insulation, check lightning arrestor and move wire to another position if better results seem possible. Inspect and solder the ground. "Pretty up" the wiring inside the house. Or—install new, modern "noiseless antenna" system.

(c) Locate and clear sources of electrical interference originating inside the house.

(d) Install modern accessories such as tone control, automatic volume control, inter-station noise suppression, visual tuning.

(e) Clean and "balance" the receiver so that it again performs as it did when it left the factory.

(f) Install extra speakers for remote use, or twin-speaker tone.

(g) Refinish cabinet, remove scratches and nicks and polish.

(h) Re-vamp receivers so that they will receive police calls.

(i) Electrify old auto receivers by installing modern "B" eliminators.

Make the most of this canvass to recondition sets in preparation for Radio Progress Week. It will bring many opportunities to sell new receivers. It will show many homes the value of a periodic inspection to keep the radio tone quality and control as good as it should be. The Service Man is a vital part of this campaign.

18. Don't quit selling when Radio Progress Week is over. Keep on. Public interest is keen. Many prospects are half sold. In October you can talk about what happened in Radio Progress Week better than you could describe it in September. *Keep on cashing in.*

Local Campaign Committees

1. Study the campaign plan in the campaign announcement booklet and figure out just how it can be applied in your city and in the neighboring communities normally served by your distributors.

2. Study the detailed suggestions that have been prepared to guide the radio distributor in the campaign and be familiar with the part he is to play.

(Continued on page 251)



for Every
**ANALYZING
REQUIREMENT**

Readrite Tester
No. 711

HERE is a practical and flexible three-meter instrument that serves every possible analyzing requirement. It makes servicing easier, quicker, more profitable. It gives all the information any service man or dealer needs to know for servicing sets.

Furnished with a practical selector switch, the Readrite No. 711 instrument tests voltages and resistances at set sockets. In addition, voltage, resistance and capacity tests are available through the meter jacks. This unit will handle the most advanced circuits and the newest tubes. Sturdily and accurately built, it will give long, accurate, trouble-free service.

Equipped with the new Triplett D'Arsonval Voltmeter, which has 1000 ohms per volt resistance. The readings are 0-15-60-300-600 volts—0 to 300,000 ohms covering a complete range for testing control grid, screen grid, cathode and plate voltages. The ohmmeter reading is secured with a 4½ volt battery. Additional resistors can be furnished, which, with additional batteries will bring readings up to any desired range.

Your Jobber Can Supply You...

at the dealer's net price of \$22.50. See him today, or send coupon for descriptive catalog.

READRITE METER WORKS
76 College Ave., Bluffton, Ohio

Send Coupon for Quick Facts!

Readrite Meter Works,
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Bluffton, Ohio

Gentlemen:

Please send me catalog on Readrite Tester No. 711, as well as information concerning your other servicing instruments.

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Street Address

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

Make MORE MONEY in RADIO with R.T.A. Professional TRAINING

Home study with R.T.A.—plus lifetime membership in our large, powerful association of radio service men—brings you up to date on all improvements in radio, television, sound, engineering, and keeps you among the real money-makers in this expanding field. Unless you have this high-type professional training you will find it hard to get out of the poorly paid "tinkerer" class.



New-Type Set Analyzer Included

As part of R.T.A. training you get this up-to-the-minute Set Analyzer and Trouble Shooter. After a few easy lessons you are ready to use it for immediate money-making, competing with "old-timers" without fear. With this wonderful piece of equipment, backed by R.T.A. professional training, you need have no fear or worry over the future. Even though there could never be a new radio set constructed—or not another improvement in radio made—there are enough sets now in service that need frequent attention to assure you good money as an accepted Radio-technician.

Start Money-Making Quickly

R.T.A. Training is especially designed—and given you by one of the outstanding teachers of radio technology in the world—to get you into the profitable end of radio quickly. It is not empty theory, but practical, down-to-earth work that makes you a money-maker in this unmet field in the shortest possible time. Don't delay your start toward success! Write at once for all details about R.T.A. training. The Coupon below brings FACTS—astounding facts that may open up a new, depression-proof future for you.

MAIL COUPON NOW!

RADIO TRAINING ASS'N. OF AMERICA.

4513 Ravenswood Av., Dept. RCA-10, Chicago, Ill.
Send me all the FACTS about R.T.A. professional training together with information about the opportunities existing for R.T.A. Radio-technicians today.

NAME.....

ADDRESS.....



AC-DC MODEL—110 to 140 VOLTS—25 to 60 CYCLES

Keep your radio business active—make extra money by installing and renting the MILES Power Amplifier Broadcasting System in churches, halls, auditoriums, studios, exhibits, courts, etc. Build a profitable and reputable public address business this summer—develop it into a year-round business.



The MILES AC-DC Power Amplifier Broadcasting System employs the latest RCA Tubes. It is simple to operate by just plugging into the current line. Portable so that it can be easily carried. Volume control permits exceptionally good clarity. Can be used in auto in conjunction with "B" batteries. Additional speakers can be added if desired. This complete portable unit consists of Power Amplifier, Mike Pre-Amplifier, Tubes, Built-in Dynamic Cone Speaker, Built-in Power Switch and Gain Control—all self-enclosed within one handsome unbreakable carrying case. Equipment also includes MILES extra sensitive lapel microphone and 25 foot flexible cable. Measures 3' x 8 1/2" x 10"—weight 7 lbs.



Complete kit form including RCA Tubes, ready to wire..... **\$15.96** Net



Completely assembled and wired ready to operate..... **\$21.00** TO DEALERS AND SERVICEMEN



Complete circular on other Miles Amplifying Equipment and new, low price list for microphone repairs.

Miles Reproducer Co., Inc.
244R West 23rd St. New York, N. Y.

1934 5-TUBE AC-DC REAL MONEY MAKER

The new Postal Radio, a super sensitive and selective receiver can be used on 32 volt battery, 110-130-170-220 and 240 volts A.C. or D.C. Employs 1-37, 1-77, 1-76, 1-43 and 1-220. Full-range dynamic speaker and self-contained aerial. Remarkable, faithful reproduction and distance ability. Easily sold on demonstration.



Complete chassis speaker wired and laboratory tested. Genuine hand finished cabinet of modern design. Complete set..... **\$8.95**
..... **1.95**

..... **3.75**

Dealers and servicemen: The above net prices are guaranteed. Send 3¢ stamp for circular. **POSTAL RADIO CORP., 135K Liberty St., New York City**

R.-C. ANALYZER

(Continued from page 219)

made in the arrangement of the push-buttons and electrical circuits, so that all of the modern tubes can be analyzed.

New Push-Button Circuits

The button formerly used for reverse switch, located in the lower left-hand corner on the front panel, is the additional current button now necessary for the extra tube element.

An additional double pole, double throw toggle switch has been mounted on the front panel, directly over the A.C.-D.C. switch and directly beneath the ohmmeter adjuster for the purpose of reversing the polarity of the current flowing through the meter.

The voltage ranges remain the same, and an additional double pole, double throw switch is placed on the right-hand side of the panel, in close proximity to the voltage-current toggle switch and the cathode-heater toggle switch. The purpose of this additional double pole, double throw toggle switch is to throw the voltmeter scale across the filament circuit or across the remaining push-button switches on the right-hand side of the panel, which indicates the voltages between cathode and the various elements in the tubes when the toggle switch K-H is in the K position; and measures the voltages between the various elements of the tubes when the toggle switch K-H is thrown to the H position.

Three new sockets are mounted in place of the older models. The center socket is a universal socket, capable of connecting four, five and six prong tubes respectively. The other two sockets are seven prong; one is selected for use with the large seven prong base tubes and the other one is for the seven prong small base tubes.

The following voltage ranges are available for A.C. and D.C.: 5 V., 10 V., 100 V., 250 V., 500 V., and 1000 V. The following current ranges for D.C.: 1 ma., 5 ma., 25 ma., 100 ma. and 500 ma. are also available. The ohmmeter scale is from 0 to 0.1-meg., and is the same circuit used in the original analyzer.

Operating Procedure

Those interested in the operation of the original model of this analyzer, should refer to RADIO-CRAFT of September, 1932, in which the whole system was carefully explained. In general, everything that has to be done in the line of testing radio circuits and radio sets, can be accomplished in the same manner as with the original model, except for the fact that it will be necessary to throw the filament voltage toggle switch when it is desired to read filament potentials, and to throw it in the opposite direction when it is desired to read higher potentials such as plate voltage, grid voltage, screen voltage, etc.

The additional current push-button on the left-hand side, giving six current readings of the six major elements of the tubes, more or less simplifies the operation of the unit; and replacement of the toggle switch for meter reversing to a position nearer the meter itself, simplifies the wiring.

The RADIO-CRAFT Analyzer Chart, the first of its kind, has been enlarged to take in all of the new tubes and corrected for use with the new engraving which should follow along the lines of the special drawings furnished for that purpose.

It will be noted that changes have been made in the method of mounting the shunts on the rotary selector switch covering the current ranges, which permit the use of low resistance wiring, thus resulting in greater accuracy on the high current measurements. The resistor strip which is mounted on the terminals of the meter has been reversed (from its position in the original model) and the leads running to the multipliers have been lengthened, resulting in a better arrangement of the current shunts. The additional length of wire used on the multipliers will not cause errors in the readings, and can be done with greater rapidity than on the old analyzer.

The most important part of building an analyzer is the wiring; this refers particularly to shunts: use as large a size of wire as possible.

Number 12 copper wire covered with spaghetti insulation is really the best thing to use. This will prevent errors in scale readings on the high current scale and is one of the most important of all points to be considered. It is not

Our Readers Say—

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The RADIO-CRAFT INDEX

It contains a thorough, alphabetical and logical arrangement of EVERY article and subject which has been published in all the issues of RADIO-CRAFT from July, 1929 to June, 1933

Radio Men have conclusively proved to us the need and practicability for a book which has included in it, a comprehensive and complete listing of every article which has thus far been published in RADIO-CRAFT. A book which has each topic so sub-divided and cross-indexed that a mere glance at a subject will give you any number of classifications and uses of it. For example, if you look at tubes, you find under this topic, various sub-titles, general, power, transmitting, photo-cells, testing of tubes, thyratrons, etc. Every article or notice in the book has been considered so deeply important that when you refer to a certain classification, listed below the main topic, you will find perhaps a dozen or more articles treating the subject from different angles. The author in each case is given—the exact issue in which the article appeared, and on what page it is to be found. So accurately compiled, by C. W. Palmer, one of radio's foremost writers, that in less than two minutes you can turn to any article—needless to waste through all the issues of RADIO-CRAFT which have been published during the past three years.

The RADIO-CRAFT INDEX is exactly the same size as the monthly magazine—it has 24 pages. It can be conveniently kept on file with the copies of the magazine—ready for quick reference. The index is printed on good paper with self covers.

This book is sold only by the publishers at 25c the copy. Mail coupon below for your copy of the RADIO-CRAFT INDEX.

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CODE—	POWER SUPPLY AND
COILS AND TUNING—	BATTERIES—
COMPONENTS—	RECEPTION—
COOPERATIVE LABORATORY—	REMOTE CONTROL—
DETECTORS AND	SELLING AND MONEY
RECTIFIERS—	MAKING SERVICING—
EDUCATION—	SET CONSTRUCTION—
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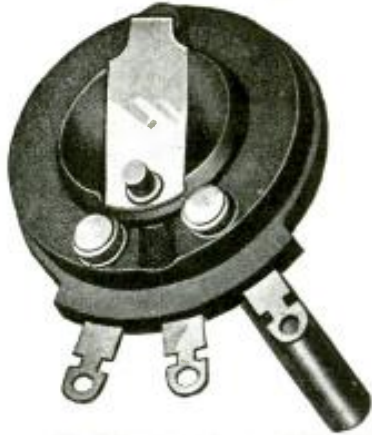
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LYNCH RESISTORS

Universally Accepted where the BEST is standard

NATIONAL COMPANY, INC. •

June 9th, 1933.
Mr. Arthur H. Lynch,
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51 Vesey St.,
New York City.

Dear Arthur:
We shall appreciate having you give the accompanying order your personal attention, so that no time will be lost.

These parts are to be used in filling an important U. S. Navy contract and immediate shipment is required.

As you know, National has standardized on your resistors for many years and they have given a fine account of themselves in service all over the world. We feel that we are justified in paying the slightly higher price necessary to obtain this performance. Cordially yours,

NATIONAL COMPANY, Inc.
(Signed) James Millen,
General Manager.

Prices of LYNCH Resistors to Jobbers, Dealers and Servicemen no higher than prices of ordinary resistors.

