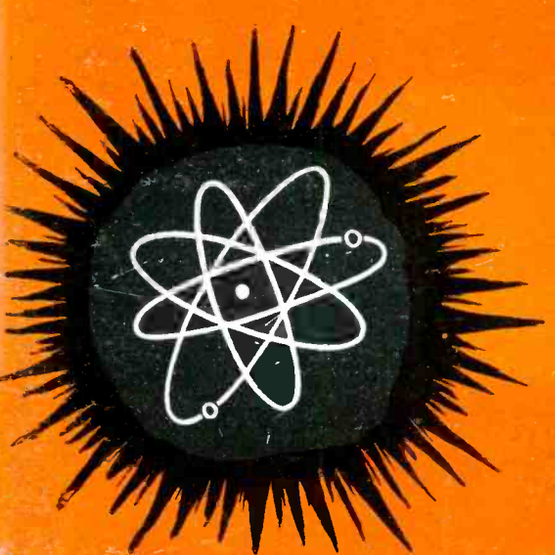
radio service dealer

NOVEMBER, 1947



IN THIS ISSUE:

PAPER CAPACITORS

MICA

ELECTROLYTIC

MALLORY Precision Quality is Built in All Three

Service jobs that don't kick back are the ones that make a profit for you. When you use Mallory capacitors in your service work, you use capacitors *that don't kick back*. That's true whether the job calls for paper, mica or electrolytic capacitors.

Most servicemen know the big things behind Mallory capacitor quality. But there are many extra little things, too, that contribute to their life, uniformity and dependability.

Raw materials, for instance, that are held to an impurity level of less than one-half a part per million. Manufacturing techniques that prohibit human hands from even touching the capacitor cartridges. These are examples of the little things that make a world of difference in the final product. No wonder so many radio servicemen say:

The MALLORY "Good Service for Good Business" Plan includes ideas that will help your business grow.
Ask Your Distributor about it.

P. R. MALLORY & CO. Inc.

MALLORY

VIBRATORS . . . VIBRAPACKS* . . . CAPACITORS . . . VOLUME CONTROLS . . . SWITCHES . . . RESISTORS . . . FILTERS . . . RECTIFIERS . . . POWER SUPPLIES.

*Reg. U. S. Pat. Off.

APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

COMPARE Before You Buy Your Service Data

The speed with which you can complete radio repairs usually depends on the quality of your technical information service. That's why you owe it to yourself to choose the best. But don't guess. Don't take anyone's word for it. Be your own judge and jury.

Ask yourself: "Does the technical information service I use provide these features:

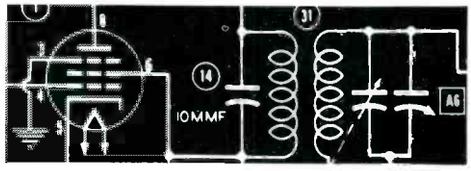
1. Is it *complete*—does it give me all the data I need to do the job?
2. Is the information *concise,* or is it padded with useless sales talk that makes needed data harder to find?
3. Is the data *uniform*—the same for all makes and models—or do I have to "dope out" a different layout for each model?
4. Does the data service give me *accurate* replacement listings—or do I have to guess what I should order from my parts distributor's stock?"

Don't guess about these important points. Compare PHOTOFACT Folders with any other service—point by point, set by set. Check specific models. See what PHOTOFACTS offer you—from complete disassembly instructions to exclusive Standard Notation schematics; from completely detailed drawings to exclusive exploded views. Then see what you find in others.

Be critical. Analyze carefully. Judge for yourself. Then you will know that *only* PHOTOFACT Folders will meet your actual needs.

Howard W. Sams

Don't Miss PHOTOFACT Sets Nos. 23-28 with exclusive "Standard Notation" Schematics



Howard W. Sams 1947 Automatic Record Changer Manual

Nothing like it! COVERS MORE THAN 40 DIFFERENT POST-WAR MODELS. Absolutely *accurate, complete, authoritative*—based on actual study of the equipment. Shows exclusive "exploded" views, photos from all angles. Gives full change cycle data, information on adjustments, service hints and kinks, complete parts lists. Shows you how to overcome any kind of changer trouble. PLUS—for the first time—complete, accurate data on leading WIRE, RIBBON, TAPE, and PAPER DISC RECORDERS! 400 pages; hard cover; opens flat. Don't be without this manual. ONLY **$4.95**

Howard W. Sams Dial Cord Stringing Guide

There's only one *right way* to string a dial cord. And there's only *one* book that shows you how. It's the Howard W. Sams DIAL CORD STRINGING GUIDE. Here, for the first time, in *one* handy pocket-sized book, are all available dial cord diagrams and data covering 1938 through 1946 receivers. Licks the knottiest dial cord problem in a matter of minutes. This low-cost book is a "must" for servicing. You'll want one for your tool kit and one for your shop bench. Order today. ONLY..... **75c**

PHOTOFACT Sets now feature the exclusive new uniform "Standard Notation" schematics—the greatest service data development in 20 years! Every diagram is drawn to the same basic set of clear, uniform, easy-to-understand standards. Here's what the new "Standard Notation" Schematics mean to you: Makes circuit analysis simpler, quicker, fool-proof, more accurate! No more time wasted puzzling over odd-looking diagrams! No more trouble with varying symbols and confusing styles! Just ONE CLEAR STANDARDIZED STYLE FOR ALL CIRCUITS—SAVES YOU TIME—HELPS YOU EARN MORE. Subscribe to PHOTOFACT at your parts jobber now. At only $1.50 per Set, it's the easy pay-as-you-earn way to build the world's finest service data library.

BOOST YOUR EARNING POWER!

FREE! New PHOTOFACT Cumulative Index

New Cumulative Index to first 25 Sets of PHOTOFACT Folders now available! Your guide to more than 2200 receiver models and chassis (1946 and 1947 models). Ask your parts jobber for FREE copy, or write us direct.

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INDIANAPOLIS 6, INDIANA

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Canada—A. C. Simmonds & Sons, 301 King St., East—Toronto, Ontario

PHOTOFACT SERVICE

"The Service that pays for itself over and over again"

Mail This Order Form to Your Parts Jobber Today
or send directly to HOWARD W. SAMS & CO., INC., 2924 E. Washington St., Indianapolis 6, Ind.

My (check) (money order) for $.....enclosed.

- ☐ Send PHOTOFACT Sets ☐ No. 23. ☐ No. 24. ☐ No. 25. ☐ No. 26. ☐ No. 27. ☐ No. 28 (at $1.50 per Set).
- ☐ Send . . . SAMS' 1947 AUTOMATIC RECORD CHANGER MANUAL(S) at $4.95 each.
- ☐ Send . . . SAMS' DIAL CORD STRINGING GUIDE(S) at $0.75 per copy.
- ☐ Send PHOTOFACT Volume 1 (including Sets Nos. 1 through 10) in Deluxe Binder, $18.39.
- ☐ Send PHOTOFACT Volume 2 (including Sets Nos. 11 through 20) in Deluxe Binder, $18.39.
- ☐ Send FREE PHOTOFACT Cumulative Index.

Name.....

Address.....

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

RADIO TUBES

When the G-E monogram's beside it, your number in the "Classified" is the one they phone!

Most radio owners have no knowledge of tubes or circuits. If a name band quits in the middle of a bar . . . if the sports announcer's voice turns into an unintelligible hiss with the ball on the one-yard line and fourth down coming up . . . impulse is to call a service-man, *but fast,* asking him to hurry over to "fix our radio; it won't play."

Whom owners telephone, depends mainly on their faith in his standards of work. The signpost that *all* owners know and trust is the General Electric monogram. For years they've bought G-E lamps; used G-E fans, irons, and toasters; kept their food fresh in G-E electric refrigerators. *What is G-E to them is dependable.*

Once the G-E monogram is associated with your name . . . with your shop . . . *you'll* have the opportunity to get radio-service business and market the tubes! So cut yourself a big, profitable slice of the goodwill which G-E products enjoy among owners in your neighborhood. Install and sell General Electric tubes . . . the best! *Electronics Department, General Electric Company, Schenectady 5, N. Y.*

• •

Technical facts you need to guide you in selecting the right G-E tube types when servicing radios, are contained in G.E.'s Tube Characteristics Booklet ETR-15. Write for your free copy!

GENERAL ELECTRIC

176-F11-8850

FIRST AND GREATEST NAME IN ELECTRONICS

EDITORIAL

History Repeats

Look at the record! 1930 through 1935 were depression years. Radio retailers couldn't sell sets so many opened service departments. Business conditions improved from 1936 through 1941. Retailers in droves gave up their service departments preferring the greater profits per unit afforded from selling as compared to servicing. War-time, 1942 through 1945, was in effect a depression period for retailers who had nothing to sell, so, they took the natural course and specialized in servicing for survival. Now sales are easy again, and it is a fact that many radio retailers are either giving up their repair departments entirely or they are beginning to "farm out" their installation and service work to independent servicemen or servicing organizations on a percentage basis.

Frankly, we believe practically every store that retails radios should also operate its own service department; and it should be a good one, well equipped, supervised by a good manager and manned by competent technicians. We also believe independent servicemen and service organizations should not confine activities solely to repair work. Instead their operations should be expanded to include sales of radios, small appliances, batteries, etc. A soundly organized and properly managed radio business can and will make profits from both sales and servicing, so why not take advantage of the situation! At the same time, there are other profit-potential side-lines that are "naturals" for aggressive Service Dealers, to wit: selling, installing and renting P-A, sound and intercom equipment; acting as sales and service agency for marine, aviation, taxi, amateur, police and fire department radio-communications equipment.

Television Specialization

If every (or if practically every) radio technician were to have a very thorough knowledge of all phases of VHF, UHF, FM and television circuits—and the technical ability to install and repair equipment of this type, manufacturers of television receivers would not have to continue the policies they now have in effect, that of restricting television set installing to "recognized or franchised factory-trained television specialists." Thus the only answer, the only logical way to get television servicing and installing back into the hands of genuine Service Dealers is for them as a class to learn all there is to know about the HF art. With television sets literally selling like hot-cakes, profitable business, such as installing television sets, should not be allowed to pass your door into a "specialists" till. Oddly enough, our own experience with some so-called factory-trained television specialists leads us to believe they enjoy a glorified status to which they are not entitled.

S. R. COWAN, ***Publisher***

Member of the Audit Bureau of Circulations

radio service dealer

VOL. 8 NO. 11

SANFORD R. COWAN
Editor & Publisher

NOVEMBER, 1947

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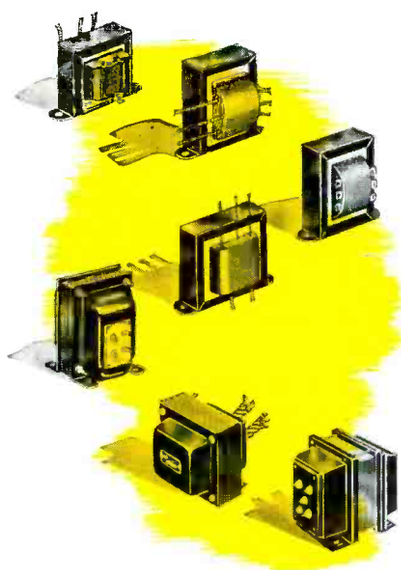
where you see the name STANCOR you can count on QUALITY



STANCOR stands for the highest standard of transformer performance . . . Wherever you see the black-and-yellow STANCOR merchandise display, you know you can rely on the product and the distributor who stands behind it. Yes, STANCOR stands foremost with radio service men . . . for the most complete selection of Replacement and General Purpose Transformers . . . and for advanced designs and universal application . . . Now, STANCOR adds new streamlined plant facilities to serve you better and faster . . . to help you make your service business bigger and more profitable.

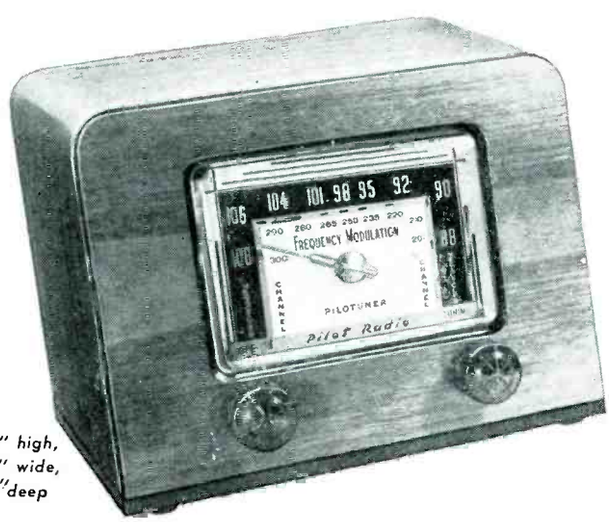
standardize on STANCOR TRANSFORMERS

STANDARD TRANSFORMER CORPORATION • CHICAGO, ILL.

GOLD MINE

for Radio Service Dealers

FM Pilotuner



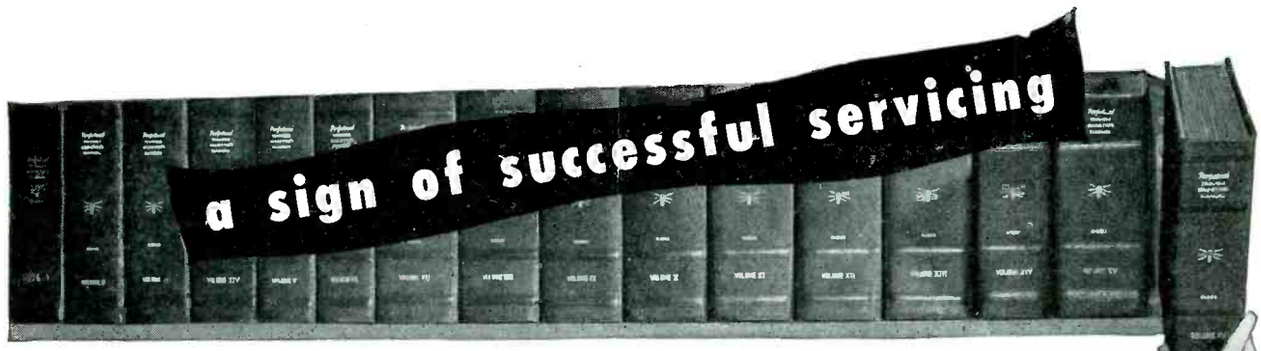
6¾" high, 8¾" wide, 5¾" deep

- Sell while you service! Enjoy *bigger* business and *bigger* profits with the amazing, new FM PILOTUNER that adds FM to *any* radio at all — yet retails for only $29.95.
- Every service call is now a potential PILOTUNER sale for you! Demonstrate it — leave it in the home on trial. And watch the volume and profits roll in with the miracle unit that has set a *new* standard of superior FM performance!
- Yes . . . here *is* your golden opportunity, Mr. Radio Service Dealer! Join the growing number of alert service dealers who are placing *reorders* weekly for the PILOTUNER! Stock the FM PILOTUNER now — and start reaping *extra* dividends.