Free Descriptive Folder Upon Request

LYNCH MANUFACTURING CO., Inc.
51 Vesey Street New York, N. Y.

OPERATING NOTES

(Continued from page 233)

half an inch above the insulating compound, in the can containing the power pack, and barely visible, is ordinarily soldered to a lug on one of the two studs that makes connection with the common negative return to the transformer and ground connections; this wire was found to be loose. See Fig. 9. Radiated heat from the transformer evidently caused the compound in the can to become soft, and the wire stub moved just far enough away from the lug to break the contact. In turning the set off the wire stub would be pulled back again to its normal position by the contraction of the mass of the compound in the can, thus making contact again with the lug.

R. F. LAMBERT,
11810 Ohio Ave.,
Detroit, Mich.

IMPROVING THE A. K. 55

To clear up distortion in the R.F. section and get better results with a shorter aerial in this model, adapt the A.K. 55 to use two type 35 tubes in the two R.F. stages, replacing the type 24 tubes originally used. Disconnect the wiring at the points marked X in Fig. 10; this will leave the original bias resistor connected from the low end of the volume control to ground. Wire the two R.F. cathodes together and solder the common lead to the second R.F. cathode. Connect this lead to a 60 ohm resistor and ground the opposite end of the resistor. The R.F. bias bypass is already soldered to the cathode of the socket. The volume control is left as is, and works very well. The performance of the receiver when so changed will compare favorably with later models.

WILLIAM GRESSEL,
1133 No. Hope St.,
Philadelphia, Pa.

IMPROVING THE BRUNSWICK S14, S21 AND S31

The Brunswick models S14, S21 and S31 sets use a chassis which may, for all practical purposes, be considered identical. After several years of service work on these machines, I find that the most practical means of overcoming their most common fault—lack of volume; particularly, during the day—can be accomplished with little or no expense to the Service Man.

As the reader will note by reference to Fig. 11A, the set uses an R.F. choke, R.F.C., as the primary winding of the second and third R.F. stage transformers. This choke is capacitatively coupled to the secondary winding by the use of a 2.5 mmf. condenser; the detector stage is coupled in like manner to the third R.F. stage.

To convert this set into a much more powerful and efficient machine simply remove the R.F. chokes and wind a primary winding, P, in Fig. 11B, of about twenty-five turns on each of the R.F. coils. This can be accomplished without removing the R.F. coils from the set.

(Note that the 2.5 mmf. condensers are thin metal disks using an insulating material for both mounting and insulating purposes. These are automatically removed upon taking out the R.F. chokes.)

CHARLES BASKERVILLE,
1922-53rd Ave.
Meridian, Miss.

WHAT IS WRONG WITH OUR PENTODE CIRCUITS?

Some of our well-designed receivers employing type 47 pentode tubes are coming in for their share of criticism, due to hum, distortion, blocking on loud audio signals, and cutting off (in some instances). These complaints are all due to one condition. Many Service Men have noticed this trouble and quickly attributed this to a defective pentode tube and one prominent writer puts the blame on "gassy" pentodes, but the trouble, which

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is becoming general, is due to neither of these causes.

When a type 47 tube suffers a slight decrease in mutual conductance and is used in a receiver, ten minutes after it is put in operation the set begins to hum, being accompanied by blocking on the louder notes; sometimes the set stops dead, a hum only being audible. Service Men have been "getting away with it" by replacing the pentode (which does not test weak in a tube checker, thus curing this trouble for a few months; sometimes a new tube will correct this fault for a few days only.

To quickly ascertain if the receiver will cut off in service, momentarily swing the pentode control-grid positive by shorting the control-grid to the screen-grid in sets having a resistance-coupled input to the pentode; put a 45 V. battery in series, momentarily, with the secondary in receivers which use a transformer-coupled input; or, read the pentode plate current when first put in operation and note, after ten or fifteen minutes, whether the plate current rises 50% or more and stays there for a half-minute or longer—this would definitely assure that this set would cut off in service. At this increased plate current it hums and sometimes cuts off.

The Philco 70 and 90 models are indicative of the above trouble. A Philco 47 tube was used, having a change of 5 when tested in our tube checker as compared to 7 for a new one. The set would cut off, and hum, and distortion was present, but when this tube was put in a set of a certain other manufacturer, it performed normally. How can this tube be defective? Inserting a new pentode quickly cures the trouble, but it is sure to occur again.

We have, after considerable time, traced this trouble to a faulty pentode output circuit. At a slightly reduced mutual conductance, the conditions become favorable for this tube to become an oscillator, due to it working into a high impedance load (7000 or 8000 ohms being recommended for maximum undistorted output for the type 47). This high impedance between our plate and screen-grid makes this tube circuit oscillate very easily.

Although the normal plate current for a tube used to check this condition was 25 ma., it gradually crept up until after five minutes it had reached 50 ma., and in seven minutes it was up to 70 ma.; the screen-grid was red hot at these currents, as it too was passing considerable current—6 ma. being the normal screen current, while after seven minutes it was up to 60 ma. This is quite an overload on the power plant, resulting in considerable drop of voltage on the remaining tubes. The hum is due to the filter chokes being saturated, with resultant loss of inductance; the A.F. distortion is due to output transformer core saturation.

In poorly designed sets, this oscillation cannot take place due to the low impedance of the plate load; the resistance of the wire is also greater, since smaller wire would be used, which also tends to dampen oscillations if present.

To stop this oscillation we can do only two things: (1) lower the load impedance so oscillation would be impossible; (2) or, introduce resistance to suppress oscillations in the circuit. We would not consider using a lower load impedance, as that would be poor design, so we must insert resistance in the circuit between screen-grid and plate in a way that it would not impede our voice currents.

To definitely cure this trouble see circuits A, B, and C, in Fig. 12; the following notes fully explain these circuits.

Figure A. To be incorporated in receiver when being designed. Resistor R1 has a value of about 1000 ohms, depending on the bleeder current, and R2 is about 10,000 ohms. That would give about 245 V. on the screen-grid and 250 V. on the plate. The resistance value is sufficient to suppress the oscillations, depending on the impedance of the output transformer primary. High impedance requires the use of a high value of resistance for R2; low impedance, a low value. This is a very satisfactory cure.

Figure B. Philco Model 90, using a single 47 tube. For R, a value of 5000 ohms is satisfactory. A higher value would make the circuit more stable, but an excessive voltage drop would lower the screen-grid voltage. A

condenser value of about 8 mf. is required to filter voltage supply ripples in this case, as it will be noted that the voltage is unfiltered at this point. This, too, is a very satisfactory cure.

Figure C. Philco Model 90, using a single 47 tube. Resistor R measures 5000 ohms. A higher value is desirable, but not permissible due to depriving the screen-grid of some voltage. A resistor of lower value would not be stable. This cure is a very simple one.

Paramount Radio Service,
C. A. Raditus,
64 Hanover St.,
Wilkes-Barre, Pa.

SPARTON MODELS 62 AND 63

With the Model 62 and 63 Sparton a 300% saving in the price of a set of tubes, together with greater range, more power and increased all-around efficiency will be experienced if the old 401 Kellogg tubes are replaced with the new type 485 fast heaters.

New 5-prong subpanel sockets are substituted for the old 4-prong type, and the heater circuit is wired beneath the subpanel. As the old sockets have the neutralizing condensers mounted directly on them it is necessary to leave them in the set and install the new sockets on the subpanel above them.

If trouble is experienced in neutralizing this set, be sure that the neutralizing condensers will open sufficiently. If they do not, a piece of paper inserted under the spring will do the trick.

The tuning condensers on this model also need attention as they do not keep alignment on all frequencies. The compensators should be adjusted at a high frequency and the outside plates bent to align at the low frequency.

CROSLY 601 BANDBOX

In the Crosley 601 Bandbox, power and selectivity may be increased if the first stage balancing condenser is shorted out. If this set is exceptionally broad tuning be sure that the rotor plates of the variable condensers are meshing properly.

Valley Radio Co.
Roy S. Lund,
603 5th Ave.,
Valley City, N. Dak.

ZELTON MODELS 746 AND 747

A complaint was recently made about a Zelton (Pierce Airo) receiver. The customer explained that the set was quite noisy. The nature of this noise was a slow putt-putting; very little volume could be obtained without running into this noise. The set was checked and all voltages seemed to be O.K. It was found that when a 1 mf. condenser was placed across one of the 8 mf. filter condensers the reception improved immediately. There are two 8 mf. condensers (encased) in this model. These were removed from the chassis and checked; one was found to be defective and the other on the verge of breakdown. These were replaced and the receiver began to function as it had never functioned before, according to the customer's statement.

James L. Hoard,
1346 Eddy St.,
Providence, R. I.

4 P. A. AMPLIFIERS

(Continued from page 236)

The amplifiers described in this article have been selected as typical examples of modern power amplifiers available for various classes of P.A. work. However, an article of this nature is naturally restricted due to lack of space and therefore it has been necessary to omit the discussion of 6 V. automotive-type amplifiers and several other distinctive types. If any of the readers of RADIO-CRAFT desire specific information on types of amplifiers not described in this article or if additional information is needed concerning the amplifiers shown, the author will be very glad to furnish the data.

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AN A.F. A.V.C. CIRCUIT

(Continued from page 226)

settings for various parts of the program. This form of anticipation is not readily obtainable in an automatic device unless a complicated delay circuit is devised or the program actually recorded on a record or wire and transcribed a part of a second later, the delay in either case being used to allow for automatic adjustment of the circuit attenuation or net gain.

Figure 1 shows a method of obtaining automatic control of volume but without anticipation. To understand its operation consider the conventional bridge circuit formed by resistors R1, R2, R3 and R4. It is obvious that if the bridge is balanced, that is, $R1=R2$, and $R3=R4$, no signal will appear at the output terminals when one is applied at the input. Conversely, if the bridge is unbalanced a signal will appear. Figure 2 shows the relation of output signal for various conditions of bridge balance, with constant input signal. (Note that transformers T3 and T4 are used to transfer the impedances R3 and R4 to the bridge circuit and may be considered as absent with R3 and R4 connected directly to the bridge circuit. These transformers were added for reasons to be mentioned later.)

Since most studio bus and telephone circuits are 500 ohms all arms of the bridge are made 500 ohms. This gives a total bridge impedance of 500 ohms for the balanced condition and only slightly lower for an unbalance. Naturally to effect a control over the level of the outgoing program, it is necessary to make one of the arms (R4 in Fig. 1) normally less than that required for a balance, and to have this arm automatically approach a balance as the input level is increased. The obvious and correct way to control this balance is by the use of the same, or a similar current as that in the operator's volume indicator meter. Accordingly, the one arm, R4, of the bridge is constructed of heaters, or filaments, in which there is great increase in filament resistance with an increase in the controlling current flowing through them. This controlling current is D.C. separate from the audio being controlled but bearing a direct relation to the level of the signal applied to the bridge input. A control over the output level is thereby effected.

Isolating the A.V.C. Current

Upon consideration of the system it is obvious that the controlling current and circuit must be effectively isolated from the audio in the bridge. This is best done as shown in the diagram, Fig. 1, where the arm R4 is divided in two parts and forming a separate bridge with the secondary of T4. The control current (D.C.) then enters the mid tip of the transformer and filament circuit which is thus completely balanced with respect to the audio system. The two filaments of R4 are approximately the same.

The use of the transformer, T1, is thereby explained as an necessary to prevent interaction between signal and control. Unit T3, an equivalent transformer to T4, is used to maintain symmetry in the audio bridge.

The controlled output of the bridge, taken from T5, may be amplified to restore the level to original average value found at the input of this A.V.C. system. Figure 3 illustrates the complete operation of the A.V.C. and shows how the loud passages are crowded into the limiting range of the succeeding lines and apparatus just as the manual operation would provide. This crowding is obtained without sacrifice of the artist's musical expression because there is still a difference remaining between the various degrees of loudness as shown.

Concerning the operation of this device there are two requirements in addition to that of simply controlling the level.

(1) It must adjust itself quickly enough on sudden application of strong input to avoid notice by the listener.

(2) It must operate slowly enough to avoid distortion of the audio frequency wave form at low frequencies.

It is known that the loudness of a signal is not appreciated by the average human ear unless the duration is about two-tenths of a second. The automatic control then must operate in less time, say one-tenth second. One tenth-second also satisfies (2) above, since it is much slower than the lowest audio frequency used in present communication equipment.

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The delay in this bridge system is obtained in the correct construction of the heaters, R4, and the device which supplies the D.C. to vary the resistance of the heaters. The heater-rectifier system is required to complete about 75 per cent of its final readjustment about one-tenth second after application of a change in input signal.