Write today for full details on the FM PILOTUNER!

PILOT RADIO CORPORATION, 37-06 36th ST., LONG ISLAND CITY, N. Y.

Makers of PILOTONE VINYLITE RECORDS • PIONEERS IN SHORT WAVE • FM • TELEVISION



(Above photo taken at servicing bench of the Heppe Co., Phila.)

ALL 16 RIDER MANUALS!

Ever stop to think how many successful servicing shops, with which you are personally acquainted, have complete sets of Rider Manuals? Ever notice how many photographs of servicing benches, illustrating success stories in magazines, show all Rider Manuals? This is more than coincidence. It is irrefutable evidence of how Rider Manuals profitably meet the day-in-day-out data needs of busy shops.

Now, consistent with "Seventeen years of Continuing Service to the Servicing Industry," Rider has further **ANTICIPATED** your needs by establishing the "24 Hour Data Service" explained below.

Here is further justification for the faith of the many thousands of servicemen who have depended upon and benefited by the time-saving, authoritative*, money-making data supplied by Rider Manuals.

It is such informed publishing which has resulted in Rider Manuals pouring out profits for servicemen year after year after year. It is such progressive services which suggest you be sure your shop has the sign of successful servicing—all sixteen Rider Manuals.

A NEW 24 HOUR DATA SERVICE

On November 30, 1947, we instituted our new photostat service to supply you with information on any newly issued, or old, receivers. For 10c (stamps are OK) we will send you the schematic, voltage data and parts list and everything else which will fit on the two pages. Additional manufacturers' data is 5c a page with a maximum charge of 35c for everything up to seven pages. If the manufacturers' data requires more than seven pages, each additional page is 3c. Here is a way to get whatever service data you need between Rider Manual publication dates.

ADDING FURTHER WEIGHT TO THE VALUE OF OUR "SEVENTEEN YEARS OF CONTINUING SERVICE TO THE SERVICING INDUSTRY"

** Rider Manual data is the OFFICIAL AUTHORIZED servicing data right from the service departments of the companies that made the sets. No one knows better than the manufacturer what servicing procedures are best for his product. This is the basis for the authority and the success of Rider Manuals.*

VOL. XVI SHOULD BE OVER YOUR SERVICE BENCH, NOW!

Volume XVI is the first to be issued under our new three-volumes-a-year publishing schedule which brings you systematically-bound, authoritative* servicing data at the earliest practical date.

It contains data from 94 manufacturers — a greatly increased percentage of "clarified-schematics"—a generous number of photographs on small table models and a separate "How It Works" book, in addition to the usual authoritative information you have come to depend upon in previous Rider Manuals — and this is made available to you in Volume XVI at the greatest possible economy; **less than a penny a page.**

Your jobber has Volume XVI in stock now—Enjoy the benefits of its use—get it **today!**

768 Pages Plus "How It Works" Book **$6.60**

YOU NEED ALL 16

Volume XVI	$ 6.60
Volume XV	18.00
Volumes XIV to VII (ea. Vol.)	15.00
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Abridged Manuals I to V (one volume)	17.50
Record Changers and Recorders	9.00
Master Index, covering Rider Manuals, Vols. I to XV	1.50

OTHER RIDER CLASSICS

Inside the Vacuum Tube	$4.50
The Cathode Ray Tube at Work	4.00
Servicing by Signal Tracing	4.00
The Meter at Work	2.00
The Oscillator at Work	2.50
Vacuum Tube Voltmeters	2.50
Automatic Frequency Control Systems	1.75
Radar—What It Is	1.00
Understanding Microwaves	6.00
A-C Calculation Charts	7.50

3 MORE NEW RIDER PUBLICATIONS

just out!

FM TRANSMISSION & RECEPTION
For the radio serviceman—for the "ham"—the student or engineer.
Over 300 pages—paper cover **$1.80**
Similar edition, but hardback, cloth cover **$2.70**

2 NEW RIDER 99'rs
PA INSTALLATION AND SERVICING
UNDERSTANDING VECTORS AND PHASE
Each over 130 pages.....each **99¢**

OUT IN JANUARY
Broadcast Operator's Handbook

JOHN F. RIDER, PUBLISHER, Inc., 404 Fourth Avenue, N. Y. 16
Export Agent: Rocke International Corp., 13 E. 40th St., N.Y.C. Cable ARLAB

RIDER MANUALS
MEAN **SUCCESSFUL SERVICING**

AIR KING'S 2 in 1 portable Revolutionizes the PORTABLE RADIO FIELD

a portable RADIO-CAMERA!

another AIR KING SCOOP

Right on the heels of the Wire Recorder, AIR KING follows through with another winner . . . . . the AIR KING RADIO-CAMERA *(2 in 1)* portable. Here is an exclusive new AIR KING innovation . . . America's first Radio-Camera . . . completely *new* . . . and different.

The ability of AIR KING to produce the unusual in radios is well known. The country's most successful merchandisers have followed AIR KING'S leadership for the past 27 years.

The Radio-Camera is an important contribution to the radio dealer . . . *today* . . . when he needs it most!

MODEL A410

AIR KING RADIO-CAMERA MODEL A410

SIZE: Height 9½"; Width 4⅞"; Depth 3⅜".
WEIGHT: Less than 4 lbs. complete with batteries.
RADIO: Superheterodyne with latest type miniature tubes.
BATTERIES: 2, flashlight type "A"
1, 67½ Volt "B" Battery

CAMERA

Eveready Camera Case: 50mm. Meniscus Lens, time and instantaneous exposures. Takes black and white or color pictures; #828 Standard Film.
Adjustable strap for shoulder or hand carry.

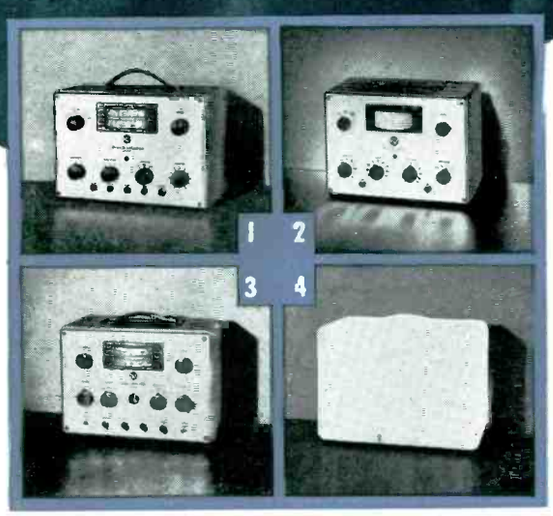
29.95 RETAIL LESS BATTERIES

★ *For quick action write or wire Air King Products Co.*
170 - 53rd Street Brooklyn, New York
Export Address: Air King International, 75 West Street, New York 6, New York

The Royalty of Radio Since 1920 AIR KING RADIO.
Division of HYTRON RADIO & ELECTRONICS CORP.

DESIGNED FOR THE BETTER SERVICE SHOP . . .

RCA's NEW FM SWEEP GENERATOR
. . . third unit of a revolutionary new line



ON THE WAY—a superior line of test equipment that puts time-consuming service jobs on a profitable, production-line basis . . . that anticipates all FM and television needs. Matched styling of all instruments permits attractive, convenient grouping. Watch for announcements of the other units in this new line.

Provides every signal you need for fast, accurate FM alignment

THE WR-53A removes the last element of doubt from FM receiver alignment . . . regardless of band-width requirements. You bring the recognized advantages of the sweep method of alignment to every FM job—speed, accuracy, and reliability that add up to a perfect job every time, in less time.

It's packed with features to make your work easier. Here's a quick check list:

. . . i-f center frequency, 8.3 to 10.7 mc . . . adjustable i-f sweep width . . . internal and external frequency modulation . . . r-f range continuously variable from 85 to 110 mc . . . provides AM or c-w signals . . . includes step and fine attenuators . . . a scope phase control permits centering of sweep patterns.

With the i-f sweep section, you can align i-f stages by the variable-frequency or visual method. When used with an oscilloscope or VoltOhmyst, you can quickly adjust an FM discriminator circuit by either the visual or single-frequency method. Alignment of r-f, local-oscillator, ratio-detector, and mixer circuits all become simple, routine jobs.

Here's an instrument that's comparable in performance yet half the price of similar laboratory-type equipment. It's a "natural" for the receiver manufacturer's laboratory as well as the radio service shop.

A new bulletin is yours for the asking. *Keep in touch* with your RCA Test Equipment Distributor.

TEST AND MEASURING EQUIPMENT

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

TRADE FLASHES

A "press-time" digest of production, distribution & merchandising activities

Tartak Again Making Speakers

Paul H. Tartak who until the war was for 20 years identified with leading loudspeaker manufacturing firms announces his return to the field using the trade name Tartak Speakers, Inc. Offices are located at 3120 E. Pico Blvd., Los Angeles, Cal. A complete line of PM and electromagnetic speakers for manufacturers and for the jobbing and replacement trade is offered by the firm.

Paul H. Tartak

Television In Dayton

The G-E Supply Corporation of Dayton, Ohio, believes it has a "television first" to its credit. They received on a G-E Model 801 a television program from Cincinnati—about 45 air miles away—despite a severe electrical storm, intervening hills and the low power (500 watts) of the experimental station there.

Plans have been announced by WLW for a Dayton television station.

All instruments manufactured by Simpson Elec. Co. of Chicago are to have supplied with them an Operator's Manual which completely describes step-by-step use of that particular instrument—its applications, ranges, etc. Each Manual also contains a complete schematic of the instrument's circuit. Five Manuals have been issued to date and others are in preparation.

Speaker Repair Catalog

Waldom Electronics, Inc., of 911 N. Larrabee St., Chicago 10, Ill., is offering without charge their Catalog 10 which completely lists available replacement cone and universal field coil assemblies. Write for your copy.

RWT Ups Calnan

The Boston branch of Radio Wire Television Inc. is now under the management of Ernest J. Calnan who succeeds Michael Scott.

Speedier Solar Service

Solar Capacitor Sales Corp. is now shipping capacitors, radio noise filters and capacitor test instruments from its Chicago plant at 4501 South Western Blvd. to overcome the transportation handicap experienced by Western and Pacific Coast parts distributors with regard to delivery time and transportation costs.

Complete stocks of parts for wholesalers have been established at Chicago, and additional personnel has been added to facilitate prompt handling of orders for Solar's customers.

Time Payments

Proposed credit controls on the sale and purchase of consumer durable goods to become effective after Federal Regulation W expired on November 1, 1947, were outlined by the American Finance Conference, national association of independent finance companies.

In an effort to increase the flow of durable goods to the public, the Conference suggested that its more than 300 member companies adopt a set of standards by which they may control the extension of credit on purchases and sales of automobiles, household appliances, refrigerators, radios, radio-phonographs and television sets, and other like items.

Proposed terms and conditions are as follows: Radios, phonographs, television receivers and commercial refrigerators—minimum down payment 20% with 24 months in which to pay balance; minimum monthly payments to be $8 or more. In transactions for television receivers or refrigerators where installation fees are extra, such fees to be included. The committee stressed that the above schedule represents the most liberal terms that should be extended on time payment sales, and urged that where possible the initial down payment should be higher and the term in which the unpaid balance is to be handled should be kept to a minimum period.

Admiral Consoles

Admiral Corporation, recently unveiled two new console radio combinations.

Model "60" features include high-speed automatic record changing, ultra-sensitive Miracle Tone Arm, four control knobs (one of which provides continuously variable tone control), and storage space for 108 records.

The walnut cabinet, Model "65" is built around a 6-tube plus rectifier straight A.C. chassis incorporating push-pull audio. High-speed, silent record changing, the new Miracle tone arm, continuously variable tone control, and an extra-large loop antenna are also features.

E. M. Braun

E. M. Braun has just been appointed Jobber Sales Manager for Maguire Industries, in charge of all jobber sales for the Meissner, Radiart and Thordarson Divisions of Maguire.

Chenault Upped By Sparton

Dave R. Chenault, formerly Assistant Advertising Manager is now Sales Promotion and Advertising Manager for the Radio and Appliance Division of Sparks Withington Co.

Petrillo OK's S-C FM

Stanley H. Manson, Stromberg-Carlson manager of advertising and public relations, has announced that James C. Petrillo, president of the American Federation of Musicians, has rescinded his recent ban prohibiting the use of the

Rochester Civic Orchestra on the Stromberg-Carlson Treasury of Music program which will now complete its scheduled 16 weeks series over 28 stations of the Continental FM Network.

Petrillo made it clear that the modification applies only to the Stromberg-Carlson Company and is not to be interpreted as a green light for other sponsors

Offers Television Franchise

Sightmaster Corporation, New York, announces that protected franchises on their new television receiver line are now available to Service Dealers. The key item in the line is a "Sightmaster" combination television model having a high fidelity FM radio receiver and listing at $375. This set's features include: bright, stable 10" picture, direct view; hi-fidelity audio with 9" speaker; full video bandwidth; coverage of all television channels and a choice of several cabinet types. For further details about the Sightmaster franchise phone Murray Hill 3-6087 or write Sightmaster Corp., 220 Fifth Ave., New York 10, N. Y.

Larger FM Audiences

The tremendous sale of FM converter-tuners, attachable to any ordinary AM radio receiver to bring in FM reception, leads John Meck, president of John Meck Industries, Plymouth, Ind., to predict that FM audiences will soon vie with AM audiences in the number of listeners.