Because of the wide range of control offered by this simple bridge circuit the entire device may be contained on a standard speech input panel, 19 x 14 ins. high, comparing in size to the conventional studio amplifier. The controls, which are few, may be arranged with the tubes on the front of the panel. A single stage amplifier also can be contained on the panel to bring the average of the controlled output back to the same as that at the input.

Although this method of A.V.C. is obvious and simple, there are certain precautions to be observed in its construction.

(1) The A.F. signal in the bridge circuit causes heating of the controlling filaments just the same as does the controlling D.C. To avoid having the audio effect a control over itself through its heating of the filaments it is necessary to make the controlling D.C. much larger than the effective value of A.F. in the filaments.

(2) Unless precautions are taken, it is possible to increase the input signal to an abnormally high value, causing complete balance of the bridge and zero output. A further increase would then result in an unbalance in the bridge in the opposite direction, with R4 being greater in resistance than R3, and a subsequent loss of control. To avoid this effect, a limiting device must be placed on the control rectifier so that its D.C. output cannot exceed a specific value, this value being slightly less than that required to completely balance the bridge.

Automatic devices for controlling circuit levels are of great assistance in recording and broadcasting where there is need for constant supervision. Such devices are also important features in theatres where the great variety of films being shown have a variety of methods of recording and as many different recording levels. The device described in this article is one of the simplest and least expensive means of obtaining this automatic supervision. It is obvious too, that in commercial communication systems, toll lines, transoceanic service, etc., where assurance of continuous level is so important the device described will be of great advantage. This scheme, which operates entirely on audio signals is not to be confused with automatic volume control used on radio receivers, as the latter, operating on carrier strength, has the distinct service of compensating for carrier fading or differences in carrier amplitudes.

It is possible in some applications of this A.V.C. to avoid the use of a rectifier by applying the amplified audio signal directly to the heater circuit through a proper transformer. The heater circuit then must be carefully balanced.

There are many other possible methods of operation. For example, it is possible to adjust this device to give constant output level for wide ranges in input. Such an application would be useful in the regulation of power supply systems or in maintaining constant output from oscillators or devices delivering test signals.

MULTI-PURPOSE TESTER

(Continued from page 238)

"ma." position to read 0 to 1000 or 10,000 ohms. Resistor R1 measures 4,000 ohms. Resistor R2 is a special rheostat, one-half of which measures 50 ohms and the other, 950; this permits the circuit to be compensated for variations in "C" battery voltage when reading low values of resistance. Resistor R3 is used only when supplied with the meter; the length of the shunt leads must not be shortened. The information in parentheses refers to the dotted portion of the circuit.

The high-grade meter used in this instrument indicates 5 V. and 1 ma. in A.C. circuits, and 50 millivolts and 1 ma. on D.C., at full-scale deflection. The connections at B follow the circuit shown at A in Fig. 1; the only difference is that the wiring to the gang-switch, etc., is more clearly indicated in B.

This new instrument is too versatile to be classed as merely a Service Man's tool—instead, it should find a place wherever test apparatus is used.

A 26W. P.A. SYSTEM

(Continued from page 217)

type 78 tube V2. The I.F. coupling coils L3, L4, and L5, are accurately pre-aligned at 175 kc. It is, therefore, unnecessary to use an expensive oscillator or output meter to "peak" these transformers. The output of the first-detector is passed through the two stages of the I.F. amplifier which also employs two type 78 triple grid super-control tubes, V1 and V5. The oscillator circuit utilizes a type 37 tube, V3, the grid circuit of which is so tuned by a special tracking condenser, CG4 (one of the sections of the 4-gang condenser) as to maintain an exact 175 kc. difference between the R.F. and oscillator signals, throughout the entire wave band. This type of coil, L2, together with its associated tracking condenser, eliminates the cost, and the "tricky" installation (not to forget the adjustment) of a number of "padding" condensers and resistors ordinarily used in single-tuned superheterodyne receivers.

The first I.F. transformer, L3, is furnished with a copper disc between the lattice-wound primary and secondary; this disc reduces the coupling and increases the selectivity of the first I.F. stage. Both L4 and L5, I.F. transformers, are "tightly" coupled (without the copper disc) to provide the necessary flat-top response curve so essential for the equal amplification of all signals throughout the I.F. wave-band. The second-detector input coil, L5, has both ends of its center-tapped secondary connected to the diode plates of the type 85 duplex-diode triode tube, V6, which acts as a full-wave push-pull detector-amplifier and automatic volume control tube, all in one.

The A.V.C. action is produced by impressing the rectified voltage set up across resistor R13 (and its condenser C20) to the grids of the R.F. and I.F. tubes V1, V4, and V5, through resistors R2, R7, R8, and R14. Condensers C2, C7, and C8 keep the A.F. component of this rectified voltage from the grid circuits of the R.F. and I.F. tubes.

The visual tuning meter, VTM in Fig. 4, is connected in series with the primary of the first I.F. transformer in the plate circuit of the first-detector tube. This tuning meter arrangement makes it possible to tune exactly to station resonance, while still retaining the inter-station noise suppression feature. The volume control, R1, may also be used as a sensitivity adjuster (the volume then being controlled by the phono-radio volume control in the input mixer control box unit). By varying the bias on the R.F. and I.F. tubes the overall sensitivity is so controlled as to regulate the amount of noise picked up. This adjustment "cuts off" all of the background noise and permits stations to be tuned in without any accompanying annoying electrical disturbances.

The power supply filter system of the tuner consists of three, 8 mf. electrolytic condensers, C15, C16, and C17, connected across the terminals of the two 30-hy. filter chokes, Ch.1 and Ch.2, and ground.

Both the "B+" and "B-" leads, together with 6.3 V. filament supply lines, are connected to the tuner plug, TP. By using this ingenious arrangement the same filter system of the tuner is employed with both the 110 V., A.C. pack and the 6 V. motor-generator. This economical circuit arrangement permits the use of one filter system to serve two purposes. No changes in the filter circuit are necessitated even if the tuner is constructed, or purchased, for only one mode of operation (exclusive use from either 6 V., D.C. or 110 V., A.C.), for in that case one of the packs is omitted while the filter system is used with the other.

The Power Supply

The schematic circuit of the power pack used with the superhet. tuner while operating from 110 V., A.C. is shown at A in Fig. 6. The specially designed power transformer, PT1, is equipped with a 6.3 V., A.C. winding capable of furnishing 2 A. at 6.3 V. for all of the heater-type tubes employed in the tuner.

A highly efficient motor-generator, with a special filter, is mounted directly upon the tuner chassis and furnishes all of the necessary "B" voltages to the tuner while it is



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being operated from a 6 V. storage battery. The connections are shown at B, Fig. 6. The "B" supply unit is characterized by its trouble-free and noiseless performance. Special, self-cleaning copper-and-graphite brushes prevent the commutator ring from becoming unduly worn or clogged. The use of ball bearings and a sealed-in lubricant in the construction of the motor-generator, make it possible to run the unit for thousands of hours without any attention.

Not only is each component of the motor separately shielded but the entire unit is completely enclosed in a metal case, as well, to avoid electrostatic and electromagnetic disturbances. No unusual precautions need be taken to prevent the sensitive superhet. tuner from picking up extraneous interference from the motor-generator, unless it is impractical to properly connect the tuner chassis to a water pipe or other good ground; in that case, it is advisable to thoroughly lead and ground all of the storage battery leads running to the "B" unit.

The special motor-generator filter, shown in Fig. 6 B, is composed of two, 8 mf., 500 V. dry electrolytic condensers, C23 and C24, a 15 hy. filter choke, Ch.10; an R.F. choke, R.F.C.1 prevents any disturbances originating in the motor-generator front reaching the filter system of the tuner.

List of Parts

- Tuner Unit**
- One 4-gang superheterodyne condenser, 350 mmf., Ck1, 2, 3, 4;
 - One mica condenser, .006-mf., C1;
 - Five tubular paper condensers, .1-mf., 400 V., C2, 4, 5, 6, 14;
 - Two paper condensers, 4-section, .25-mf., 300 V., C3, 7, 18, 19 and C8, 9, 11, 13;
 - One mica condenser, 500 mmf., C10;
 - One tubular paper condenser, .02-mf., 400 V., C12;
 - One electrolytic condenser, triple 8 mf., 500 V., C15, 16, 17;
 - Two mica condensers, .001-mf., C20, 21;
 - One paper condenser, 1 mf., 200 V., C22;
 - One CRL potentiometer, 10,000 ohms with special taper and A.C. switch Sw.1, R1;
 - One Lynch metallized resistor, .25-meg., 1 W., R2;
 - Two Lynch metallized resistors, .1-meg., 1 W., R3, 15;
 - One Lynch metallized resistor, 1,000 ohms, 1 W., R1;
 - One Lynch metallized resistor, 5,000 ohms, 1 W., R5;
 - One Lynch metallized resistor, 2,000 ohms, 1 W., R6;
 - One Lynch metallized resistor, 50,000 ohms, 1 W., R7;
 - Two Lynch metallized resistors, 40,000 ohms, 1 W., R8, 11;
 - Two Lynch metallized resistors, 7,500 ohms, 2 W., R9, 10;
 - Three Lynch metallized resistors, 0.5 meg., 1 W., R12, 13, 14;
 - One wire-wound, center-tapped resistor, 60 ohms, 2 W., RCT;
 - One antenna band-selector coil and shield, L1;
 - One detector and oscillator mixing coil, with plate R.F. choke and coupling condenser CL2 and shield, L2;
 - One first I.F. coil, with shield, 175 kc., L3;
 - One second I.F. coil, with shield, 175 kc., L4;
 - One third I.F. coil, with shield, 175 kc., L5;
 - Two Remington filter chokes, 30 hy., 500 ohms, 40 ma., Ch.1, Ch.2;
 - Two I.F. chokes, 16 mhy., I.F.C.1, I.F.C.2;
 - One Readrite visual tuning meter, VTM;
 - One post assembly, Ant. and Gnd., BP1, BP2;
 - One post assembly, output, BP3, BP1;
 - One heavy-duty battery switch, Sw.2;
 - One Coast-to-Coast drilled chassis: Assortment of necessary hardware, including tube shields, sockets, tuning dial, escutcheons, etc.
- 110 V., A.C., Power Supply**
- One Remington power transformer, type E670, PT1;
 - One Lynch metallized resistor, 1.5-meg., 1 W., R16;
 - One fuse, 2 A., F1;
 - Assortment of necessary hardware.
- 6 V. Battery Power Supply**
- One Remington 6 V. motor-generator, type E670, to deliver 250 V. at 45 ma., MG;
 - One Remington "A" and "B" filter for motor-generator;

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- World-Wide Short-Wave Review, edited by C. W. Palmer.
- The Evolution of Ultra Short Waves.
- A "53" 1-Tube TWINPLEX—One Tube Serves As Detector and A.F. Amplifier, by J. A. Worcester, Jr.
- A Portable 5 and 10 Meter Transmitter-Receiver, by L. L. Horsenpiller.
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One Lynch metallized resistor, 0.5-meg., 1 W., R17;

One "on-off" switch, Sw.1;

Assortment of necessary hardware.

An additional 25 mf., 20 V. electrolytic condenser, C. and an R.F. choke, R.F.C.2, in the "A—" lead keeps ignition interference from the power and filament supply of the tuner (particularly, if broadcast signals are being picked up while the car is in motion).

It should be noted that if a radio tuner of any type is to be used with the amplifier described in the preceding issue, it is then necessary to also equip the 6 V. motor-generator employed with the amplifier, with a suitable filter system similar to the one described above.

Detailed information concerning the accessories which complete this power amplifier system will appear in a subsequent issue of RADIO-CRAFT. Meanwhile, radio technicians will find it convenient and profitable to build the radio tuner described above, preparatory to concluding the construction of the power amplifier system.

"SELECTIVE ANALYSIS"

(Continued from page 238)

very complete chart is furnished showing the prongs connected to the various electrodes on all tubes available today and this chart can be extended indefinitely as different combinations are used so that the material replacement is largely confined to a printed piece of paper.

The tube selector mounts by means of a pair of pin tips on its lower side which engage with blank jacks on the standard model 665 measuring unit. These pins will also fit into the top pair of jacks on the model 660 analyzer, the model 663 volt-ohmmeter and the model 664 capacity meter. The jacks which are used for this mounting are still usable otherwise since extensions bring these connections out to make them available where connections to these jacks are required.

And there is no reason why one cannot use these units with any analyzer, of whatever vintage it may be. A pair of holes to take the pins on the selector will allow it to be mounted on the case or the panel of an older device and immediate measurements of current, voltage and resistance may be made as in any method of analysis and within the limits of the ranges of the particular instrument available. It is believed that this method of attack is a far more logical one than that of rebuilding a unit since rebuilding only defers obsolescence; the procedure followed in "selective analysis" eliminates it. The model 666 tube selectors are obtainable separately or in groups as may be required. It is believed that through their use a more intelligent survey can be made of any radio set as compared to the older, less flexible methods.

INFORMATION BUREAU

(Continued from page 239)

from 30 to 35 kc. This beats directly with the crystal, thus producing a resultant frequency at its output, ranging from 0 to 5,000 kc. The indicator is a rectifier stage with associated gain controls, and is used to mix the various energies to be compared, and to indicate on a millimeter placed in the plate circuit when the two compared frequencies are at zero beat.

The heterodyne oscillator is a calibrated oscillator with a frequency range of from 100 to 2,000 kc. When measuring signals within its fundamental range, it is used as a channel identifier. On high frequencies, its use is somewhat different, and it will be discussed further under "Methods of Measurement."

Only one multi-vibrator, the 10kc., is used in the actual measuring. The others are used for calibrating purposes. The 90 kc. multi-vibrator is used to calibrate the heterodyne-frequency oscillator. After the 90-kc. points have been located, the 10-kc. multi-vibrator is switched into operation and the area between the 90 kc. points is calibrated by 10-kc. steps. Thus it is easy in zero-beating a signal within the fundamental range of the heterodyne-frequency oscillator to determine the approximate frequency.

The 1-kc. and 0.1-kc. multi-vibrators are used to calibrate the audio oscillator. In making a measurement with the heterodyne oscillator alone

one must necessarily interpolate between 10-kc. points. But when the audio oscillator is used, the interpolation is only between 0.1-kc. points. As the frequency curve is practically a straight line over such a short range, very little error is introduced by interpolation.

Methods of Measurement

The general method in making a measurement within the fundamental of the frequency meter is to first zero-beat the signal with the heterodyne-frequency meter, to determine the nearest 10-kc. channel. The 10-kc. multi-vibrator is thrown on, and the signal beats with one of the 10-kc. harmonics. As there is a harmonic present every 10 kc., the resultant beat between the signal and standard is always within the frequency range of from 0 to 5,000 cycles.

This is always present in the output of the receiver and is fed back to the input of the beat indicator where it is zero-beat with the audio oscillator. The audio oscillator has a large precision condenser paralleled by a smaller trimming condenser. The larger condenser has been previously calibrated by the 1-kc. and 0.1-kc. multi-vibrators while the vernier condenser was at a center position. As soon as the difference frequency between the standard and signal has been zero-beat by tuning the large condenser of the audio oscillator, the 0.1-kc. multi-vibrator is thrown on and the 100-cycle points above and below the signal are located. Then it is a matter of easy calculation to find the exact number of cycles the signal is above the lowest 100-cycle point.

As this difference frequency may be above or below the nearest standard harmonic, it is necessary to refer to the heterodyne meter-reading to determine this. The measured difference frequency is then added or subtracted from the nearest standard frequency, as the case may be.

A different procedure is followed in the case of a station signal whose frequency is above the highest fundamental of the heterodyne-frequency meter. In that case, a harmonic of the heterodyne-frequency meter is used to beat with the signal, while the fundamental is measured by the standard. The resulting measured fundamental frequency must be then multiplied by the order of harmonic used. This is determined by previous receiver calibration.

In case a station is only a few cycles off the frequency from a standard harmonic, the audio oscillator is not used, as the difference beat can be counted. Such a measurement is accurate to within one part in a million! A measurement made by use of the audio oscillator is guaranteed to ten parts in a million.

The Monitoring Station has already been a great help to United States radio stations in all classes of service, and especially so to the broadcast class. It is hoped that it will become of greater help as soon as it is generally understood by the owners of transmitting stations that they can obtain a frequency check at any time during a measuring watch by merely calling the Monitoring Station by telephone, or by telegraphing. The work the station is doing in international frequency-checking is expected to be of inestimable value at the international radio convention to be held this year.

"ANALYZER UNIT"

(Continued from page 220)

while the button is pressed. There are spare points available, also, on the current selector switch. All switching is done automatically by the selector switches; there is no awkward and complicated plugging of connectors into a maze of jacks.

Tube testing is available by providing grid-shift switches, Sw.4 and Sw.5, and batteries to function in both the external control-grid circuit and the normal control-grid circuit. This gives the usual relative mutual conductance test as furnished in most conventional style analyzers.

A new feature is the efficient, simple and economical design of the analyzer plug and "sure pull out" adapters. Suitable connectors provide easy connection to the analyzer plug from the set chassis or ground, and also from the control-grid cap. Future changes that might require new analyzer plugs and adapters can be made very easily and cheaply. (This is not the case with most analyzers on the market.)

Although there are many desirable features of this analyzer unit which are not to be had in

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many more expensive analyzers, the entire instrument may be constructed at a cost not exceeding eleven dollars; this includes a crystalline finished case with an accessory compartment, and all adapters and accessories.

Construction Details

Refer to the panel layout, Fig. 2. Turn over the panel so that the back or under-side faces you. Insert sockets V1 to V5, inclusive, in their respective positions so that the filament terminals correspond to the filament markings on the front of the panel.

Wire the sockets in accordance with Fig. 1. (As the terminals of the 8- and 9-prong socket have not yet been announced, omit the wiring of this socket until the relative positions of the filament terminals are published.)

Mount selector switches Sw.1 and Sw.2 in such position that the knob indication corresponds exactly to the position of the switch arm. Proper care should be taken so that the necessary insulating washers are used when mounting these switches to prevent a short-circuit through the panel. Now wire these switches to sockets V1, V2, V3, V4. Next, mount the current selector switch, Sw.3 with the knob indication corresponding to the actual switch arm position, and wire it up. Finally mount the momentary button switches Sw.6 to Sw.11, inclusive, and wire them to Sw.3. Adjust the position of the momentary switches so that there is plenty of spring action; the switch should always make good closed contact unless depressed, when it should sharply open the circuit.

Fasten sockets V1 to V5, inclusive, rigidly to the supporting strip by means of screws and nuts. The "C" batteries are fastened to the supporting strips by friction tape. Insert the two grid-shift switches, Sw.4 and Sw.5, and complete the wiring from them to the batteries and switches.

Mount and wire the insulated tip jacks. One end of the ten-wire analyzer cable is connected to the various switches exactly according to the wiring diagram; the other end connects to the plug. Be sure that these connections are correct to prevent transposition of the leads. Insert the lead with the control-grid connector and connect to the circuit as indicated.

Mount the panel in the case and the complete instrument should be ready for use. It is best to first thoroughly check all the wiring. This can easily be done by means of a continuity test from the terminals of the adapters when inserted into the analyzer plug to make sure that all wiring is continuous to the correct socket terminals and to the tip jacks when the switches are in their respective positions. It is just as important, if not more so, to make certain that no connection is made to wrong terminals which might result in tube burn out or circuit damage.

Operation

The use and application of this instrument is extremely simple. All socket terminals and switch positions are directly etched on the panel so as to be practically self-explanatory.

For analysis, a suitable meter is connected to the tip jack terminals. The analyzer plug with the proper adapter is inserted into the socket of the receiver. Naturally the set must be disconnected from the supply for resistance measurements. Resistance between any two points in the receiver's circuit terminating at the socket terminals may be obtained by setting one of the resistance-voltage selectors at one point and the other selector at the other point.

The same method applies to any voltage measurement between any two points only in this case, the set obviously must be "live." Of course, the conventional voltages and resistances to which most analyzers have been limited can also be measured, but this test unit provides a large number of additional tests that are highly desirable. It is not necessary to refer to charts or diagrams to determine switch settings.

Current measurements are made by turning the current selector switch to the desired circuit and then pressing the momentary switch for meter readings. Obviously the meter is connected to the jacks marked "MILS" for current measurements. When this test unit is used in conjunction with the multimeter, the meter connections can be made permanently so that the multimeter selector switch will automatically connect the meter into the circuit as desired for any range as either voltmeter, ohmmeter or milliammeter.

(Continued on page 251)

READERS' DEPARTMENT

(Continued from page 227)

position.

GEORGE WALLACE,
New York, N. Y.

(Refer also to the Information Bureau of the preceding issue of RADIO-CRAFT.—Technical Editor.)

AN IMPROVEMENT FOR AUTO SETS

Editor, RADIO-CRAFT:

I would like to submit to any one interested in increasing the signal strength (and reducing ignition interference) of auto radio sets, or receivers of any type where it is impossible to secure a good ground connection, a system whereby a small alteration in the original circuit will permit the use of a "counterpoise." The first R.F. transformer must be removed and the electrical connections between the primary and secondary removed, as shown in Fig. 2. Opening the circuit at X, Fig. 2A, leaves one end of the primary free for connection to a second antenna or counterpoise, as shown in Fig. 2B. If the original antenna was in the car roof the second (and additional) antenna should be placed under the running board or between the axles; or, if the original was under the car, the second should be in the roof.

GLENN KELLEY,
Clovis, New Mexico.

TRANSPPOSITION LEAD-IN BLOCKS

Editor, RADIO-CRAFT:

While searching for a suitable transposition block for a receiving antenna of the type described in a recent issue of RADIO-CRAFT, the writer conceived the idea of using $\frac{3}{4}$ -in. "slices" from coil forms about 3 in. in diameter, as illustrated in Fig. 3. Four holes are drilled 90 degrees apart, one pair of opposite holes being on one edge of the form and the other pair on the other edge. By bringing the wires through the holes, as shown, they are transposed at right angles, the wires being about $\frac{1}{2}$ -in. apart.

This gives a unit which transposes the wires, is lighter than any substitute the writer has run across, and can be built for next to nothing.

ROLAND FITZGERALD,
Gilroy, California.

ANOTHER WAY TO REDUCE SPEAKER HUM

Editor, RADIO-CRAFT:

Many of the earlier types of dynamic speakers were equipped with low-resistance field windings, and low-voltage oxide-die rectifiers for field excitation. To reduce the A.C. hum, some of these speakers were equipped with "shading rings," and others with high-capacity electrolytic condensers. The Peerless is an example of a speaker having both the shading ring and condenser. Still other speakers were equipped with nothing except blind faith in Providence to insure satisfactorily hum-free operation.

Shading rings are of only meager benefit in hum reduction, and the high-capacity electrolytic condensers used for such filtering invariably "lose their prime" in a few months, and require replacement with a new condenser or other filtering scheme. The writer proposes to explain one method which has been found expedient in reducing speaker hum.

Let us first understand that this method is recommended only for speakers having separate, low-voltage rectifiers for field excitation, and low resistance field windings, up to perhaps 50 ohms. It is not recommended for speakers in which the field winding is used as a choke in the power supply circuit of the receiver itself, since such speakers invariably have high-resistance windings—400 to 500 ohms, or more.

As Fig. 4 shows, a resistor, R, is connected in parallel with the field winding. The resistance of this unit represents an additional load on the rectifier, and consequently, it should have from five to ten times the resistance of the field. Such a portion of this resistance is included in the voice-coil circuit and the polarity of the connection so chosen, that the hum voltage introduced into the voice-coil circuit by the



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Any of the equipment comprising the Playhouse Sound System may be purchased separately.

- 1 Acratone 125 Class A Prime Triple Push-Pull Power Amplifier complete with Raytheon tubes \$ 42.50
- 1 Acratone No. 725 Condenser Microphone complete with Raytheon tubes 37.50
- 1 Acratone No. 720 Condenser Microphone Supply 19.50
- 2 Oxford No. 548 Theatre Model Dynamic Speakers 16.90
- 1 Acratone No. 85 Speaker Exciter 44.25
- 3 Raytheon '80 type Full Wave Rectifier tubes 1.34
- 100 Ft. Silk Parallel Wire95
- 2 Studio Speaker Cabinets, No. 755 13.90

\$136.94

Our Special Unit Price \$130.00 complete

Federated Purchaser, Inc.
25 Park Place, New York, N. Y.

Send for your copy of the valuable Acratest Sound Book FREE

portion of the shunt resistance included will be equal and opposite to the hum voltage induced in the voice coil itself by the speaker field. Since the ratio of hum current to D.C. is much larger in the shunt resistance (which offers the same impedance to either D.C. or A.C.) than in the highly reactive field winding, and since the voice coil is not closely coupled to the field winding, it is necessary to include only a small fraction of the total shunt resistance in the voice-coil circuit to secure the requisite bucking voltage. Usually, considerably less than 1% of R, connected between A and B in Fig. 4, will do the trick. For speakers of the type for which this scheme is recommended, the absolute value of this portion of resistor R will be small compared to the voice-coil impedance, and so will introduce no appreciable loss in efficiency.