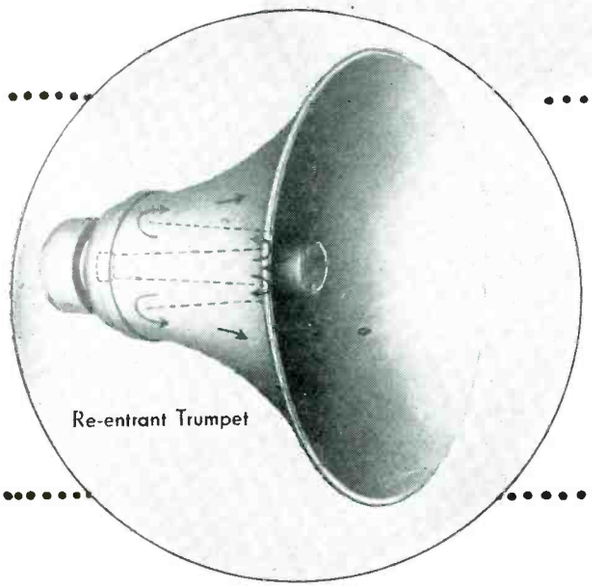
"The public is now ready for something new in radio reception. They are fed up on commercials and singing jingles, static, and the soap operas," Meck said.

Meck warns, however, that the FM stations themselves still have to change some of their programs. "Too much classical music is tiresome. More light, popular music is indicated as well as children's programs and some round-table discussions, with emphasis on public service programs. As FM listeners increase," Meck concluded, "more large FM consoles will be sold."

Earlier this year Mr. Terry P. Cunningham was named advertising manager of Sylvania Electric Products, Inc.

AUDIO ENGINEERING SUPREMACY

is built into every RACON Sound Reproducer

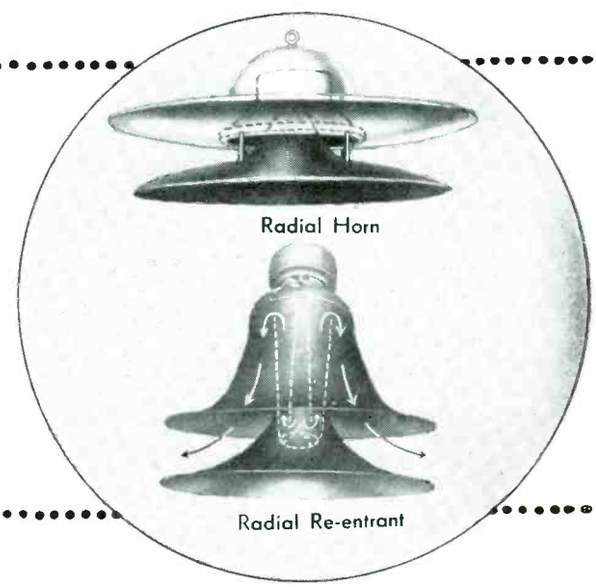


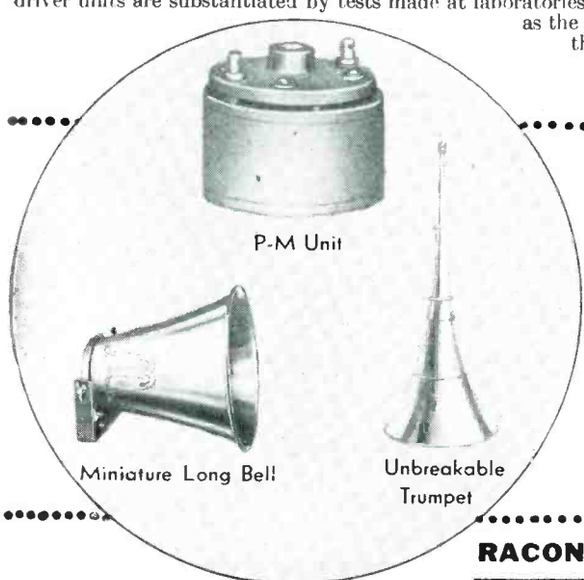
ACOUSTIC & STORMPROOF MATERIAL

Only RACON makes speakers with Racon Acoustic Cloth which is processed by a patented method which gives a non-vibratory wall, thereby increasing the output of the horn without loss due to wall vibration. Supplied as a part of all re-entrant horns, and on all straight horns when so ordered. Stormproof types are guaranteed for life in all kinds of weather and temperature, regardless of climatic conditions.

ADVANCED ENGINEERING & DESIGN

RACON'S leadership in sound reproducer engineering has been recognized for almost three decades. RACON driver units have a rated output for peak and continuous performance far in excess of any other brands—continuous operating capacity 30 watts, peak capacity 60 watts. RACON speakers and driving units require less energy input yet they deliver more efficient sound reproduction output. All claims made by RACON as to cutoff frequencies and acoustic lengths of speakers, power handling capacity, efficiency and frequency range of driver units are substantiated by tests made at laboratories recognized as the foremost in the industry.





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FOR SALE—Stancor 60P, 60 watt phone, c.w. transmitter, $80, complete with coils for 80 and 40 meters. F.O.B. Paul J. Zink, W20SM, 1246 S. Lawrence Ave., New York 60, N. Y.

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TELEVISION ANTENNAS

Their Characteristics & Applications

This is probably the most comprehensive article on the subject published to date.

by EDWARD M. NOLL

THE antenna type for television reception can be simple or complex depending on height, signal strength, signal-to-noise ratio, and receiver sensitivity. For a good location in the primary area of the transmitter a simple dipole and good low-loss transmission line is satisfactory. In fact, if the receiver has a resistive input which matches the transmission line impedance the antenna need not match the transmission line. This means there will be some attenuation and a lower signal-to-noise ratio, depending on the extent of the mismatch, but the antenna system will have approximately uniform sensitivity over a wider band of frequencies. One dipole will suffice for the low frequency channels and a second dipole for the high channels. This method, which considerably simplifies antenna construction, is only satisfactory when we can sacrifice signal amplitude for simplicity. To be free of a transmission line reflections the receiver must present the proper resistive termination to the transmission line.

In areas in which the signal is weak or there is difficulty keeping the signal above the noise level a properly matched antenna is essential. A correctly designed and matched antenna not only results in peak signal strength so far as the match is concerned but can be further improved, with the use of larger and/or additional elements, to have better horizontal and vertical directivity, resulting in better signal sensitivity and higher signal-to-noise ratio.

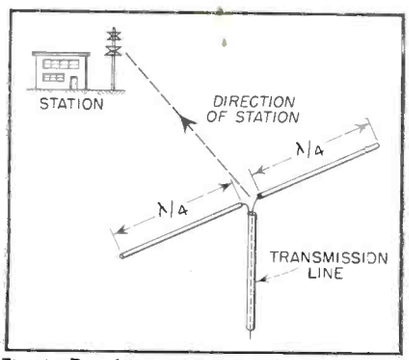


Fig. 1. Dipole antenna properly oriented for reception.

Antennas as used for television are either resonant or non-resonant. The dimensions of the resonant antenna are critically dependent on frequency of signal to be received and have, in most cases, a physical length less than a wavelength, generally a half-wave for most common types. An example of the resonant or tuned antenna is the simple dipole, *Fig. 1*, the physical dimensions of which are approximately a half-wavelength at the frequency to be received. Other tuned antennas, most of them dipole elaborations, are the folded dipole. V-antenna, fanned, and conical antennas.

The shape and dimensions of tuned antennas affect their bandwidth and, to some extent, their horizontal directivity. The more elaborate variations have greater bandwidths. The horizontal directivity of these resonant antennas can be sharpened with the use of reflectors behind the antenna and directors ahead of the antenna. These directors and reflectors are generally parasitic elements and have no electrical connections to the main antenna element.

The vertical directivity of the antenna system can be narrowed to low angles by stacking antenna elements a half-wavelength apart. A typical stacked system appears further on as *Fig. 14* and consists of two dipoles and reflectors stacked one above the other. Any type of resonant antenna can be stacked with or without parasitic elements with a substantial concentration of the antenna sensitivity vertically.

The non-resonant or aperiodic antenna is sensitive to an extremely broad-band of frequencies provided certain minimum dimensions are maintained. The length of such an antenna is at least three wavelengths. Both bandwidth and sensitivity rise as this dimension is increased. Typical aperiodic antennas are the rhombic and long-wire, *Figs. 20* and *22*. These long antennas are occasionally used for home receivers but do find application in television relay systems.

Dipole Antenna

The simplest and one of the most common antennas is the dipole, *Fig. 1*, which is a half-wave antenna opened at the center for feeding and, consequently,

FREQUENCY (CENTER)	47	57	63	69	79	85	177	183	189	195	201	207	213	66	195
CHANNEL NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	L SET	H SET
λ/4 ELEMENT IN FEET $1 \leftarrow \frac{234}{f\,(MC.)}$	5	4.1	3.6	3.4	3	2.8	1.32	1.28	1.24	1.2	1.16	1.13	1.1	3.5	1.2

Fig. 2. Dipole Dimension Chart.

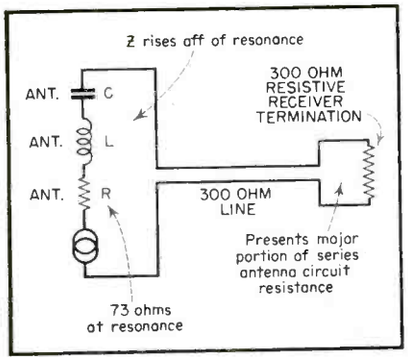


Fig. 3. Equivalent antenna circuit—current take-off.

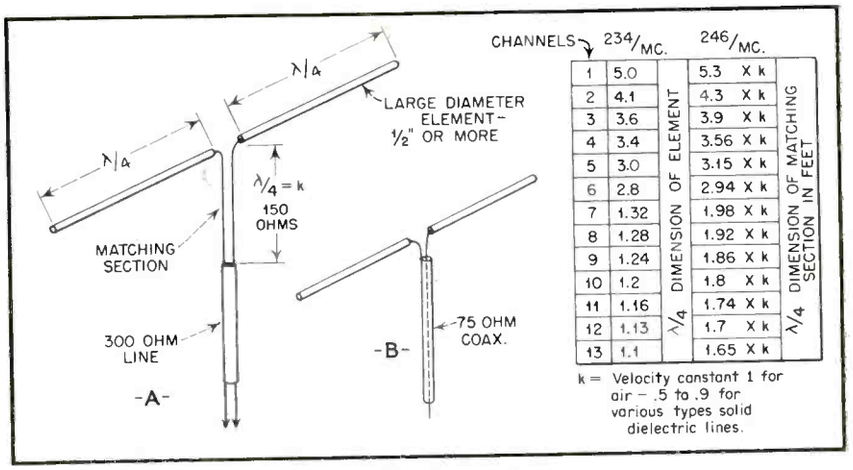


Fig. 6. Matched dipole.

divided into two quarter-wave sections. Actually the physical quarter-wave dimensions of the antenna element to produce an electrical quarter-wave is approximately 94-95% shorter than a free-space quarter-wave at the frequency to which it is cut because of end effect. In fact, practically all of the tuned antennas are cut shorter. However, all element spacing and transmission line matching-section lengths are based on equivalent physical and free-space dimensions.

The following extremely simple formulas can be used to calculate the physical and free-space lengths.

Length of a quarter-wave for antenna dimensions after considering end effect is:

$$\lambda/4 \text{ in feet} = \frac{234}{\text{frequency in megacycles}}$$

Length of a free-space quarter-wave to be used in calculating spacing and matching-section lengths is:

$$\lambda/4 \text{ in feet} = \frac{246}{\text{frequency in megacycles}}$$

Fig. 2 has been compiled which gives the actual element lengths as computed for the center-frequency of each of the 13 channels and for the mid-frequency of the low frequency channels and high frequency channels.

Antenna Equivalent

The dipole and other resonant half-wave antennas when current-fed at the center have characteristics very much like a series-resonant circuit. The antenna has a certain Q, a reactive component and a resistive component. At the resonant frequency of the antenna its impedance is largely resistive and constant over a certain band of frequencies, depending on the Q of the antenna. For a wider-band television antenna a low Q is preferable because as in a conventional lumped-constant tuned circuit the lower Q tank circuit has a broader bandwidth. In a high Q antenna the reactance is appreciable (Q equals reactance over resistance) and rises rapidly off the resonant frequency of the antenna. Consequently, the impedance of the antenna, which is now *resistive* and *reactive*, increases and a mismatch occurs.

However, if a low resistance antenna is made to feed a higher impedance transmission line the equivalent antenna circuit, *Fig. 3* shows us that the mismatch does not affect the relative sensitivity of the receiver over a wideband of frequencies. A common antenna used by tele-set manufacturers is a simple dipole connected to 300-ohm line shown as *Fig. 4*. The characteristic resistance of a dipole at resonance is 73 ohms and, consequently, there is a four to one mismatch at the frequency at which maximum signal is induced into the antenna. Off of the resonant frequency the signal pick-up is less but the antenna impedance increases (impedance now the vector sum of reactive and resistive components) and the mismatch is not as severe. Thus at a sacrifice in gain this antenna presents a reasonably flat response over a number of channels, and permits a simple antenna to be used on a number of channels.

It is important we realize that satisfactory operation of this system depends on three factors.

1. *Strong signal from transmitter.*
2. *High signal-to-noise ratio.*
3. *Receiver presents a 300-ohm resistive component on all channels. As shown a mismatch of 2 to 1 causes only a slight attenuation.*

Actual attenuation caused by mismatch can be observed in *Fig. 5*.

Weak-Signal Dipole

If the signal is not strong, noise components high, or receiver not too sensitive, a properly matched antenna is essential. The dipole can be matched by either of the two systems shown in *Fig. 6*. In the first drawing a quarter-wave matching section of 150 ohms matches the standard 300-ohm line to the 75-ohm antenna resistance. Impedance of quarter-wave matching sections can be calculated with the following simple formula:

$$\text{Matching Section} = \sqrt{Z_{\text{Transmission Line}} - Z_{\text{Antenna}}}$$

In the second drawing the antenna is properly matched by attaching a 75-ohm coaxial line. This matched system is excellent so far as noise rejection is concerned because of the shielding of the outer conductor. However, for a very long span the 300-ohm line has less attenuation. When a 75-ohm line is used be certain the receiver has a 75-

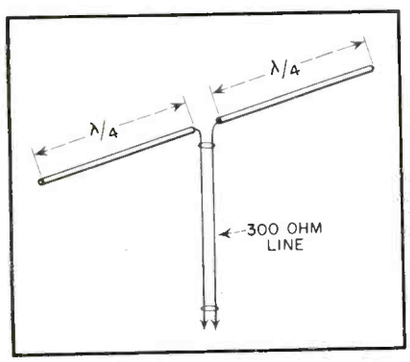


Fig. 4. Dipole antenna—mismatched.

IMPEDANCE RATIO OF MISMATCH TO 1	1	1.1	1.3	1.5	1.75	2	2.5	3	5
PERCENT ADDITIONAL POWER LOSS	0	1	4.5	10	18	27	45	66	160

Fig. 5. Power transfer loss caused by mismatch.