The field hum cannot be entirely eliminated by this method, because accurate control of the phase of the bucking voltage is not possible with such a simple circuit; but the writer has found it very beneficial in reducing field hum, notably on Peerless speakers.

Occasionally, hum due to insufficient filtering of the power supply of the set can be partially compensated in this manner, by balancing it against an equal amount of hum of opposite polarity in the voice-coil circuit, picked up in the manner shown from the speaker's field supply circuit.

C. G. SERIGHT,
E'wood, Ind'iana

IT DOESN'T PAY TO BE CARELESS

Editor, RADIO-CRAFT:

Every radio technician knows what a task it is to move a heavy console containing the radio receiver; or, in many cases, a phonograph combination with all its heavy component parts; yet it must almost always be done in order to obtain access to the interior of the console for testing the radio or the phonograph equipment. What generally happens, when this heavy piece of furniture is moved, particularly on highly polished hardwood floors, is that deep and unsightly scratches are made, resulting in a displeased customer.

I have found that the simplest and the easiest way of moving a console, is to place a piece of heavy, 6x6 in. felt pad under one leg using this leg as a pivot. Try this little stunt and you will be surprised to note how easy it works, and best of all there will be no scratches on the floor surface.

R. F. LAMBERT,
Detroit, Michigan.

AMERICA'S OUTSTANDING MICROPHONE VALUE!



Lifetime Model No. 88

Is the most remarkable value in a microphone ever offered! It is ruggedly constructed—precisely machined—beautifully chrome plated— $3\frac{1}{2}$ " diameter—2" thick overall—and weighs $1\frac{1}{2}$ pounds. It has a duralumin diaphragm .002" thick—gold spots—special stretch ring arrangement—gold contact buttons of 200 ohms each—is scientifically dampened and possesses a curve response between 40 and 7500 c.p.s. within 1 db. Unconditionally GUARANTEED to more than please you!

Our Special Introductory Offer
A \$43.00 Value Double Button Microphone Outfit for only **\$9.95**

- sent postpaid on receipt of remittance—or C.O.D. plus charges.
- HERE'S WHAT YOU GET—**
- 1 Model No. 88 Microphone, List \$35.00
 - Sold Separately at \$6.95
 - 1 Model No. 88 Stand with springs \$4.50
 - Sold Separately at 1.95
 - 1 Shielded Matching Transformer, \$2.75
 - Sold Separately at 1.45
 - 1 Three Conductor 8 foot mike cable .45

Write for descriptive literature of our Electro-Dynamic Speaker Unit—Aluminum Trumpets, etc., offered at lowest prices in America.

Another Amazing Offer!

Model No. 6 Double Button Microphone — for amateurs — public addresses, etc. A \$17.00 value for only **\$4.95**

- This outfit consists of—
- 1 Model No. 6 Mike, List \$10.00, our price \$2.50
 - 1 Model No. 6 Stand and springs, and individual call letters, \$3.50 1.75
 - 1 Matching Transformer, \$2.75 1.45
 - 1 Set, 3 cond. Mike Cable, \$7.5045

Model No. 6 in a bright aluminum finish, precisely machined Mike— $3\frac{1}{2}$ in. diameter—1 in. thick—weighs 8 oz. Has gold plated diaphragm of special construction—gold plated buttons—200 ohms each. Frequency 40 to 3500 cycles within 4 db.



The LIFETIME CORP. 1300 Dear St. Toledo, Ohio

The Radio-Craft Library Series covers accurately every branch of Radio—and thoroughly, too

Presented on this page are the new books of the RADIO-CRAFT LIBRARY—the most complete and authentic set of volumes treating individually, important divisions of radio. Each book has been designed to give radio men the opportunity to specialize in one or more of the popular branches of the industry. The material contained

in these books will increase your knowledge; you will find them a real help in your work and they will contribute to your money earning capacity. Read these books during your spare time at home. The authors of these books are well-known to everybody. Each one is an expert radio man; an authority on the subject—each is thoroughly

familiar with the field which he represents. This is perhaps the first real opportunity that you have ever had to build a radio library of books that are authentic, right-up-to-the-minute and written so that they are easily digested and clearly understood. Mail coupon below for your books.

TO THE RIGHT WILL BE FOUND A SHORT RESUME OF EACH BOOK



Book No. 1 Radio Set Analyzers

And How To Use Them
With Full Instructions and Descriptions of Set Analyzers, Tube Checkers, Oscillators, Etc.
By L. VAN DER MEL
This book explains thoroughly the operation of set analyzers, tube checkers, oscillators and other testing equipment. For every radio man this book is extremely helpful. It covers every phase of testing and gives you valuable short cuts; completely illustrated with photographs and diagrams to facilitate the use of modern testers. Recently reprinted.

Book No. 2 Modern Vacuum Tubes

And How They Work
With complete Technical Data on All Standard and Many Special Tubes
By ROBERT HERTZBERG
MODERN VACUUM TUBES describes the fundamental electron theory which is the basis of all vacuum tube operation, and goes progressively from the simplest two-element tubes right up to the latest pentodes and thyatrons. It is written in clear, simple language and is devoid of the mathematics which is usually so confusing. Valuable reference charts and characteristic curves of standard and special tubes are to be found, also diagrams of sockets and pin connections.

Book No. 3 The Superheterodyne Book

All About Superheterodynes
How They Work, How to Build and How to Service Them
By CLYDE FITCH
There is no more fascinating a subject in the large array of radio circuits than the famous superheterodyne circuit. Whether you are a Service Man or experimenter, first-hand knowledge about the construction of superheterodyne receivers is very important. The book on Superheterodynes gives underlying principles of their construction, right from the very first set made.

Book No. 4 Modern Radio Hook-Ups

The Best Radio Circuits
A Complete Compendium of the Most Important Experimental and Custombuilt Receivers
By R. D. WASHBURNE
It is fascinating to the experimenter, or even to the up-to-date Service Man, to take a commercial set and to change it into one using a famous hookup that is not found in any manufactured set. Many excellent circuits have never been commercialized, but limited only to home set builders. Thousands of these popular circuits have been requested from time to time, and in this book we have included over 150 circuits, which include the famous Peridyne, Cash-Box, A.C.-D.C. Set and others.

Book No. 5 How to Become a Radio Service Man

How to Get Started and How to Make Money in Radio Servicing
By LOUIS MARTIN
The ambition of many men in radio today is to become a first-grade Service Man. It is not as difficult as one might believe, but it cannot be done in a few short months. Following very carefully the advice of Mr. Martin, who has dealt with the problems of thousands of Service Men, this book deals very carefully with the essential stages in the preparation for qualifying as a Service Man.

Book No. 6 Bringing Electric Sets Up to Date

With Pentodes, Multi-Mus, Dynamic Speakers—Complete Information How to Modernize A. C., D. C. and Battery Operated Receivers
By CLIFFORD E. DENTON
In this country there are over ten million electrically operated receivers that could be modernized by placing in them new type tubes, new speaker equipment and other modern improvements. This business of improving old sets can go to the experimenter and Service Men if they will quickly jump into action.

Book No. 7 Radio Kinks and Wrinkles

For Service Men and Experimenters
A Complete Compendium on the Latest Radio Short-Cuts and Money-Savers
By C. W. PALMER
It often becomes necessary for experimenters and Service Men to call upon their memory for some short cut or radio wrinkle that will solve a problem quickly. In business, "short cuts" mean time and money saved, and to the Service Man "time saved" means money earned.

Book No. 8 Radio Questions and Answers

A Selection of the Most Important of 5,000 Questions Submitted by Radio Men During the Course of One Year
By R. D. WASHBURNE
There have been collected a wide variety of questions which have come into our editorial offices during the past two years, and only those whose answers would benefit the majority of men engaged in radio have been incorporated in this amazing question and answer book. A tremendously long list of topics is treated.

Book No. 9 Automobile Radio and Servicing

A Complete Treatise on the Subject Covering All Phases from Installing to Servicing and Maintenance
By LOUIS MARTIN
Automobile radios are up and coming, and someone has to service them properly. It therefore behooves you to read this immensely important new book on the art of Automobile Radio. The book is concise, and full of illustrations, photographs, diagrams and hookups.
A few of the really interesting chapters: Introduction; Automobile Radio Installations; Complete Descriptions of Commercial Automobile Receivers; Servicing Automobile Receivers; The Ignition System; General Servicing Considerations; Effects of Temperature on Power Supply; Conclusion.

Book No. 10 Home Recording and All About It

A Complete Treatise on Instantaneous Recordings, Amplifiers, Commercial Machines, Servicing, etc.
By GEORGE J. SALIBA
If there is one subject that is fascinating to every radio man, it is that of Home Recording. Of course, this volume is not all on "Home" recording, but the information contained therein is important to commercial radio men, studio operators, engineers and others interested in this phase of radio.
The art of recording and reproducing broadcast selections is becoming more important every day to radio men, experimenters and Service Men. Equipping dance halls, auditoriums, churches, restaurants and homes with public address systems and amplifiers brings many extra dollars and often an excellent income.

Book No. 11 Point-to-Point Resistance Measurements

The Modern Method of Servicing Radio Receivers
By CLIFFORD E. DENTON
Of the difficult problems which Service Men face today when repairing receivers, the greatest is that of replacing proper resistors in place of worn-out resistors. This task has become even more difficult when the value of resistors are unknown and manufacturers of many standard sets do not give this information on their Service Men. In this new book, radio men will find the information needed to quickly place a resistor in normal operating condition. This book cuts in half the time usually required to adjust the average set. Sufficient space has been devoted to the elementary problems and the theory of electricity as it is applied to resistance measurements so that the Service Man will have a comprehensive basis to overcome this problem. Below you will find a partial list of the contents which will assist in this new book.
INTRODUCTION; Advantages of Resistance Measurements; Method of Servicing for Radio Work; Basic Principles; Methods of Resistance Measurement; Resistance in Radio Receivers and Amplifiers; Point-to-Point Resistance Measurements in Typical Radio Set using Ohmmeter; Resistance Measurements using Modern Tester; Resistance Testing where Circuit Diagram is Available and where Resistance Measurements are Unknown; the Relation of Voltage Testing Methods to Resistance Measurements; APPENDIX; Resistance Charts, etc.

Book No. 12 All Books Uniform

The books in the new RADIO-CRAFT LIBRARY are all strictly up-to-date, and written by men who know their subjects. The volumes are all uniform, i.e. 6 1/2 inches, and contain an average of 50 to 120 illustrations. Each book is printed on the book paper and no expense has been spared to make it an outstanding value for its editorial contents as well as from the mechanical standpoint.

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I have circled below the numbers of books in the RADIO-CRAFT LIBRARY, which you are to send me, and have deducted 20% for ordering five (5) books or more. I have included my remittance in full, at the price of 50c each, when less than five books are ordered.

The amount of my remittance is.....(Stamps, checks or money orders accepted.)
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In order to make it possible for everyone to buy these books the fifty (50) cent price has been made uniform for all volumes. You can buy these books separately, but you should take advantage of our special offer.

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Deduct 20% from Your Remittance

Simply fill in the coupon at left, and mail it to us together with your remittance, checks, stamps or money orders enclosed.

"ANALYZER UNIT"

(Continued from page 248)

List of Parts

- One Super Test etched and drilled panel;
- Five sockets V1, V2, V3, V4, V5;
- Two 12-position selector switches, Sw.1, Sw.2;
- One 8-position, 2-section switch, Sw.3;
- Three knobs with indicators;
- Six momentary S. P. S. T. switches, Sw.6, Sw.7, Sw.8, Sw.9, Sw.10, Sw.11;
- Two momentary S. P. D. T. toggle switches, Sw.4, Sw.5;
- Six ft. 10 wire analyzer cable;
- One 7-prong analyzer plug;
- Four analyzer plug adapters, 4-, 5-, 6-, 7-prong;
- One control-grid lead and cap;
- Four insulated tip jacks;
- Two 4½ V. flashlight "C" batteries;
- One crystalline finish case with accessory compartment;
- One set of connectors for control grid and chassis.