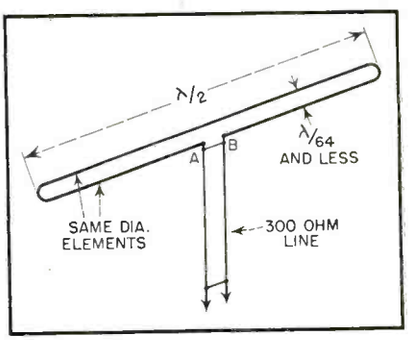


Fig. 7. Folded dipole.

CHANNELS	1	2	3	4	5	6	7	8	9	10	11	12	13	L	H
FULL-WAVE DIMENSION A to B 936/MC.	20	16.4	14.4	13.6	12	11.2	5.28	5.12	4.96	4.8	4.64	4.52	4.4	14	4.8
$\lambda/64$ SPACING 31/MC.	.66	.54	.5	.45	.4	.36	.18	.17	.165	.16	.155	.15	.145	.47	.16
$\lambda/2$ ELEMENT LENGTH 468/MC.	10	8.2	7.2	6.8	6	5.6	2.64	2.56	2.48	2.4	2.32	2.26	2.2	7	2.4

Fig. 8. Folded dipole Dimension Chart.

ohm input. Receivers are now designed with 300-ohm inputs although some few have a 75-ohm input in addition to be used in noisy locations.

When the dipole is properly matched its bandwidth is narrowed considerably and it performs best on only one channel because now the sharply rising reactance off of resonance influences matching seriously (sharp higher Q system). Consequently, it is important that the antenna Q be held down. In effect we are reducing the reactive component of the antenna while the resistive component is held essentially constant. This reduction in the reactive component is accomplished by increasing the diameter of the antenna elements (larger surface and less inductance per given length of dipole) causing a smaller rate of reactance increase off of resonance.

For a mismatched dipole it is permissible to use a small dipole element because the Q of this system is inherently low. When a higher gain matched dipole is used the element diameter should be more than ½ inch to obtain a good bandwidth.

Antenna Q can also be reduced by causing an increase in the resistive component of the antenna. This method is used to increase bandwidth in a number of the antennas to be discussed. At the same time the sensitivity of the antenna is not reduced.

Folded Dipole

The folded dipole, *Fig. 7*, is ideal for television because of its higher resistance and broader bandwidth. Its resistance is approximately four times greater than the resistance of a dipole element and, therefore, conveniently matches a 300-ohm line. If a shielded line is required two 150-ohm coaxial lines can be used with their outer conductors common. Better still dual-coax line of 300-ohm impedance can be obtained.

The dimension chart for the folded dipole is given in *Fig. 8*. The folded dipole is a full wavelength of line bent around to form an antenna approximately one-half wavelength long. The spacing between the elements for best performance should be 1/64 of a wavelength or less.

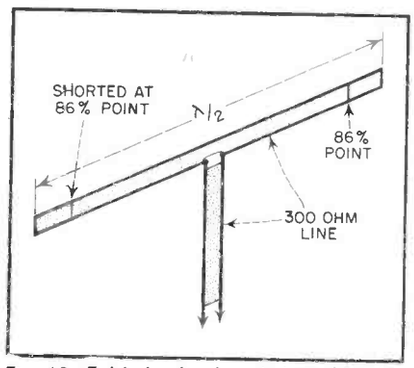


Fig. 10. Folded dipole—dielectric other than air. Standard 300-ohm flexible transmission line.

The most common folded dipole is the antenna shown as *Fig. 7*. However, a number of other versions are expected to be used. One of these is the folded dipole, (*Fig. 9-A*), constructed of three elements which has an impedance of nine times that of a single dipole or 675 ohms. In *Fig. 9-B* is shown a folded dipole with unequal element diameters. When the element diameter of the fed element is decreased with respect to the other element the resistance increases; when the diameter is increased the resistance of the antenna decreases.

Another folded dipole often used for temporary or text installations is a folded dipole constructed of 300-ohm twin-wire line, *Fig. 10*. This type of dielectric covered antenna again should be approximately .95 $\lambda/2$ so far as signal pick-up is concerned. However so far as the currents in the antenna are concerned the dielectric constant is less than air and, consequently, it is necessary to shorten the antenna by 86%.

Therefore, as shown in *Fig. 10*, the antenna is made the correct length but it is shorted at a point 86% from the ends. The ends may or may not be shorted together.

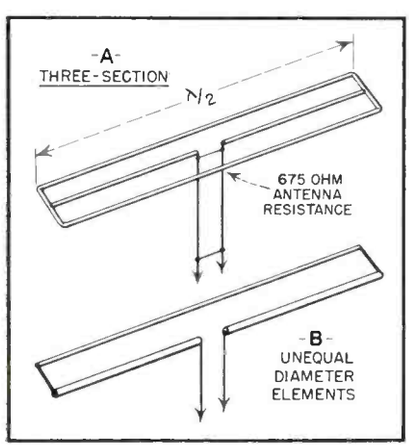


Fig. 9. Special Folded dipoles.

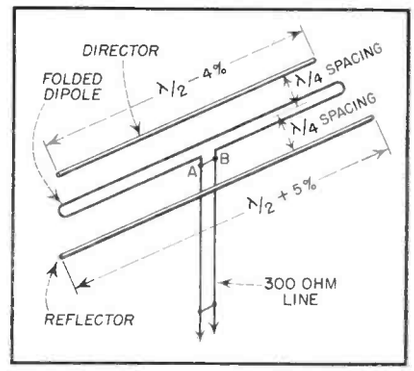


Fig. 11. Folded dipole with reflector and director.

Reflectors and Directors

To improve the horizontal directivity of the television antenna and to reduce noise pick-up from the back, directors and/or reflectors can be used. The reflector is positioned in back of the main antenna element approximately a quarter-wave and is 5% longer than the dipole element as shown in *Fig. 11*. A director is generally positioned a quarter-wave ahead of the dipole element with respect to the location of the transmitting station and is 4% shorter. So far as television is concerned it is best to use a folded dipole to prevent serious loss of bandwidth. Use of a reflector and director with a simple dipole is *not* recommended because of bandwidth reduction. Dimension chart for directors and reflectors is tabulated in *Fig. 12*.

Fanned Antenna

When a director or reflector is spaced a quarter-wave ahead of or behind a dipole or folded dipole element the antenna resistance only decreases 10% to 20% and, consequently, has little effect on the antenna-transmission line

CHANNELS	1	2	3	4	5	6	7	8	9	10	11	12	13	L	H
FOLDED DIPOLE A to B 936/MC.	20	16.4	14.4	13.6	12	11.2	5.28	5.12	4.96	4.8	4.64	4.52	4.4	14	4.8
REFLECTOR 492/MC.	10.4	8.5	7.8	7.1	6.2	5.8	2.78	2.69	2.6	2.52	2.45	2.37	2.31	7.5	2.52
DIRECTOR 450/MC.	9.6	7.9	7.1	6.5	5.7	5.3	2.54	2.46	2.38	2.31	2.23	2.17	2.11	6.8	2.31
$\lambda/4$ SPACING 246/MC.	5.3	4.3	3.9	3.56	3.15	2.94	1.98	1.92	1.86	1.8	1.74	1.7	1.65	3.72	1.8

Fig. 12. Dimension Chart for reflectors and directors.

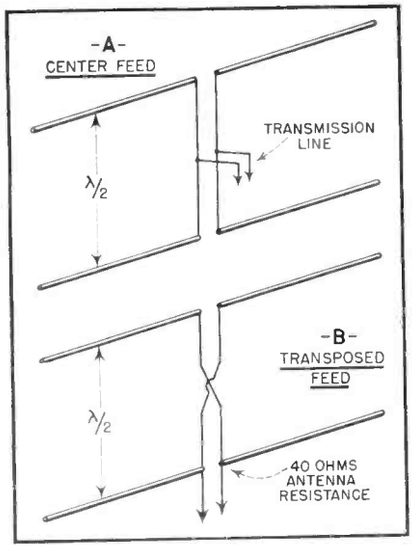
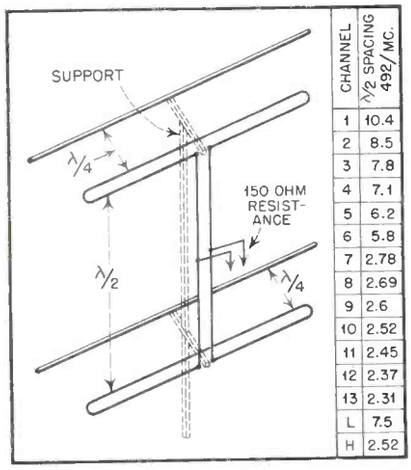


Fig. 13. Stacked dipoles and feed systems.



CHANNEL	λ/2 SPACING 492/MC.
1	10.4
2	8.5
3	7.8
4	7.1
5	6.2
6	5.8
7	2.78
8	2.69
9	2.6
10	2.52
11	2.45
12	2.37
13	2.31
L	7.5
H	2.52

Fig. 14. Stacked folded dipoles and parasitic reflectors.

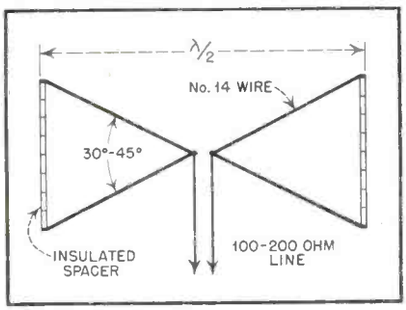


Fig. 15. V-dipole antenna.

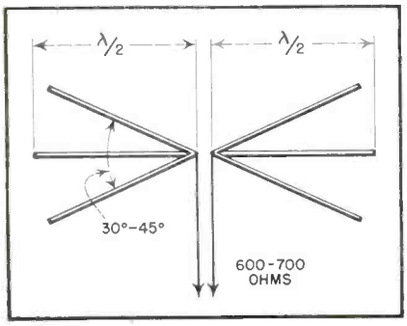


Fig. 16. Fanned antenna.

CHANNEL	1	2	3	4	5	6	7	8	9	10	11	12	13	L	H
EACH λ/2 ELEMENT 468/MC.	10	8.2	7.2	6.8	6	5.6	2.64	2.56	2.48	2.4	2.32	2.26	2.2	7	2.4

Fig. 17. Fanned antenna Dimension Chart.

match. It is true, however, if the parasitic element is moved closer than a quarter-wave spacing, the antenna gain increases somewhat but the antenna resistance and bandwidth decrease considerably. Thus if a simple dipole is used with close-spaced parasitic elements the bandwidth is again too narrow. In one of the newer television antennas a folded dipole is used with a close-spaced element. This is permissible because of the inherent broad characteristic of the folded dipole. It is important to remember that the antenna resistance also decreases and a lower impedance transmission line must be used. In the case in which a parasitic element is spaced .15 λ instead of .25 λ the antenna resistance is approximately halved. It is apparent, therefore, that antenna resistance and transmission line impedance required can be varied by changing the spacing of the parasitic element.

Stacked Array

The stacked array is used to concentrate the receiver sensitivity to low vertical angles. The use of parasitic elements concentrates the antenna sensitivity in one horizontal direction and reduces side and back noise pick-up. A stacked system reduces noise pick-up from top and bottom and, therefore, further improves receiver sensitivity in the desired direction.

A stacked system consists of essentially two dipole elements spaced a half-wave vertically, and excited in phase—that is, signal arriving in the proper direction induce in-phase voltages into the antenna which add in-phase in the transmission line. Noise signals arriving from top or bottom induce voltages which cancel at the transmission line.

A simple stacked array and two methods of feeding it are shown in *Fig. 13*. The method of *Fig. 13-A* is preferred inasmuch as the transmission line point of attachment is centered and at the same distance from the dipole elements. Consequently, the signals from both dipoles always appear in phase at the input to the transmission line. A transposed feeder system can also be used, *Fig. 13-B*, the signal from the top element appearing in-phase, through the transposition, at the bottom element where the transmission line is attached. However, the spacing has to be exactly a half-wave and, therefore, the method supplies in-phase voltages only over a limited range of frequencies.

When two dipoles or similar antennas are stacked and excite the transmission line in-phase the antenna resistance is halved. Thus if two simple dipoles are stacked the antenna resistance is cut-down to less than 40 ohms. These stacked dipoles along with a pair of reflectors are often used in a mismatched system as discussed earlier. An ideal stacked folded dipole with reflectors, shown in *Fig. 14*, matches a 150-ohm line.

In summation, most any type of resonant antenna can be stacked with a resultant improvement in vertical directivity. A stacked antenna can also incorporate parasitic reflectors and directors. If the receiver has *only a 300-ohm resistive input* always use a 300-ohm line and let the mismatch occur at the antenna where it does least damage.

V Antenna

Another dipole modification which has a higher resistance and a broader bandwidth is the small V shaped antenna shown in *Fig. 15*. The V antenna is very economical and can be constructed of number 14 wire separated by moisture-treated wooden spacers. It matches a 100 to 200-ohm line.

The fanned antenna, *Fig. 16*, a full-wave resonant one, is suitable for television receiver application because of its high resistance and exceptional bandwidth. The simple fanned antenna consists of three half-wave fans on each side of the center feed point. Inasmuch as the full-wave antenna is center-fed it is fed at a high impedance point. Consequently, the antenna resistance is high and of the order of 600-700 ohms, requiring use of a high-impedance line for exact match. Two of these fans stacked would very suitably match a 300-ohm line. This antenna is mounted

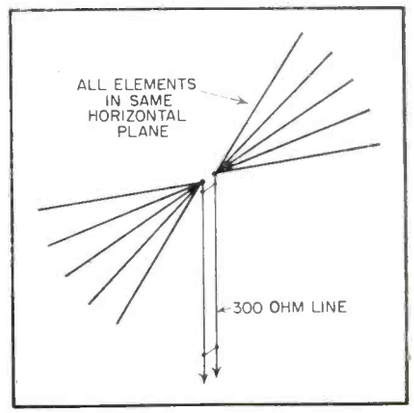
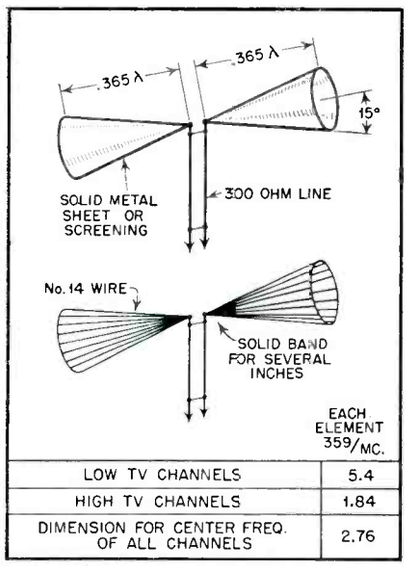


Fig. 18. Andrew Di-Fan antenna, 44-216 mcs.



	EACH ELEMENT 359/MC.
LOW TV CHANNELS	5.4
HIGH TV CHANNELS	1.84
DIMENSION FOR CENTER FREQ. OF ALL CHANNELS	2.76

Fig. 19. Conical antenna and Dimension Chart.

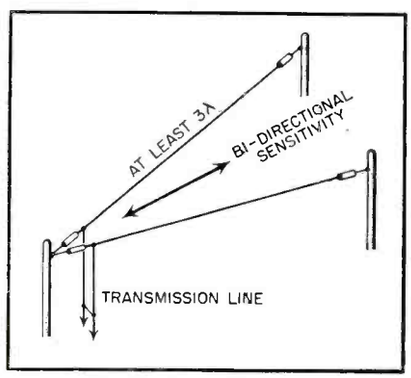


Fig. 20. Long V antenna.

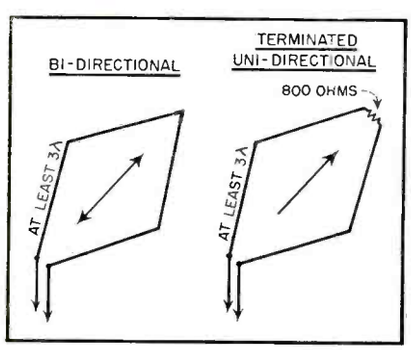


Fig. 21. Rhombic antennas.

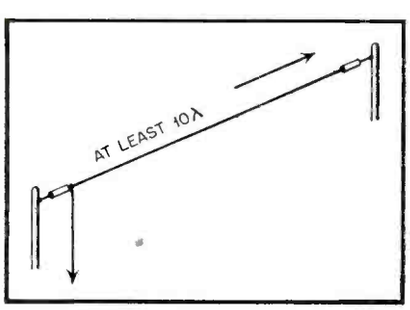


Fig. 22. Long-wire antenna.

horizontally with the fans usually mounted in the vertical plane. Thus a set of directors can be mounted in back of it to improve horizontal directivity. A fanned antenna will present a good match over the entire low frequency set of television channels while a shorter fanned antenna will cover the high frequency set. Dimension chart is given in *Fig. 17.*

A new fanned antenna with five fans has been developed by Andrew Company, *Fig. 18,* which presents a satisfactory match to a 300-ohm line from 44 to 216 megacycles. In this antenna the fans are in a horizontal plane.

Conical Antenna

One of the most effective broad-band antennas for television application is the conical antenna. This antenna also has a high resistance and a uniform sensitivity over a wideband of frequencies. The length of each side is critically set at .365 λ. Dimension chart is given in *Fig. 19.*

The conical antenna can be constructed of sheet metal, 12 equidistantly spaced wires, or of copper screening suitably supported. The actual physical rigidity of the cone construction is the major problem of this type of antenna.

Another advantage of the cone is that it can be constructed to match a selected impedance line by properly choosing the angle of revolution. To match 300 ohms the angle of revolution of the cone should be 15 degrees.

Long-Wire—Rhombic Antennas

A long wire antenna commonly called an aperiodic antenna, is not critical as to length so long as it is a number of wavelengths long. Long-wire antennas can be made highly directional—the directivity increasing with the number of wavelengths. The most common long-wire types used for television are the rhombic and long V-antennas. The V-antenna, *Fig. 20,* is made of two lengths of wire fed at the apex of a V. Maximum directivity is in a line passing through the center of the V. It is bi-directional.

A rhombic, *Fig. 21,* is formed by further extending the V into a diamond shape constructor. The rhombic has improved horizontal directivity and a lower vertical angle. It does, however, require more space for erection. The rhombic antenna is also bi-directional when it is not terminated. It can be made uni-directional by terminating the far end in a 800-ohm non-inductive resistor. The antenna resistance of the rhombic is 800 ohms. It can be suitably matched to 500-800-ohms line or to a 300-ohm line through a matching section.

Inasmuch as the rhombic and V-antenna are sharply directional they

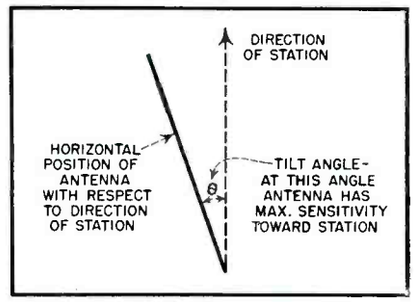


Fig. 23. Tilt-angle layout.

must be layed out with a compass before construction. The angle between the antenna legs must also be considered in the lay-out. For satisfactory television service the tile angle (angle between antenna wire and direction of wave propagation) is considered satisfactory if the length of each antenna leg is made a half wavelength longer than a line which starts at the apex and is stepped-off toward the station to a point where a right angle line will meet the other end of the antenna. See *Figs. 23* and *24.* It is apparent, therefore, that the longer the antenna is in wavelengths the smaller the tilt angle becomes. The long-wire antennas, (*Fig. 22*), have exceptional bandwidth and one antenna will take in all television channels if it is made at least three wavelengths on a leg on the lowest frequency channel. Long-wire antennas require considerable space and are only used for extended range reception and television station relay systems.

Construction of a Rhombic

In the construction of a rhombic the first step is to estimate just how many wavelengths on a leg can be erected on the space allotted. The more wavelengths can be used the sharper and more sensitive the antenna will be.

The next step is to lay off a string line from the near end to the far end in the direction of the station, *Fig. 24.* If it has been decided that the space will accom-

[*Continued on page 46*]

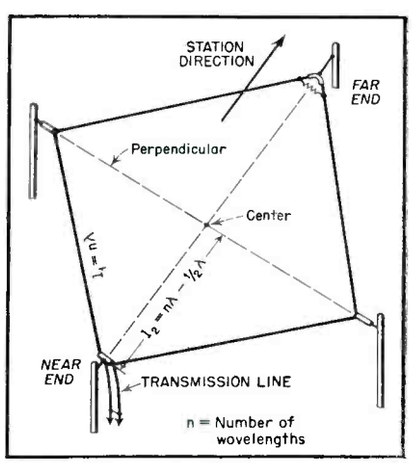


Fig. 24. Rhombic construction.

MAKE A UNIVERSAL

Here is an essential "substitution device" that speeds up and simplifies servicing procedure. Build your own at a nominal cost.

A UNIVERSAL test speaker now is an essential tool in the busy modern radio shop where profitable operation demands that radio set and amplifier troubles be located quickly. In fact, the test speaker has become a permanent and important member of the fast-growing family of *substitution devices*. This useful piece of equipment can be built so cheaply and quickly by any service technician, that no enterprising shop need to be without one.

Fig. 1 shows the simple circuit diagram of a test speaker which requires only the following parts: 1 permanent magnet dynamic speaker (6-ohm voice coil shown) of whatever diameter the builder prefers, 1 replacement-type universal output transformer, 3 binding post terminals, 2 single-pole, 6-position, single-gang rotary selector switches, and a suitable wood or metal cabinet to enclose the equipment.

If the specified Utah type 8776 universal output transformer is employed, the test speaker unit may be connected to either single-ended or pushpull output stages in radio sets or amplifiers delivering up to 18 watts output. This transformer has six taps on its voice coil secondary winding. When these taps are connected to the six points of each of the two selector switches, as shown in *Fig. 1*, fifteen different combinations are made possible by the various numbered switch settings. The two switches, of course, never are set to the *same* point, since this would result in a short circuit of the voice coil. *Table 1* shows several common primary (Tube load) impedances available through switch settings for the 6-ohm voice coil. These settings give values which do not depart, in any individual case, further than a few tenths of an ohm from matching the 6-

PRIMARY LOAD IMPED. (ohms)	SWITCH SETTINGS	
	S_1	S_2
2,000	1	6
4,000	1	5
7,000	1	4
8,000	4	6
10,000	2	5
14,000	1	3
18,000	3	5

TABLE 1

Primary Load Impedance	18,000	14,000	10,000	8,000	7,000	4,000	2,000
Single	1F4-1F5G	10-38-950-12A7-1J5G	41-49-6G6G	89 Pentode 1G5G-6K6G 6A4/LA	12A-20-31-33-42-47-59 Pentode 89 Triode 2A5-6AC5G-6B5-6F6-6N6G-GA-PZ-PZH	43-45-50-71A-2B6-6L6-6V6-12A5-25A6-25A7G-59 Triode	48-2A3-6A3-6A5G-6B4G-6Y6G-25B5-25B6G-25L6-25N6G-35L6GT
Push Pull	1J5G	41-47-1G5G 6A4/LA-6E6-6K6G- 31-33 20-GA-PZ-PZH	42-2A5-6AC5G-6B5-6F6-6N6G	43-50-71A 2B6-6V6-12A5	45-6L6 Class AB_1	48-2A3-6A5G 6B4G 6L6-25L6	
Class B		79 250V. 6Y7G 250V.	19-49-52 89-6A6-6AC5G 6Z7G 1J6G	30-53-6N7	46-59-79 180V. 6Y7G 180V.	10	
Parallel					10	12A-31-33 41-42-49-2A5-GA PZ-PZH	45-50-71A-59 Triode

TABLE 2

TEST SPEAKER

by **RUFUS P. TURNER**

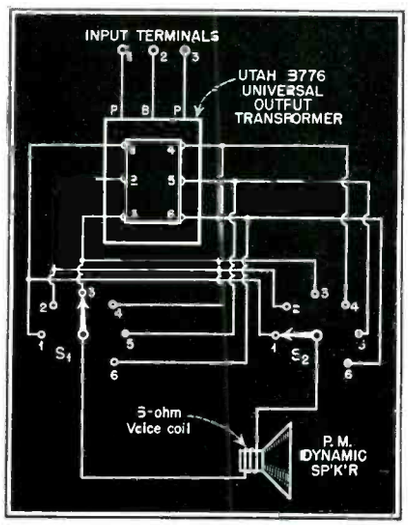


Fig. 1. Schematic of test speaker

ohm coil. The primary impedance values given in *Table 1* are those corresponding to a number of common tubes. For single-ended amplifier stages, connect input terminal 2 to B-plus, and either 1 or 3 to the tube plate. For pushpull stages, connect input terminal 2 to B-plus, and 1 and 2 to the tube plates.

As an example of the use of *Table 1* for determining the test speaker switch settings, let us assume that we will connect the test unit to match a 50L6 tube in a 110-volt a-c/d-c receiver. Tube tables give the plate load impedance of this tube as 2000 ohms at 110 volts. Referring to *Table 1*, we find that the required 2000-ohm impedance will necessitate setting switch S_1 to position *1*, and switch S_2 to position *6*.

The values given in *Table 1* assume a test speaker voice coil impedance of 6 ohms, as given in *Fig. 1*. However, many service dealers undoubtedly will choose to use available speakers, for building this test device, which have voice coils of different impedance value. For their convenience, *Table 2* is reproduced here. This latter table shows (in the first column) the switch positions required to match the desired voice coil impedance (or the nearest value obtainable from the main body of the Table) to the primary (plate load) impedance values given at the bottom of each column. Either one of the selector switches may be set to one of the two positions indicated in column 1 of *Table 2*. For example; for the 2-3 combination given in the top space, S_1 may be set to *2* and S_2 to *3*—or S_1 may be set to *3* and S_2 to *2*. Both arrangements will connect the speaker voice coil to the same transformer taps.

Suitable Tubes

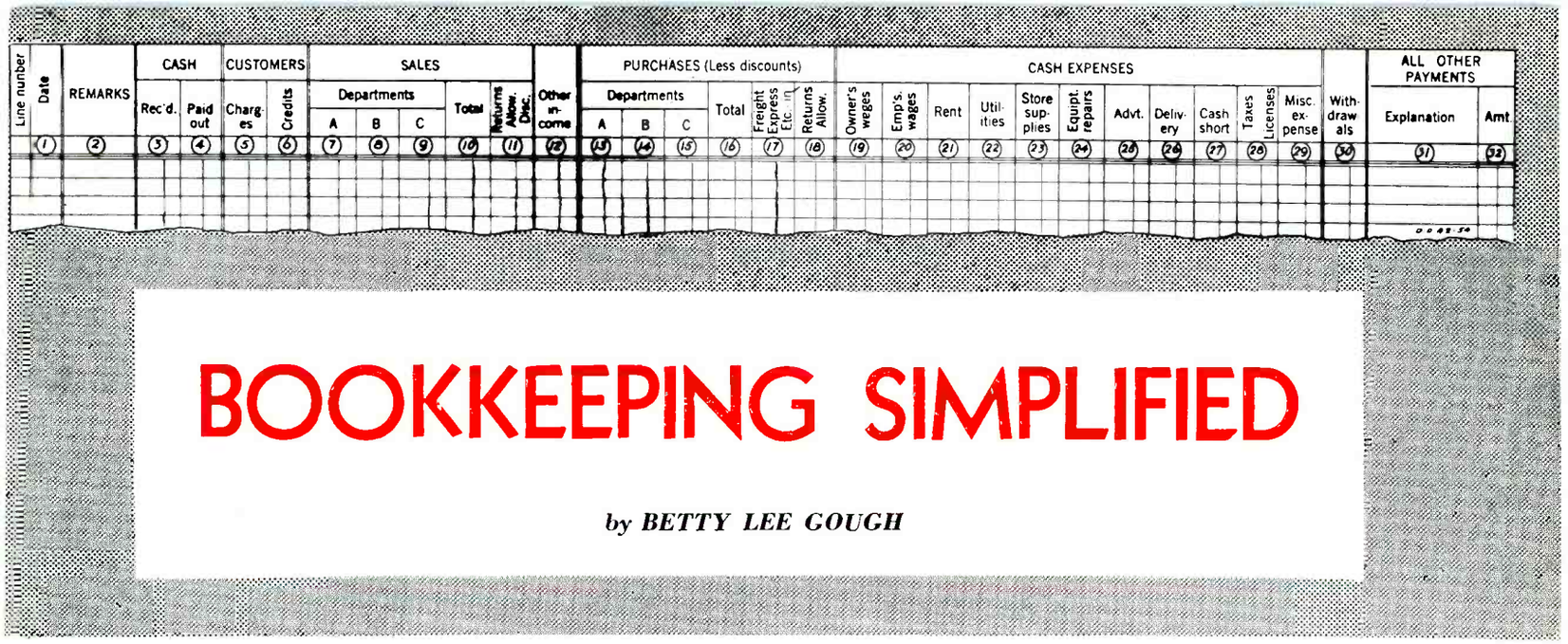
A few of the common tubes, in single-ended and pushpull circuits, having the listed plate load impedance ratings are listed in *Table 3*. Other tubes, new and old, may be referred to *Table 2* after first consulting tube tables for their load impedance ratings. Use the nearest *Table 2* primary impedance value for a given tube. Multiply the single-ended impedance, obtained from tube tables, by 2 for pushpull amplifiers, by 0.5 for parallel amplifiers, and by 4 for class-B amplifiers.