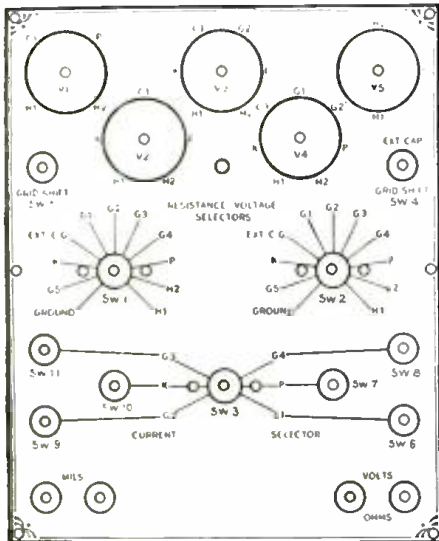


Fig. 2
Panel layout of the "analyzer."

SERVICING TALKIES

The forthcoming issue of **RADIO-CRAFT** will contain an introduction to a series of articles opening up an entirely new field for the radio Service Man.

Up to now, the talkies have been "forbidden fruit" to independent Service Men—learn how you can reap profits from this "gold mine!"

CLASSIFIED ADVERTISEMENTS

Advertisement in this section are inserted at the cost of twelve cents per word for each insertion—name, initials and address, each count as one word. Cash should accompany all classified advertisements unless placed by a recognized advertising agency. No less than ten words are accepted. Advertising for the November 1933 issue should be received not later than September 9th.

POCKET RADIO

GUARANTEED "POCKET RADIO," \$2.00. Catalog, 10c. Neil Tasker, Shamokin, Penna.

RADIO

RADIO PARTS—WE CARRY EVERYTHING for receiving and transmitting. Wedel Co., Inc., Wholesale, Seattle, Washington.

RADIO-CRAFT for OCTOBER, 1933

RADIO PROGRESS WEEK

(Continued from page 239)

3. Study the dealer plan book and the detailed suggestions prepared for the dealer and Service Man and see just how he fits in and the opportunity it provides to increase his sales.

4. Work out on paper what can be done cooperatively by your committee to overwhelm the competition of automobiles, refrigerators and other appeals in your town and capture public interest for radio operation during this campaign to stimulate buying, in advance of Radio Progress Week and arouse and guide local dealers to do a better selling job.

5. Make every radio distributor in town a member of the local campaign committee. Under the chairman of this general committee establish three standing sub-committees to run the local campaign—an executive committee, a meetings committee and a publicity committee. The executive committee can appoint other sub-committees that may be required for special activities.

6. As soon as plans are formulated, the executive committee should meet with the heads of the local broadcast companies and discuss their interests in the campaign and the opportunities for cooperation between the studios and the trade in the campaign and after.

7. The general chairman and the chairman of the publicity committee should visit the local newspapers calling on both the editor and the advertising manager, explaining the purpose of the campaign asking for cooperation in the editorial columns and offering to help them develop radio advertising through cooperative pages, etc. News stories will be provided from the national Campaign Headquarters that can be released by the local chairman to the newspapers, at different times during the campaign, but other opportunities for publicity should be developed by the publicity committee.

8. Call on the local power company and tie them into the campaign both as radio dealers and because they benefit by the use of extra light. Whenever there is an important evening broadcast, the lighting load on the power line goes up. They should be willing to support the campaign in their advertising and contribute to the committee fund.

9. Call a meeting of all radio dealers and independent Service Men in the city to tell the main features of the campaign and develop harmony of purpose and enthusiasm. In this meeting emphasize—

(a) The necessity for getting ready in advance for the September sales drive, following the dealer plan book and the suggestions to dealers and Service Men from Campaign Headquarters.

(b) The value of playing up Radio Progress Week in every store by using the campaign advertising and display material and featuring the coming broadcast programs to every customer and prospect.

(c) The importance of harmony and cooperation among the dealers in supporting the local program, if the radio business is to ride over the competition of automobiles, refrigerators, etc., and capture the home market this fall.

10. Invite to this dealer meeting radio dealers and Service Men from neighboring communities served by the local distributors and offer to guide them in forming local dealer committees in their towns to organize cooperative publicity. Impress upon them that there will be extensive national advertising to the farm market which should be capitalized by every rural dealer to increase his sales of battery sets and auto sets beyond the reach of power lines.

11. Have the publicity committee check up on all dealers in time before September 1, to see that they are provided with the campaign display and advertising matter. Help coordinate the distribution of this dealer help material to prevent waste and insure its use.

12. Ask at headquarters for information on Radio Progress Week as the program builds up. See that dealers and newspapers all have the details and public interest is aroused in the monthly features of the broadcast, as programs are scheduled on the national networks and at the local stations.

13. It is the business of the local committee to organize publicity and promotion activities that can be done cooperatively with better effect and more profitably than by a single dealer. Many suggestions will be received from many sources. They should be reviewed by the com-

Silver-Marshall Manufacturing Co. Presents



Round-the-World receiver
LABORATORY BUILT
—the startling new
Hallicrafters'
All-Wave SUPERHETERODYNE

Guaranteed Selectivity

New Clough Quadro-Tuned Intermediate Amplifier provides selectivity guaranteed to be greater than that of any other set, yet eliminates distortion from sideband cutting.

Automatic Tone Control

Another great first! Noise-free short-wave reception. Interstation noise on both local and distance reception and annoyance from static eliminated.

World-Wide Reception

England, France, Italy, Australia, Germany and many others tuned consistently because of new super power tubes used in circuits of high efficiency developing tremendous amplification.

Color Band and Frequency Index Tuning Dial

Tedious hunting for short-wave stations is done away with. New colored frequency-band dial with shadowgraph band indicator and each band divided into channels marked with the class of stations occupying them, it used.

Write for complete information about this new super-power receiver. It is totally unlike any set ever before designed. Learn what Hallicrafters' will mean to the future of radio!

FREE — this new book
Hallicrafters'

The Silver Marshall Manufacturing Co.
417 N. State St., Chicago, U. S. A.

Silver Marshall Manufacturing Co. Dept. A
417 N. State St., Chicago, U. S. A.

You may send me FREE your new book telling the remarkable story of HALLICRAFTERS'.

Name _____
Address _____

TRY



TUBULARS

They're Triple-Tested



body-wax covering—and finally, after its ends have been sealed with the famous Tobe MOISTURE-PROOF end seal.

By using Tobe Triple-Tested Tubulars, you can be sure that your replacements will stand up. Available in single and dual sections, 200, 300 and 400 volts.



We carry a complete stock of Tobe condensers

BURSTEIN-APPLEBE COMPANY

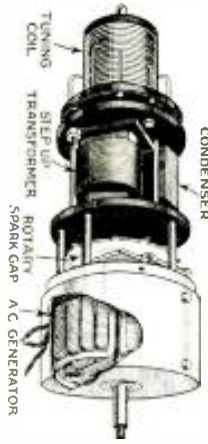
1012 McGee Street, Kansas City, Missouri



Outside View of Aircraft Generator

BARGAIN SALE of 3000 WESTINGHOUSE Power Generator Aircraft Transmitters

Hundreds of Uses for Radio Experimenters



View of Aircraft Generator with Hood Taken Off

The Government Paid Originally \$147.00 Each for these Westinghouse Generators

OUR PRICE \$4.95 EACH AS LONG AS SUPPLY LASTS

Technical Specifications

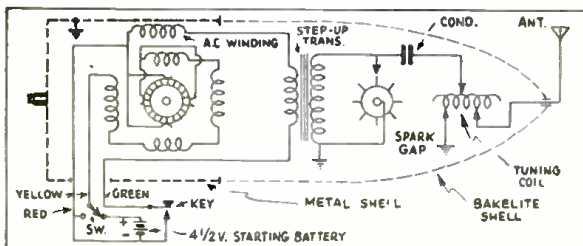
The special generator illustrated is of the self-excited inductor type. The rotor serves two entirely distinct purposes: 1. It carries the inductors for the A.C. generator, which has stationary field and armature coils. 2. It carries the D.C. armature, which corresponds to the exciter in other machines.

There are two pairs of stator poles—two North and two South. Around these four poles are wound the four field coils which, when energized, produce poles of alternate polarity. Each of these poles is provided with four slots into which are fitted the A.C. windings. The rotor is a 12-tooth inductor that carries the D.C. armature coils which supply the D.C. exciter current required by the alternator; a built-in commutator takes off the generated D.C. Three leads extend through the casing to permit a 4½ V. flashlight-type battery to be switched into circuit for starting, and to control the A.C. output of the generator. Rotated at its normal speed of 4,500 r.p.m., the output is 200 W., at 115 to 125 V. (on open circuit), 900 cycles.

Manufactured by Westinghouse for the U. S. Signal Corps, the sturdy construction of this instrument recommends it to the technician. The rotor turns in ball bearings. In order to perfectly withstand the extremes of temperature and humidity encountered in air-craft service all the coils are thoroughly impregnated with a special

compound and then baked. Shaft length (driving end), 2 ins.; diameter, 9/16-in.; the end is threaded for a distance of ½-in. At the end opposite from the drive the shaft extends ¼-in. Case dimensions, exclusive of the shaft, 4½x6¼ in. in diameter.

The output of this self-excited generator is fed to a step-up transformer which, in turn, is fed to a 12-point synchronous rotary spark-gap; a rocker permits the single stator point to be accurately adjusted to phase the spark and the power supply. The spark-gap is included in a secondary that comprises a mica fixed condenser, and a tapped tuning inductance adjustable in the range of 250 to 550 meters. This coil consists of 25 turns of No. 14 wire wound on a threaded bakelite form 3 ins. in diameter and 3 ins. long; the over-all length is 4 1/8 ins. One set of taps is brought to a contact plate at one end and provided with a switch; the other set is brought to a contact plate at the opposite end and provided with a pair of laboratory-adjusted contacts. A stream-lined bakelite housing slips over the entire transmitter assembly. The over-all length of generator (exclusive of shaft) and transmitter is 18 ins. Weight of complete outfit, 20 lbs.; shipping weight, 35 lbs.



WELLWORTH TRADING COMPANY
Dept. RC-10
111 West Lake Street CHICAGO, Illinois

THESE GENERATORS HAVE NEVER BEEN USED AND ARE SHIPPED IN THEIR ORIGINAL PACKING BOXES. THEY ARE FULLY GUARANTEED TO BE AS DESCRIBED ABOVE.

WELLWORTH TRADING CO., Dept. RC-10
111 W. Lake Street, CHICAGO, Illinois

Enclosed find \$4.95 for which ship by express collect one Westinghouse Power Generator Aircraft Transmitter as per your description.

NAME
ADDRESS
CITY STATE.....

mittee and those adopted for use referred to appropriate sub-committees to put them over. Ideas that are discarded should be offered in rotation to individual dealers and if not accepted by them for use, passed on to some one else, so that the widest possible variety of promotion can be featured to increase public interest for the benefit of the entire trade. The following ideas are typical of the kind of promotion stunts the committee can profitably organize—

- Run a prize contest to locate the oldest set in town; or the best "DX" receiver; or the best short-wave receiver.
- Conduct a cooperative parade of auto-radio equipped cars, tuned to the same program, throughout the residential district and take names for future demonstrations.
- Install an auto radio in a kid's toy pedal-car and have him pedal it through the downtown section. Advise newspapers of the stunt and get Radio Progress Week publicity.
- Make a public bonfire of old trade-ins to obtain publicity.
- Give away old trade-ins (renovated) to institutions during Prosperity Month.
- Stage a "broadcast" from the store window via a public address system carrying it to the street. Use local talent in a sort of "amateur radio artist night."
- Arrange with some local amateur or amateur club to transmit messages (without pay) to distant points. Accept messages at the dealers' stores.
- Conduct a "treasure hunt" with a rebuilt trade-in or inexpensive midget as the hidden prize. Get names and addresses of all entries before giving out sealed "search-instructions."
- Stage a "radio man hunt" with clues broadcast from the local studios, through sets on the sidewalks before every radio store, all tuned in.
- Hold a "radio dance" in town, music to be provided by a public address system and each dealer to present a ticket to those who purchase or recondition sets during September and to sell tickets to others. Modern sets to be displayed around the walls.
- Organize a radio show and have the broadcasting from a local station conducted in the show behind a large glass window through which the public can observe—with personal presentations of artists. Hold the show a week or two before Radio Progress Week so people will make selection and have their new sets installed before the week of special broadcasting.
- Arrange with local broadcast studios to keep open house during Radio Progress Week. Admittance to be by cards, presented by local dealers, to every customer for a new set or reconditioning job during the September Sales Drive. Stations will send invitations to their own prospective program sponsors. Artists to act as hosts and hostesses.
- Arrange with local movie house to give away radio sets as prizes during September and Radio Progress Week.
- Schedule the presentation of a radio set by the committee each day of Radio Progress Week to a crippled or blind child where there is no radio now.
- Erect a booth in some prominent public spot and equip it with a sign, "Free question and answer service about radio during Radio Progress Week." Alternate Service Men in the booth to do the actual work.
- With the cooperation of other dealers, rig up loudspeakers all over the main street. Induce storekeepers in other lines to borrow sets and tune in before their shops. Every evening during Progress Week tune all sets to same program so that no matter where shoppers walk they hear the same, continuous broadcast.
- With other local dealers, declare "open house" during Radio Progress Week. Instruct salesmen to stay in the background and wait until approached by prospects before making any attempt to sell. Call attention to the "no salesman" idea. Take all prospects who ask questions away from the set display into an office or another room so that others will not see the actual selling process.
- Establish a fund to defray the moderate expenses of such a program by subscriptions from local distributors and dealers. Avoid expense by drafting mechanics and salesmen of local radio wholesalers and retailers for emergency work in putting on these publicity stunts.
- At the close of the campaign impress on all distributors and dealers that they need not quit selling when Radio Progress Week is over.

SURPLUS RADIO PRODUCTS

(ORDER DIRECT FROM THIS
ADVERTISEMENT—WE DO NOT
ISSUE ANY CATALOG)

We have on hand



779 UTAH DYNAMIC SPEAKERS

(10" Diameter)

SPECIFICATIONS: Field 1,750 ohms; for single '47 tube; equipped with hum-bucking coils and bakelite connection strips.

PRICE
as long as
supply lasts

\$2.29
Each

Sale of 337 King-Silvertone POWER PACKS



A replacement unit for the popular King and Silvertone sets. Contains of Power Transformer and Choke for Silvertone 1928 and 1929 Models, and for King Models H and J. Measure 6 1/2 x 5 1/2 x 2 3/4". Wt. 5 lbs. Supplies 4-226, 1-227, 2-71A and 1-280. Specification: 1 1/2 V. at 3 1/2 amps.; 2 1/2 V. at 1 1/2 amps.; 5 V. at 1/2 amp.; 5 V. at 2 amps.; 600 V. C.T. at 60 mils.

PRICE
as long as
supply lasts

\$1.73
Each

REMIT BY CHECK OR MONEY ORDER FOR FULL AMOUNT OF EACH ITEM—SHIPPED EXPRESS COLLECT, NO C. O. D. ORDER ACCEPTED—MONEY REFUNDED IF NOT SATISFIED.

Wellworth Trading Company 107-1033
111 West Lake Street, Chicago, Ill.

Enclosed you will find my remittance of \$..... for which please send me:

- () Utah 10" Dynamic Speaker, \$2.29 each
() King-Silvertone Power Pack, \$1.73 each

Name

Address

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

Meet Us At The RADIO SHOW

Three full years of progress in the electrical and radio industries, combined, will be shown in the 1933 National Electrical and Radio Show now definitely scheduled for Madison Square Garden, in New York City over a period of eleven days, September 20 to 30, inclusive—for there have been no major public shows in these allied fields during that time, not since 1929.

"The most interesting and educational show in the history of radio is now assured," was the opinion expressed by Irving Sarnoff, in behalf of the Electrical Association of New York, sponsor of the exposition.

"For the first time these allied interests of radio and electricity have teamed up to exhibit their new developments and styles, both commercial and scientific, to the interested public at just the right time to most benefit manufacturer and dealer, when business and buying are on the upturn, via the New Deal." Mr. Sarnoff continued. "In my opinion the coming show not only will mean much to the radio buying public which for the past two years has not been afforded the opportunity to see the new styling and developments in radio sets and equipment at a big exhibition, but its success is going to mean even more to the dealers and manufacturers."

"Stocks on hand are very low. At Madison Square Garden, the public, now ready to buy, will see fresh merchandise, new merchandise, better merchandise. With attendance likely to run into some hundreds of thousands during the eleven days of the exhibition, dealers and manufacturers will have the opportunity to quickly sense and gauge the likely demand and fancy of their immediate consumer market."

According to Joseph Bernhart, manager of the Show, more than 60 percent of all available space on the show floors has already been contracted for, with an additional percent of space reserved for the use of present exhibitors in case they decide to put in more displays. Many of the exhibitors have nationwide radio programs and for their benefit, as well as for the broadcasting of special programs now being arranged by N.B.C., Columbia and other radio groups, two completely equipped studios will be erected at Madison Square Garden.

In addition to these special radio program features, when the public may see many of the favorite radio stars in action, other colorful and interesting radio developments will be displayed and demonstrated as educational drawing cards. Invitations have been extended to the New York Police Department to show its newest equipment in short-wave radio communication to squad cars, police aeroplanes and harbor boats which has aroused much interest among radio listeners and also to the various branches of the United States Army and Navy to demonstrate means and methods employed for radio signalling and sound and sight detecting on land, sea and air.

To further stimulate attendance the newest in radio and electrical aeronautical devices for the safety and comfort of passenger and private air travel will be shown. Devices such as were used by General Balbo to direct and safeguard his Italian air armada on its recent trans-oceanic trip, by Wiley Post on his record-breaking round-the-world flight, and the newest radio-electric navigation instruments to be taken by Roger Q. Williams in his projected New York-Rome-Athens-Dublin-Chicago scientific aerial survey and research flight—all will be exhibited. Visit the Radio-Craft booth at the show.

ULTRA-SMALL MIRRORS

Mirrors only 1/64-in. wide, 1/32-in. long and 5/1000-in. thick are used regularly in the General Engineering Laboratory of the General Electric Company. A single one weighs only about three one-millionths of an ounce.

Used in an electromagnet oscillograph, each mirror is suspended between magnets by two wires, sometimes only three ten-thousandths of an inch in diameter; the human hair is usually more than ten times that thickness. The mirror moves with each variation of voltage applied to the suspension wires, and traces these variations by means of a beam of light, necessarily tiny, on a sensitive photographic film.

The mirrors are made in the laboratory by silvering a microscope cover-glass, diamond ruling it, and breaking it into 2048 pieces per square inch.

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Sensational Bargains



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95% of radio-set troubles can be located quickly and accurately with the



SHALLCROSS No. 681 Quick-Change Volt-Ohmmeter

10 - 100 - 500 - 1000 volts
1 ohm to 3 megohms

This instrument is very easy to build. The important parts required are a 1-milliamper D.C. meter and the SHALLCROSS Resistor Kit No. 681.

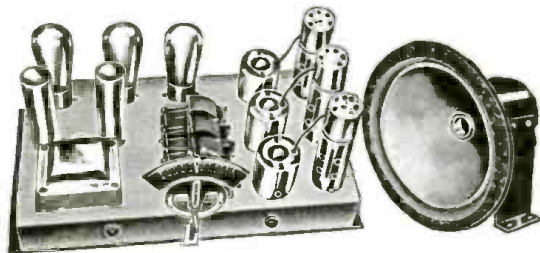
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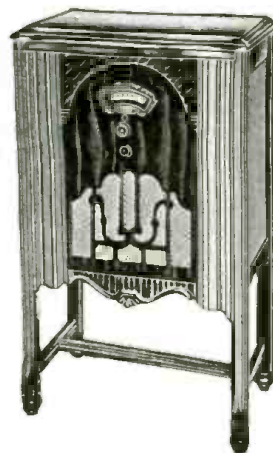
6 TUBE CONSOLETTA RADIO



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EXTREMELY LOW PRICE

Of this handsome set has regained the prestige that the Console Radio has maintained for several years.

At last a full sized console receiver at the price of an A.C.-D.C. midget. Produces remarkable tone quality with ample sensitivity for all requirements. Employs a highly developed T.R.F. circuit



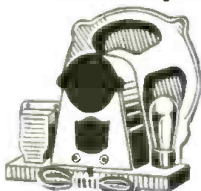
Our Price
\$12.95
 Complete Set of Tubes \$1.95
 Cabinet Only\$3.95

using the latest type tubes, thus producing remarkable performance. Beautiful in appearance, will fit into any surroundings. Supplied in two distinctive cabinet designs. Incorporates the following tubes: 2-'58, 1-'57, 1-'56, 1-2A5 and 1-'80 tube. These tubes deliver 6 watts of undistorted output. Only the finest quality parts are used throughout the entire construction. A matched electro dynamic speaker mounted on a special built-in baffle handles the full output with realistic tone.

PRESSED WOOD INLAID CABINETS

Handsome walnut two tone finished cabinet created by craftsmen with a background of years of furniture building. Finely blended design with attractive pressed wood panels. Exquisitely moulded—the contours form a handsome unobtrusive design. Will harmonize with any home surroundings. Cabinet measures 35½ inches high, 21 inches wide, and 10¾ inches deep.

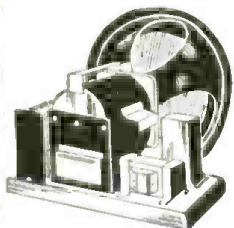
Jensen Model D-7 A.C. Dynamic



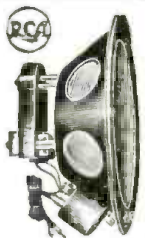
Is widely used as an additional speaker in many homes, as well as on public address systems. Will handle an enormous amount of volume without distorting or rattling. Equipped with a 280 rectifier tube. The speaker measures 12½ inches high, 11½ inches wide, and 7-7/32 deep. Baffle opening required, 10 inches. Supplied complete with tube. Our Price, with tube,**\$8.95**

12½ inches high, 11½ inches wide, and 7-7/32 deep. Baffle opening required, 10 inches. Supplied complete with tube. Our Price, with tube,**\$8.95**

Peerless A.C. and D.C. Dynamic Speaker Chassis



An efficient and powerful reproducer. Ideal for use with the most powerful public address amplifier. It is equally suited for use with any receiver employing the average type of audio amplification system using as low as 90 volts "B" current. The speaker will work with any receiver regardless of output characteristics. D. C. Model has a 1,000 ohm field and a push-pull output transformer. A.C. Model uses a dry rectifier system with a hum condenser for minimum A.C. hum. Dimensions: 12 inches high and 8 inches deep. D. C. Model. Price.....**\$5.95**
 A.C. Model. Price.....**\$7.95**



R.C.A. 100B-103 Magnetic Chassis

This chassis is the identical one used in the R.C.A. 100A-100B Speakers which list for as high as \$35.00. Note built-in output transformer which permits use of 450 volts without distortion, rattling or blasting. Generous oversized magnet. The thick armature is accurately centered, the sturdy metal frame is lined with a special self-baffling fabric, greatly improving acoustic properties of this sensational speaker. Note the corrugated surface of the cone. An exclusive feature—enhances perfect reproduction qualities considerably; most compactly made; 9" outside diameter, 4½" deep overall. Our Price.....**\$2.75**

Baldwin A.C. and D.C. Dynamic Speaker Chassis



The tremendous power handling capacity of this speaker makes it suitable for use in modern console receiving sets or for power amplifiers. The A. C. models are equipped with a 280 rectifier tube and a 8 mfd. dry electrolytic condenser to reduce A.C. hum. D. C. models are available with or without output transformers. Field resistance of the D. C. model is 2500 ohms. Dimensions: 9½ inches high and 7 inches deep. (A. C. Model, complete with 280 tube.) Price.....**\$4.95**
 (D. C. Model with output transformer.) Price.....**3.25**
 (D. C. Model, less output transformer.) Price.....**2.95**

FARRAND INDUCTOR DYNAMIC

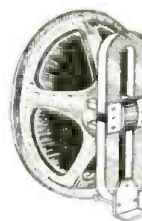


9 Inch Model
 The 9 inch model has the two magnets parallel to each other with a bracket placed between them to facilitate mounting. Please specify type of power tube when ordering. Price.....**\$4.50**

FARRAND Inductor Dynamic

12 Inch Model

These models are not to be confused with the various types now on the market and labeled Farrand Inductors. These models are all factory built and not just put together haphazardly.



The 12 inch models have two magnets standing upright, with a bracket on the bottom to ease mounting. Dimensions of the 12 inch model: 12 inches high and 6½ inches deep. (12" Model) Our Price.....**\$4.95**

Replacement Unit

The genuine replacement unit mechanism for the R.C.A. 100A, 100B, and 103 speaker chassis. This unit is complete in every detail except that it is furnished less the magnets. Guaranteed to be in perfect condition. Can also be used for replacement purposes in any other type speaker. Our Price.....**95c**
 With Magnet.....**\$1.25**



All orders are F. O. B. New York, and subject to prior sale. Terms: A deposit of 20% is required with every order. Balance may be paid on delivery. Deduct 2% if full amount is sent with order. **DO NOT SEND FOR CATALOG**

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(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

HOW LOUD IS "LOUD"?