In spite of its extreme simplicity and compactness, the universal test speaker is an instrument of wide utility. Many costly minutes of cutting and trying and of searching out the "right" replacement speaker are saved by this device. And any instrument which saves the service dealer's time and makes his diagnosis more accurate is a profit builder.

SEC. TAP	VOICE COIL IMPEDANCE							
2-3	.97	.75	.54	.43	.38	.22	.11	.25
3.4	1.2	.90	.64	.51	.45	.26	.13	.32
4-5	1.8	1.4	1.0	.80	.70	.40	.20	.50
1-2	3.2	2.5	1.8	1.4	1.2	.71	.36	.89
2-4	4.2	3.3	2.4	1.9	1.6	.94	.47	1.2
5-6	4.8	3.7	2.7	2.1	1.9	1.1	.53	1.3
3-5	5.9	4.6	3.3	2.6	2.3	1.3	.65	1.6
1-3	7.7	6.0	4.3	3.4	3.0	1.7	.85	2.1
2-5	11.6	9.0	6.4	5.1	4.5	2.6	1.3	3.2
4-6	12.5	9.7	6.9	5.6	4.9	2.8	1.4	3.5
1-4	14.8	11.5	8.2	6.6	5.8	3.3	1.6	4.0
3-6	21.3	16.5	11.8	9.5	8.3	4.7	2.4	6.0
1-5	27.0	21.0	15.0	12.0	10.5	6.0	3.0	7.5
2-6	31.5	24.3	17.4	14.0	12.2	7.0	3.5	8.7
1-6	54.5	42.4	30.2	24.2	21.2	12.1	6.1	15.0
Pri.Ld. Imped.	18,000	14,000	10,000	8,000	7,000	4,000	2,000	*500 Ohms

*on Trans. 8776 Green & Yellow Wires

TABLE 3



BOOKKEEPING SIMPLIFIED

by ***BETTY LEE GOUGH***

Do Radio Service Dealers need accounting training to keep their own books accurately? No! Here is the first of a series of articles detailing a system of simple bookkeeping that the average Radio Service Dealer can keep up with a few minutes' work every day.

IN A study made recently of business failures in St. Louis by the U. S. Department of Commerce, the reasons behind the failures of thirty small companies were gone over. Of the thirty, only *two* had kept accurate books to tell them whether they were making or losing money, and which operations were profitable, which unprofitable.

Until bankruptcy was upon them, many of these firms did not know that they were losing money. Had they kept simple but accurate books, they would have known in advance that business was not good. Knowing this, they could have found the factors that made it bad, and perhaps corrected them. To be sure, each of the failed firms kept records of a sort. Often, they were no more than notebook notations of cash pay-outs and receipts. Such records indicate nothing. A simple system of true bookkeeping, which is only a little more trouble to keep, could have warned the bankrupt businessmen of approaching failure in time perhaps to do something about it.

While bookkeeping is no guarantee of certain business success, in every study made of business failure a lack of it glares out like a neon sign. In addition to telling when and where the company is making money, and warning of unprofitable operations, bookkeeping is a *must* for income tax purposes. Section 54 (a) of the Internal Revenue Code provides that "Every person liable to . . . tax . . . shall keep such records . . . as the commissioner, with the approval of the Secretary of the Treasury, may from time to time prescribe." The commissioner's ruling in turn calls for business men to "keep such permanent books of account or records, including inventories, as are sufficient to establish the amount of the gross income and the deductions, credits and other matters required to be shown. The books of record shall be kept at all times available for inspection by internal revenue officers."

Hundreds of radio service dealers miss out on legal deductions because they do not know the expenses that can be taken off their returns, nor how to deduct them.

Basically, there are four kinds of records necessary to the successful operation of a Radio Service Dealer establishment: sales records, showing what is selling, how quickly it is selling and how profitably; records of credit operations and cash sales controls; expense and inventory records; and special sales, income, social security and withholding tax records.

Item	Amount	Percent of net sales
Net sales	$	
Less: Cost of goods sold		
Gross margin		
Add: Other business income		
Gross income		
Less: Operating expenses:		
Wages:		
Proprietors' wages		
Employees' wages		
Store expenses:		
Rent or occupancy		
Heat, light, power and water		
Store supplies		
Repairs to equipment		
Depreciation of store equipment		
Advertising		
Delivery expenses (not including wages)		
Management losses:		
Bad debts		
Cash shortages		
Taxes and licenses (except sales, real estate, and income)		
Miscellaneous expenses		
Total operating expenses		
Net operating profit	$	

Fig. 1. A simple type sales slip that records all pertinent data.

Sales Records

Sales records are not merely figures showing how much business was done today and how much yesterday; they are a tool with which to estimate how much will be rung up tomorrow. They show when volume is slipping. They show where it is slipping. They also show when and where volume is gaining. By a study of the sales figures, the radio service dealer can tell which lines to drop, which lines to carry in heavier stock; which lines to push; which lines to clear out.

And it can all be kept simply in one book—along with the other records necessary to the operation of a radio store. Only a few minutes' work is needed each day. Let's look at the book on which all of these records can be kept.

Illustrated at the heading of this article is a good example of a one-book system. This one was devised by the U. S. Department of Commerce to fit every business. In its thirty-two columns is space for entering every transaction for one month. Let's look, first, at sales records and how they can help the Radio Service Dealer.

There are two principal methods for compiling the information that goes onto this main control sheet: by cash register records and sales slips. If the store's cash register can mark on the

[*Continued on page 47*]

The ELECTRONIC ANALYZER

by CHARLES BABCOCK

A new instrument for general trouble-shooting and accurate field tests is described along with the recommended step-by-step method of procedure.

MANY measurements are needed in present day analyzers for general trouble shooting and field testing. Of prime importance is a wide range volt-ohm-milliammeter. High impedance measurements are a necessity on mobile and battery operated equipment. Also these instruments must be of the direct indicating type as many times tests must be made when there is no external power for operation of an electronic volt-ohmmeter. Direct indicating voltmeters are limited to a maximum sensitivity of 20,000 ohms per volt and ohmmeters cannot measure much above five megohms without a high voltage battery which would possibly be injurious to the equipment under test. Milliamperes must be measured with a minimum of added series resistance, especially in low resistance circuits. As a result there are available many direct indicating volt-ohm-milliammeters that meet one or more of these requirements. They are partially satisfactory but accomplish only a small part of the job.

High impedance tests

Voltmeters having high input impedance are often needed and this requirement is met by the electronic volt-ohmmeter. High voltage d-c measurements in plate circuits are necessary and such testing must sometimes be made in the presence of HF, RF, or AF while the equipment is operating. This type of measurement has to be made with a high impedance instrument and readings cannot be affected by the presence of these alternating voltages. The high resistance of plate and grid circuits means that the parallel voltmeter resistance must be many times higher than the circuit resistance to avoid upsetting the voltage being measured. The most satisfactory answer to this problem is an electronic voltmeter. The measurement of high resistance and insulation testing calls for a high sensitivity ohmmeter. This can be accomplished with an electronic ohmmeter.

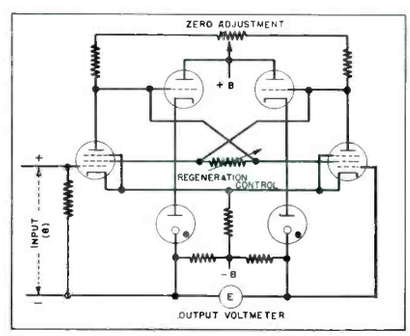
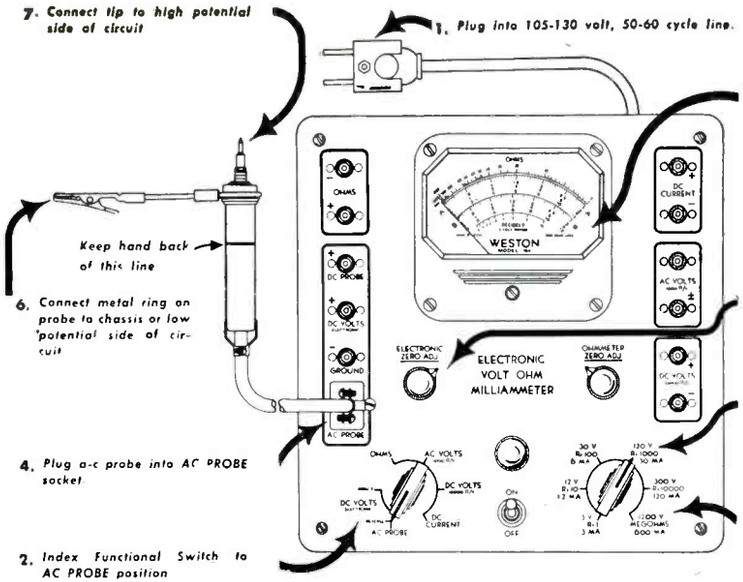


Figure 1—the unity-gain D-C amplifier circuit of the Weston Electronic Analyzer.

Complete analysis of r-f circuit voltages can be made only with a high impedance vacuum tube voltmeter. Such a meter will satisfactorily show stage by stage gain in control devices, receivers, transmitters, etc. and rapidly locate any defective stages. It also provides a rapid means of resonating tuned circuits. Oscillator action can be easily watched. FM needs require such an instrument for checking limiter action, the adjustment of the discriminator stage, and of course, the usual alignment of the IF and RF stages. The testing and adjustment of equipment operating in still higher frequencies calls for test devices which will accu-

A-C Voltage Measurements (Electronic)



— Notes On Use of A-C Probe —

Use only the 3-12-30 and 120 volt ranges

Maximum d-c voltage allowed on A-C Probe is 500 volts

Front panel of Model 769 is grounded, therefore always connect metal Grounding Ring on probe to chassis or low potential side of circuit

D-C Voltage Measurements (Electronic)

1. Plug into 105-130, 50-60 cycle a-c line.

6. Use DC PROBE lead if the d-c voltage has an AF or RF component

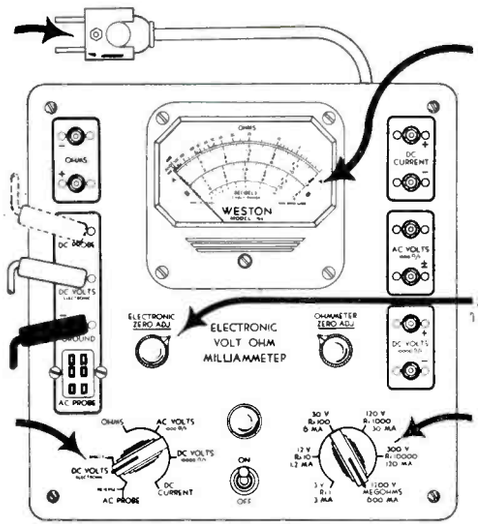
5. Connect Red test lead to + DC VOLTS ELECTRONIC if measuring pure d-c

4. Connect Black test lead to chassis or low potential side of circuit under measurement.

2. Index Functional Switch to DC VOLTS ELECTRONIC:

(a) Use DIRECT position if the voltage to be measured is (+) with respect to chassis

(b) Use REVERSE position if the voltage is (—) with respect to chassis.



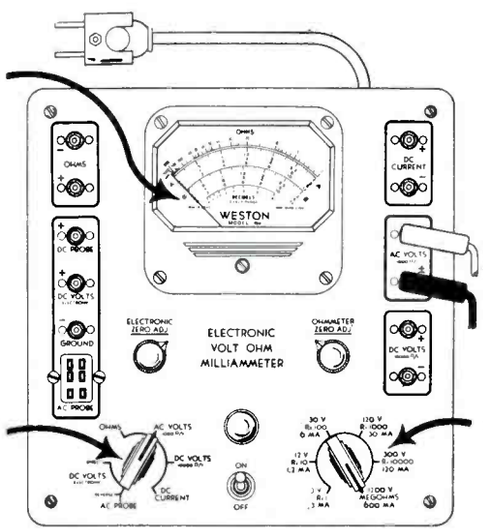
— CAUTION —

The front panel of Model 769 is grounded, therefore always connect ground jack to chassis or low potential side of circuit under test.

A-C Voltage Measurements (at 1000 ohms per volt)

4. Take readings on arc marked "8" i.e.,

Switch Setting	Scale Used
3 v.	3 Full Scale
12 v.	12 Full Scale
30 v.	3 x 10
120 v.	12 x 10
300 v.	3 x 100
1200 v.	12 x 100



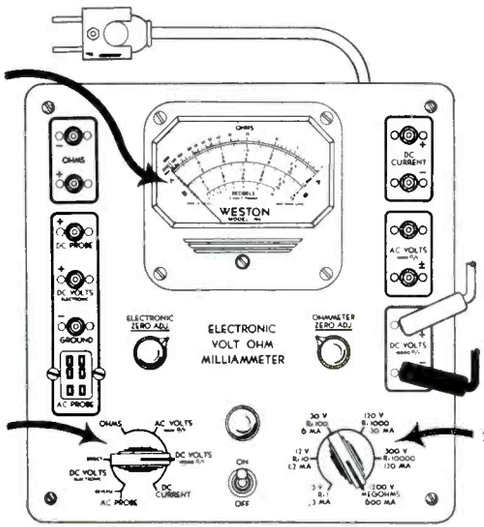
— NOTE —

NO A-C POWER IS REQUIRED FOR A-C VOLTAGE READINGS AT 1000 OHMS PER VOLT

D-C Voltage Measurements (at 10,000 ohms per volt)

4. Take reading on arc marked "A", i.e.,

Switch Setting	Scale Used
3 v.	3 Full Scale
12 v.	12 Full Scale
30 v.	3 x 10
120 v.	12 x 10
300 v.	3 x 100
1200 v.	12 x 100



— NOTE —

NO A-C POWER IS REQUIRED FOR D-C VOLTAGE READINGS AT 10,000 OHMS PER VOLT

Figures 2, 3, 4 and 5—simple to understand step-by-step adjustments required for various types of tests.

rately read voltages with a minimum of disturbance in high resistance circuits such as is found in electronic equipment. Thus, an a-c vacuum tube voltmeter must have an extremely high impedance over its whole operating range.

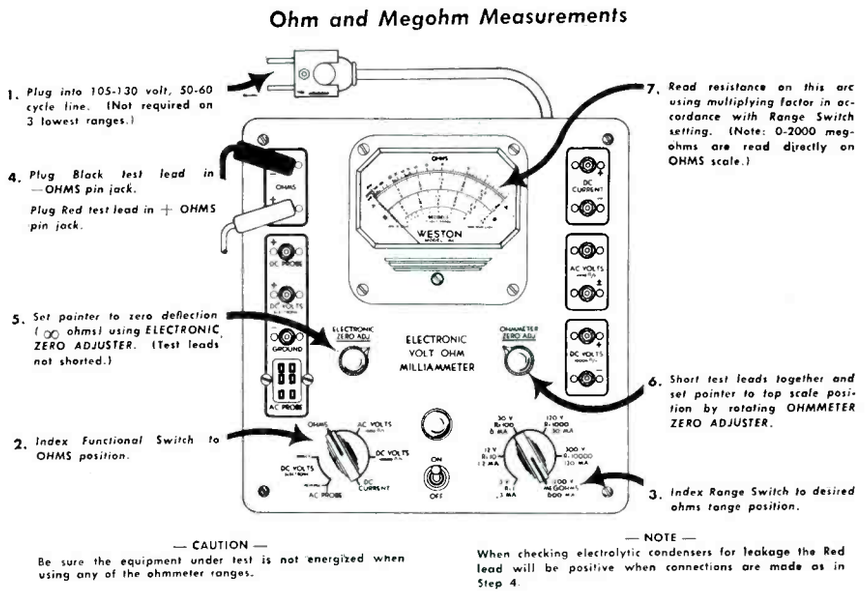
Causes of Instability

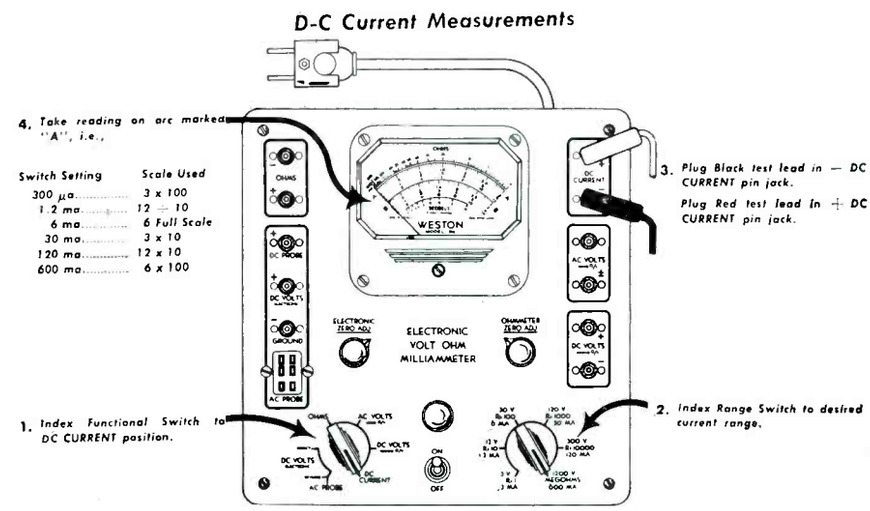
Most available d-c electronic voltmeters are unstable. This instability is frequently caused by line voltage fluctuations, drift of the amplifier balance, and variations between ranges. Contact potential in the probe rectifier also causes trouble in accuracy on the lower ranges. This results in bothersome checking of the zero mark, usually before each desired reading. The alternating voltage measuring devices available will usually cover only a limited frequency range. One type will cover AF, others RF, a few will measure HF voltages, and a very limited number cover all three. Such vacuum tube voltmeters suffer from the same defects as does the d-c VTVM. Many of the devices claimed to be suitable for the higher frequencies introduce such a low impedance that they are useless for this work. Some have probes that are large and cumbersome, introducing hazards to the operator and equipment because of the large metal areas exposed.

The realization of these problems has lead to the development of a new Electronic Analyzer.* All electronic functions of this instrument operate through a direct-coupled amplifier originally designed by R. W. Gilbert. See the schematic diagram, *Fig. 1*, showing the unity gain d-c amplifier circuit. Extremely stable amplification is obtained by the use of degeneration in a conductively coupled amplifier of practically infinite gain. This condition is realized by the use of a four-tube amplifier where in the first two tubes one plate is directly coupled to the screen of the other to obtain regeneration. This circuit is then conductively coupled back to the control grids by a degenerating potential. The amplifier unit consists of a compact assembly using two single tubes and a dual purpose tube.

The Electronic Analyzer is unique in its high stability. *Line voltage variations of 15 volts do not change the meter indications.* Other instruments sometimes show as much as five percent variation when line voltage drops but 5 volts. The stability of the amplifier also allows for the switching from one voltage range to another without having to check the zero adjustment of the device. Thus the danger of erroneous readings through failure to check the zero setting is minimized and there is no necessity for

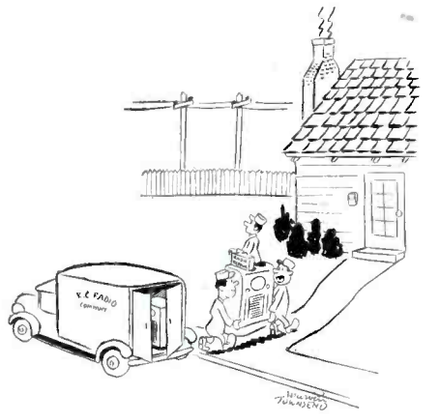
*The Weston Model 769 Electronic Analyzer. A booklet and price schedule on this is available without cost. Write the manufacturer: Weston Elec. Instru. Corp., P. O. Box 328, Newark 2, N. J.





Figures 6 and 7

obtaining matched or pre-aged tubes because the amplifier stability is not dependent on the tube characteristics. The tubes used are all commercially available. How this instrument should be set for step-by-step procedure in making Electronic A-C or D-C voltage measurements; Ohm and Megohm measurements; D-C current measurements; A-C voltage measurements at 1000 ohms per volt; and D-C voltage measurements at 10,000 ohms per volt are illustrated in *Figs. 2* to *7* respectively.



"The Boss has no faith in this brand of set. A repairman is included as part of every sale."

It's Versatility

The functions of several instruments have been incorporated into this instrument to make it as versatile as possible. To this end there is available a complete analyzer without external power. The non-electrical ranges are as follows: DC volts at 10,000 ohms per volt have ranges of 3/12/30/120/300/1200 volts top scale, DC current ranges are 300 microamperes and 1.2/6/30/120/600 milliamperes top scale. The DC accuracy is plus or minus 3%. AC volt ranges at 1000 ohms per volt with an accuracy of plus or minus 5% are 3/12/-

[*Continued on page 38*]

CIRCUIT COURT

SEVERAL interesting features occur in the Musiphonic instruments. The circuits of the power supply and audio system are shown. The components shown are mounted on a separate chassis from the receiver section. Terminals are indicated on the octal cable plug.

A 6SN7GT, dual-triode, doubles as a straight audio amplifier and phase invertor. The audio voltage developed at the voice coils of the dual speakers is fed back to the cathode of the first section, via an 18K-ohm resistor. Since the cathode is returned to ground through an 1800-ohm resistor, the result is a 10% feedback voltage. This provision serves to minimize distortion and hum.

Out of phase voltages are developed in the second section of the 6SN7 to feed the push-pull parallel 6V6 output tubes. One pair of 6V6's is fed from the plate, the other pair from the cathode. Actual bias for the triode appears across the 2700-ohm resistor in the cathode circuit.

Elimination of possibility of oscillation in the output stage, and provision for minimizing effects of differing tube characteristics, is provided by supressor resistors of 1000 ohms in each 6V6 grid, and 1000 ohms in each screen lead.

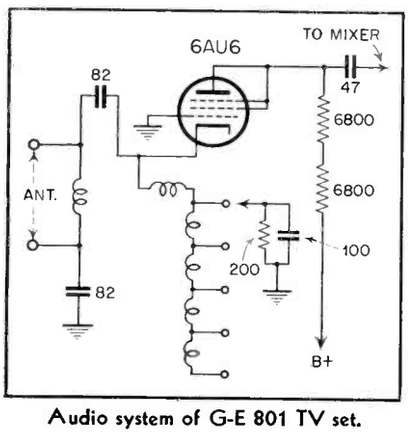
Tone correction is provided in the first stage by a .001 μf from the plate to ground, and by a 5600-ohm resistor and .002 μf condenser in series, across the primary of the output transformer.

A simple 150-ohm resistor provides bias for the four 6V6 output tubes. The two section filter employs both choke and resistor elements.

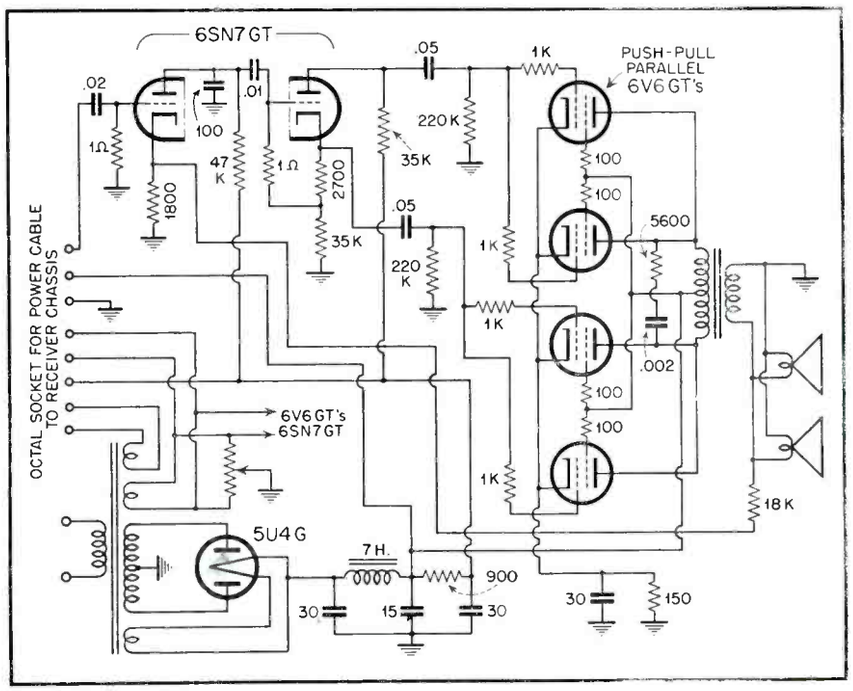
The r-f stage in this new G.E. television receiver uses a recently developed type of circuit, but with a normal type of tube.

The tube, a 6AU6, is a pentode r-f amplifier. In this case, however, the elements are triode-connected, by connecting the screen and suppressor elements to the plate.

The circuit is a grounded-grid amplifier. Signal voltage from the transmission line is fed to the cathode, broadly resonated by the proper coils, and the control grid, being grounded provides needed isolation between plate (output) and cathode (input) circuits.



Audio system of G-E 801 TV set.



Power supply circuit of G-E Musiphonic Model 40.

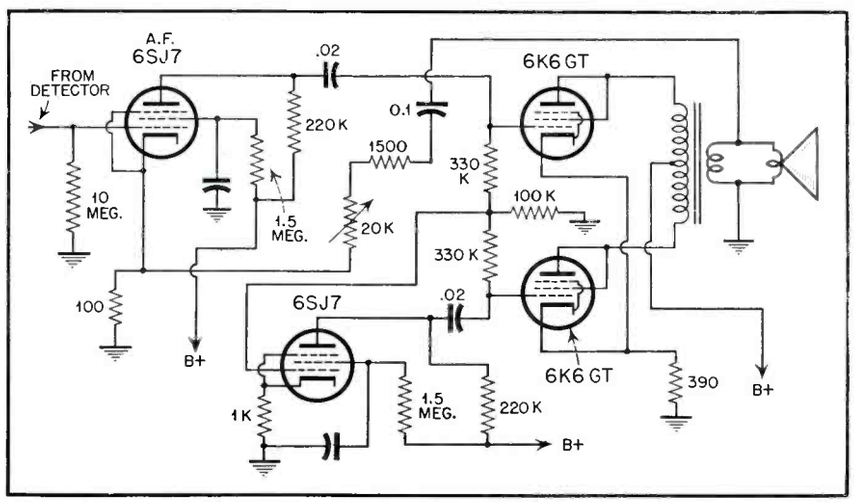
Knight-Model 8B-210

A somewhat unusual audio arrangement is to be found in the Knight model 8B-210. In place of the more common triodes such as 6J5 or 6SQ7 in the first audio and phase inverter stages, we find pentode-connected 6SJ7 tubes employed. With the added gain of these tubes it becomes possible to operate the output tubes as triodes. This is done with the 6K6GT tubes in this instrument and the anticipated improvement in audio quality is doubtless obtained.