Measurements of some of the loudest and faintest noises in the world and of many familiar noises in between are listed in a new sound "thermometer" prepared by the E. E. Free Laboratories, of New York City, and published by the American Institute of Physics; this listing, reprinted in part, below, supersedes previous ones published in RADIO-CRAFT. Expressed in the unit of audio power—"decibels," or "db.," representing the degrees of the noise or music "thermometer" scale, a boiler factory rates 105 to 115 of the db. degrees; even louder than thunder, which averages only about 95 of the same units. A lion can roar as loudly as average thunder, for this roar has been measured as 95 db. A dog barking, piano practice and even ordinary conversation at a party, may be as loud as 70 db., which also is about the average noise of a city street.

The loudest noise in the world unfortunately was never measured. It is believed to have been the explosion of the volcano of Krakatoa in 1883, the noise of which was heard nearly 3000 miles away and was proved by delicate instruments to have traveled seven times around the earth! When Krakatoa blew up, the new instruments for accurate measurement of noise in the decibel units had not been invented but calculations based on the distance at which the Krakatoa noise was heard indicate that it may have equalled 180 or 190 db.

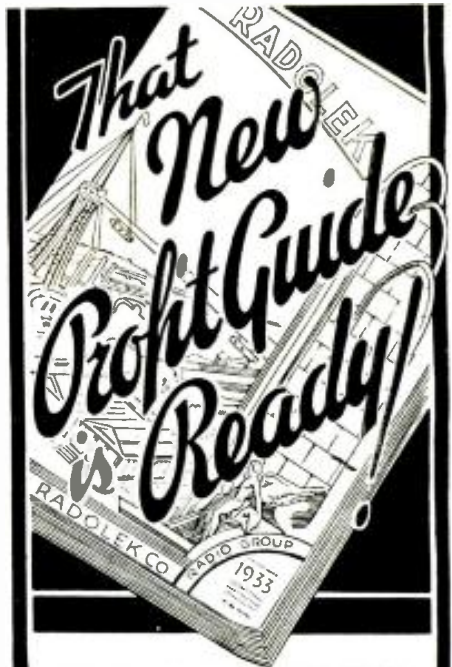
At the other extreme, the faintest ordinary noise is the rustling of leaves in a slight breeze in an unoccupied forest. This is listed as about 17 db. Insects or other animals make most actual forests considerably noisier. For example, one purring cat makes a noise of about 25 db. In an underground vault in New York City, at night and with every possible source of sound avoided, instruments still registered 22 db., due to noises carried through the city's foundation of solid rock. *Anything near an absolute zero of noise is impossible if even one human being is present.* For measurements show that the beating heart and the circulating blood inside one human body make a noise of 10 to 15 db.

Like below-zero temperatures, noises below zero are theoretically possible, since the zero of the standard sound "thermometer" is set to correspond with the faintest noise which average human ears can hear when protected from all outside noise by a sound-proof telephone receiver. On earth this probably is the actual zero of noise, for it has been computed that continual movement of the atoms of matter creates a tiny noise about of this intensity. In outside space, however, noise may be far below zero, just as is true of temperature.

Sound meters now are used in factories to measure and control the noise of fans, vacuum cleaners and other machinery; by police or health officers to measure city noises, inspect noisy automobiles or control alleged noise nuisances; by musicians, singing teachers and students of public speaking to measure the exact loudness of music or speech, and for many other practical purposes.

"A Sound Thermometer"

Source of Sound	Audio Power Value in DB.
Explosion of Krakatoa (doubtful).....	about 190
Airplane engine and propeller.....	110 to 125
Boiler factory.....	105 to 115
Pneumatic riveter.....	100 to 110
Thunder.....	80 to 110
Roaring lion.....	95
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Average factory.....	50 to 90
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"HAVE YOU SEEN IT?"

Filled with valuable data. Characteristic of all RCA-Cunningham, Majestic, and other tubes. Dozens of circuit diagrams. Finest Public Address circuits and parts. Volume control guide—most complete ever published—volume controls for every set on the market. Resistance Tables—all sizes of wire and composition resistors. New test equipment—exclusive Radolek design. Nationally known radio sets. This is a real Profit Guide—a radical departure from every other publication in America. Your copy is free. Please enclose business card or letterhead. Write now—

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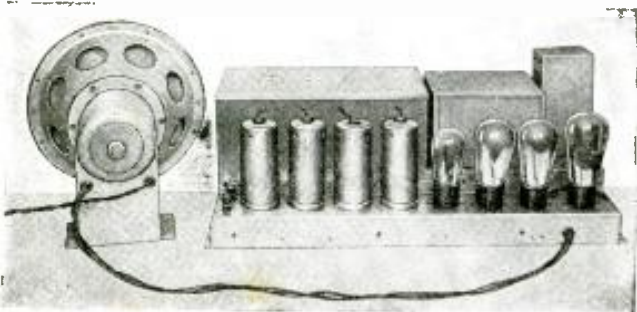
Every month we list on this page a few STAR ★ items which are not listed in our catalog. These are all specials of which the quantities on hand are not sufficient to catalog them. Once sold out, no more can be had. ORDER NOW—TODAY.



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★ **"PEERLESS" 7-TUBE SCREEN-GRID T.R.F. RADIO RECEIVER**
Complete with Full Dynamic Speaker
ONLY 100 LEFT AT THIS PRICE



Back View

The selectivity and sensitivity of this 7-tube receiver due to its three tuned stages are just as sharp as those of an expensive 11 tube superheterodyne receiver. The construction of this receiver is best described as "standard." Its circuit is none other than the "good old steady" TRF type which is the most reliable. It incorporates two stages of tuned I.F. amplifier using type 24 Screen grid tubes, the power detector in a 24. A single stage of A.F. amplifier utilizing the type 27 tube, feeds a 247 super-power pentode, the full wave rectifier in an 80. All provisions are made for mounting loud speaker for the 9 inch genuine Magnavox. Imparts the high note response (brilliance) without impairing the low note production. Tuning is extremely simple, the tuned circuits being controlled by a single central knob; a vernier drum type illuminated tuning dial is employed. The second's knob controls the on-off switch and the third, the one on the back are all individually shielded. The chassis itself is made of non-magnetic aluminum. The use of three tuned circuits, employing screen-grid tubes and high gain R.F. transformers, together with careful usage of new tubes recently through upon the market, it is generally conceded that for average home use a single 247 pentode supplies adequate power with the least distortion. Why build a set when a complete receiver, a good and ready to use, and complete with speaker, can be bought at this phenomenally low price? Here is an excellent opportunity for "side-saddle service" in the "clean up" sale. Remember that the supply is limited! "Hurry, 'ere, 'ere, 'ere serve!" (Overall size 11" x 10" x 5 1/2", net only). Note at 45 lbs.

List Price \$75.00
NO. SP-2000 Peerless 7-Tube TRF Receiver
YOUR PRICE with speaker but less tubes..... **\$10.83**
LIMITED SUPPLY—ORDER TODAY—TOMORROW MAY BE TOO LATE

BUILD "NEW DEPENDABLE" TUBE TESTER

Sold Either Wired or in Kit Form

Here indeed is your opportunity to build one of the finest tube checkers ever designed—an instrument which is MODERN in every sense of the word. Will test all the latest type tubes, including those with 7 AND 8 PRONGS—DIRECTLY—without the use of a "single adapter".

This "NEW DEPENDABLE," despite its high degree of accuracy, is extremely simple to operate. Both plates of the 80—82—83 and other rectifier tubes are readily tested without the use of a "second plate" button.

The instrument employs a high grade, DARSONVAL TYPE, MOVING-COIL, METER. Insuring thorough extreme accuracy. This instrument will check more than 120 different tubes and even those which have not as yet been placed on the market. The tube tester is amply guarded against tube "shorts," which condition is indicated by the flashing of a small pilot light. All component parts are mounted on a beautifully etched panel and the entire instrument placed in a sturdily constructed, leatherette-covered, carrying case. For operation on 105-125 volts, 50 60 cycles, A.C. This instrument is available either in kit form or completely wired and tested, ready to use. Shipping weight 9 lbs.

NO. 303 "New Dependable" Tube Tester. NO. 303A "New Dependable" Tube Tester in kit form.

YOUR PRICE..... **\$18.75** YOUR PRICE..... **\$14.75**

EXTRA SPECIAL

Baird Universal Short Wave and Television Receiver
Seven Tubes—15 to 500 Meters
Only 20 at This Price

This is the same receiver which a short time back sold for \$50. It is a receiver which is "interested" in the shortest wave of the world. Not only will it intercept SHORTWAVE and TELEVISION SIGNALS but REGULAR BROADCASTS AS WELL. In other words, it will receive practically everything which is on the air below 550 meters. This receiver has obtained world wide recognition as the most advanced type of short wave and television receiver for home use yet devised. Amateurs and professionals alike are exceedingly prominent in performance. When used in connection with a Baird Television or any other television set, it will produce clear cut images of definite detail. The set F.M. PLO's 7-11 tubes, 1-45 and 1-BH rectifier. Provision is made for connecting a television neon tube and for supplying from loudspeaker for television. A complete complement of 12 phono coils is furnished with the set. These coils cover a range of from 15,000 to 100,000 cycles per second. The additional radio receiver the broadcast range of from 200-550 meters will be furnished at an additional cost of \$1.00 per coil. Provisions are also made for extreme reception as well as for a phonograph pick up connection. Only high grade parts such as Hammarlund condensers, MAHONGANY CABINET. The supply of these sets is very limited, being only twenty in all. Act fast if you desire to take advantage of this offer. Shipping weight, 45 lbs.

LIST PRICE \$80.00
No. 35 Baird Universal Short Wave and Television Receiver
YOUR PRICE..... **ONLY \$22.50**

NEW READRITE MODEL 710 ANALYZER

TESTS LATEST TYPE 6 AND 7 PRONG TUBES
NINE METER SCALES AVAILABLE

This new Readrite precision instrument embodies features which have not been desired in any instrument built for accuracy, (1) low cost (2) simple use (3) a variety of measurements (4) ruggedness of the complete unit. It is needless to add that the kit is capable of testing anything from old battery muddle to the latest screen-grid, pentode, and multi-grid receiver.

The "Model 710" is an extremely compact device. The outside dimensions of the carrying case are only 10 1/2 by 7 1/2 by 3 1/2 inches. The analyzer contains a 1 1/2 x diameter, an A.C. voltmeter and a milliammeter. The D.C. voltmeter has four ranges: 0 to 10, 0 to 50, 0 to 100 and 0 to 1000 volts. The milliammeter has two ranges: one for 15 mill. reading and the other for 150 mill. This variety of ranges makes it possible to test every conceivable radio circuit; high voltage secondaries of power transformers, current drain of all radio tubes, including the high power 250 and 210 tubes, etc.

CONVENIENT SELECTOR SWITCH—The instrument is equipped with a ten-point selector switch, by means of which readings may be obtained of 4 volts, 100 volts, reversed, 1/2 volts, 1/2 volts reversed, plate voltage screen grid voltage, etc. A 4 1/2 volt battery is supplied with the analyzer, to provide the D.C. for grid tests, continuity tests, etc.

TESTS PENTODES—"MULTI-MUS" '57's and '58's
—'50 RECTIFIERS, ETC.—There are four sockets on the panel of the analyzer to take care of the four, five, six and seven prong tubes. There is a "grid test" push-button. Pin jacks are available for the individual use of all meters; externally, in every range. There is a screen grid pin jack and there are two pin jacks for connecting the external battery. Both plates of the 1-45 pentode may be tested by use of a special adapter furnished. It also is provided for measuring resistances and capacitance. The Analyzer is furnished complete with test leads, connecting cables, Burgess 4 1/2-volt battery, several battery leahs, 1 1/2 to UX adapter, 50 rectifier adapter and resistances and capacity charts. Shipping weight, 8 lbs.

Model 710 Analyzer. List Price, \$25.
YOUR PRICE..... **\$14.73**

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HERE IS A PARTIAL LIST OF CONTENTS

Fundamental Principles of Radio—Ohm's Law—Discussion of New Tubes—Constructing a "Triple-Twin" Amplifier—All about Superheterodyne—Eliminating Man-Made Static—Constructing a Two-Tube Short-Wave "Globe Trotter" Receiver—\$3.00 Prize Suggestions—Radio Kinks, etc., etc.

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machines, home talkies . . . the leading makes actually demonstrated under one roof . . . New short-wave receiver picking up world-wide broadcasts . . . Try-outs for coming radio talent.

• • •
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