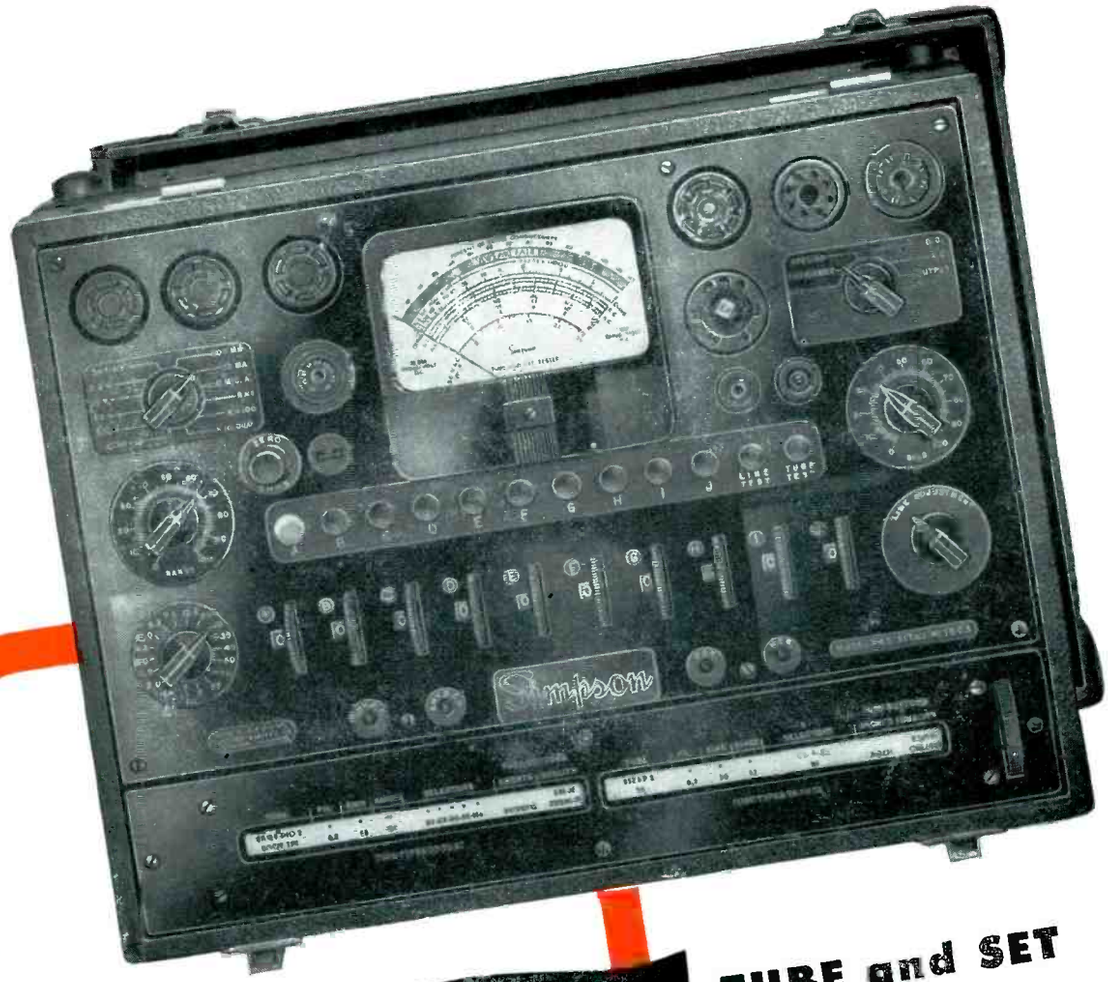
An examination of the partial schematic circuit shown discloses details of the arrangement. It will be noted that the values of components in the two 6SJ7 stages are identical except for the cathode bias resistors. Since the object of the phase-inverter is to provide phase reversal only, and no gain, a larger resistor is used, thus holding the gain to unity.

Signal input for the inverter stage is derived across the 100K-ohm resistor

[*Continued on page 47*]



Unusual audio arrangement of Knight Model 8B-210.



SIMPSON MODEL 445

TUBE and SET TESTER . . .

with the famous Simpson "No Backlash" Roll Chart

. . . Combining a 20,000 ohms per volt Set Tester and a Plate Conductance Tube Tester

Model 445 embodies a *tube* tester of the plate conductance type. The dial indicates percentage of rated plate conductance which can also be considered as percentage of mutual conductance since, in most cases, the amplification factor remains constant. When a tube test is finished the Simpson Automatic Reset mechanism clears the meter for the next test. Just press the button and instantly all switches, both push button and rotary, return to normal automatically. Sockets for all types of tubes are provided, including the new 9-pin miniature; also the subminiature as used in hearing aids, etc.

The volt-ohm-milliammeter *set* tester provides the ranges that have made the Simpson Model 260 the most famous set tester in the world. At 20,000 ohms per volt D.C., it has no peer for sensitivity in its price range.

Model 445 is housed in a durable, easy-to-carry case. Its panel is of heavy molded bakelite with all letters and figures recessed and filled in white for easy reading.

ASK YOUR JOBBER

RANGES

Volts (20,000 ohms per volt D.C., 1000 ohms per volt A.C.): 0-2.5, 10, 50, 250, 1000, 5000.

Milliamperes (D.C.): 0-10, 100, 500.

Microamperes (D.C.): 0-100.

Decibels (5 ranges): —10 to +52 DB.

Output (A.C. volts): 2.5, 10, 50, 250, 1000, 5000.

Ohms: 0-2000 (12 ohms center)
0-200,000 (1200 ohms center)
0-20 megohms (120,000 ohms center)

SIZE: 16" x 12½" x 6¾". WEIGHT: 9 LBS.

SHIPPING WEIGHT: 12 LBS.

Dealer's Net Price **$110.00**

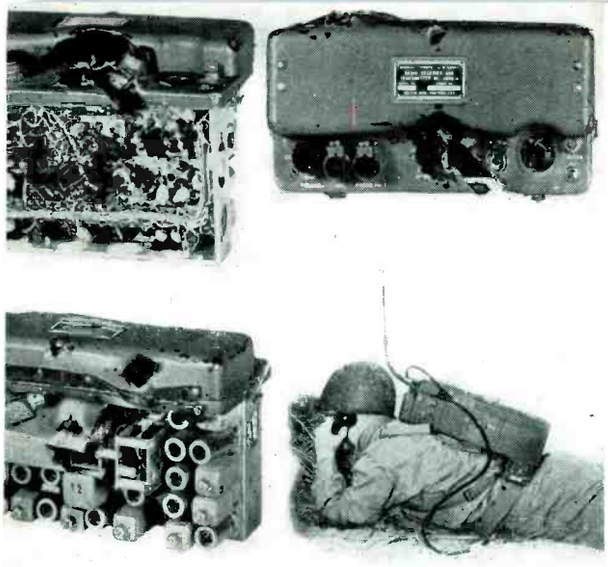
SIMPSON ELECTRIC COMPANY

5200-5218 West Kinzie Street, Chicago 44, Illinois

In Canada, Bach-Simpson Ltd., London, Ont.

Simpson

INSTRUMENTS THAT STAY ACCURATE



"Handie Talkie" and "Walkie Talkie" Explained

Unrestricted civilian communications on 460-470 MC opens a vast new market for light, 2-way radio transmitter-receivers while industrial applications and uses of Handie Talkies are becoming commonplace. It's a trend worth keeping an eye on.

(Above) A G.I. using a Walkie Talkie and views of such a unit that was badly shot up in Normandy. Note pictures below that show the size of Handie-Talkies.

THERE has been some confusion about the difference between the Motorola "Handie Talkie" and the "Walkie Talkie" and this, it is hoped, will help to clarify the average man's ideas about these war-time radios. GI's readily know the difference as they used both types of equipment in the European theatre and in the Philippines, Okinawa and throughout the Pacific area.

These two units are radio transmitters and receivers, and while they form a complete 2-way radio communication system, still they do not even remotely look alike. Each is comprised of a separate receiver and a separate transmitter complete within a portable housing. Both units are battery operated. Each unit has its own antenna which is used for both receiving and sending radio messages. From there on, here are the main differences:

The "Handie Talkie" is about the size of a narrow cracker box, 3 x 3 x 12 inches long. The "Walkie Talkie" is about 17 inches high, 12 inches wide and about 7 inches deep. The smaller "Handie Talkie" weighs a little over five pounds, and the larger "Walkie Talkie" about thirty-five pounds. The "Handie Talkie" is carried and operated in the hand, the "Walkie Talkie" is a back-pack type.

The mouth and earpiece are attached to the "Handie Talkie" while the "Walkie Talkie" has connections into which are plugged a hand set similar to a cradle type telephone set, and an earphone head set can also be attached. The range of the "Handie Talkie" is somewhat less than that of the more powerful "Walkie Talkie".

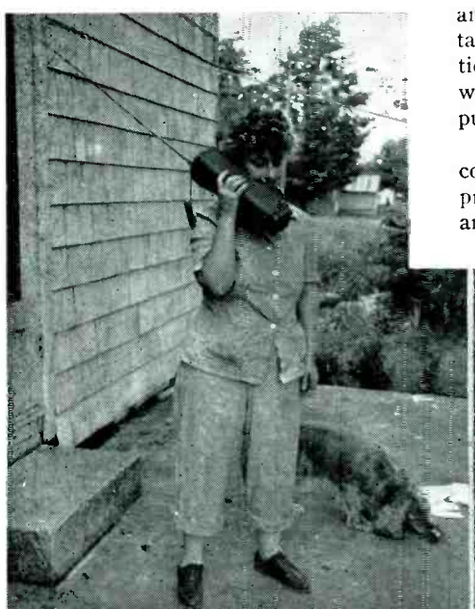
Both are 2-way radio communication sets which means that one person can broadcast and also listen to another who is broadcasting. When using, one person talks and the other listens. When through, the other person may talk while the first one listens. The reason for this is that the sets are tuned to the same wave length and if two people were broadcasting at the same time, the waves would be jammed.

On the battle field, the "Handie Talkie" and the "Walkie Talkie" were assigned different wave lengths. The "Handie Talkie" is a medium low frequency AM set, while the "Walkie Talkie" is a high frequency FM unit. Each pair or more of the sets have their own wave lengths assigned for certain sections of the battle front so that the sets used by different companies or divisions will not interfere with each other. Wave lengths were readily changed frequently to avoid detection by the enemy.

Each "Handie Talkie" set operates on a fixed frequency which can be quickly changed by simply changing a crystal. The telscoping antenna attached to each unit is used for both receiving and sending. The operator holds the unit in his left hand, the earpiece at the top, the mouthpiece at the bottom. To speak through, he pushes a button which causes the transmitter to operate and his voice is carried over the air. To listen, he releases the button and the receiver is connected for the incoming message.

When used for both sending and receiving messages the batteries have a life of 12½ hours. For receiving only, the batteries will last 50 to 60 hours. The range is limited to short distances and was used by troops to keep in contact with each other in landing operations and under battle conditions, as well as for other war communication purposes.

The SCR-536 "Handie Talkie" is completely waterproof and fungus-proof and if dunked in the surf during an invasion was still ready for imme-



The X Family's children take a hike yet keep in touch with Mom who is at home

Capt. C. F. Morris and Chief N. F. Anderson of the Pasadena police force use Motorola Handie Talkies in regulating traffic at the 1946 Rose Bowl game.

diate use. It has an effective range of approximately one mile. It uses a 103 volt "B" battery and a 1-½ volt "A" battery. The antenna wave length is fractional—less than ⅛ wave—and the power output is 115 milliwatts. The chassis is houses in a die-cast aluminum case. When the collapsible aerial is pulled out, it acts as a switch, turning the set on. When collapsed, it turns the set off. Almost any number of sets may be used on the same frequency channel.

At present there is very little civilian use of this equipment due to regulations by the Federal Communications Commission. However, the FCC has authorized the use of the 460 to 470 megacycle band for civilians. Of course, this is a very ultra high frequency band and at this time it is too early to predict all the civilian uses of these sets. There are some wild-eyed predictions regarding "Handie Talkies" and "Walkie Talkies", but many of these predictions may not come true due to the fact that their use at present is not economical.

Remember, ordinary broadcast band runs from 550 to 1720 kilocycles, and the "Handie Talkie" and "Walkie Talkie" will have to be made to operate on 460,000 to 470,000 kilocycles.

There may be many emergency peacetime uses for the "Handie Talkie." In fighting fires, the "Handie Talkie" may be carried by firemen right to the source of the fire from where instant reporting of the conditions encountered to the Battalion Chief will expedite the application of proper measures. The police may use the "Handie Talkie" to clear traffic jams, to obtain better control of crowds, to muster and direct their forces in case of riots, strikes and other emergency situations. Forest rangers may find many advantages in using the "Handie Talkie". In industry and on railroads the office may be placed in instant touch with men in the plant, in the yards and in other distant places by using the "Handie Talkie".

According to a recent FCC press release, "Small portable radios may be used, for example, to establish a physicians' calling service, for communication to and from trucks and tractors operating in and around large plants, on farms and ranches, on board harbor and river craft, in mountain and swamp areas. Sportsmen and explorers can use them to maintain contact with camps. Department stores, dairies, laundries, bakeries and other business organizations can use the service to communicate with their delivery vehicles".

However, there are many problems which must be overcome despite this liberal ruling of the FCC. "Handie Talkies" are powered by batteries inasmuch as they are portable sets. Using such low power in such an ultra high frequency will not permit good communication over a very great distance—and long distances plus low cost is what is usually wanted by those using radio communication. Some day "Handie Talkies" will be utilized for the Citizens' Radiocommunication Service. Perhaps at first dry battery operated portable sets will not be used. Power will come from central stations or 6-volt wet batteries, but later on, when new tubes and stronger, longer-life batteries are developed, there will then be much commoner uses of "Handie Talkies".

The licensing control will be handled by the Federal Communications Commission and it will be necessary for them to decide who shall and who shall not utilize 2-way radio communication.

When fire destroyed Douglas Aircraft Co.'s telephone lines Handie Talkies maintained communications.

"Walkie Talkie"

While war in Europe was raging and before the United States was involved, the United States Army Signal Corps knew that present-day warfare of lightning movements, mechanized equipment and highly mobile personel units demanded the best there was in two-way radio communications of a certain limited range. Specifically, the Signal Corps was not thoroughly satisfied with the performance of the small portable battery operated 2-way radio carried on the back on one man.

This old-type set was designed for both sending and receiving 2-way radiotelephone messages for distances up to five miles, but it was an AM se

[Continued on page 41]

NEW PRODUCTS

Westinghouse Model H-157

Mahogany veneer cabinet and large inclined lighted dial with 14 to 1 ratio for easy tuning are features of model receiver number H-157, announced by the Home Radio Division of Westinghouse Elec. Corp. at Sunbury, Pa.

The soft orange glow of the candelabra base indicator lamp sharply outlines the fully edge-lighted dial. The set operates on A.C. and D.C., covers 540 to 1600 kc and has five tubes plus rectifier, gives 2.75 watts of undistorted output. It also has variable tone control, automatic volume control, and built-in antenna.

Plastic Tubular

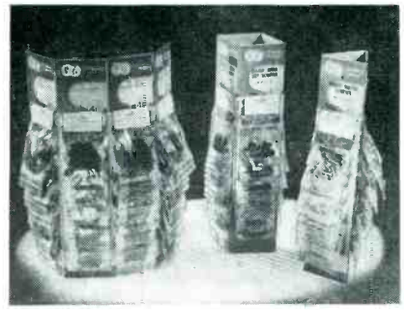
Added to the Amcon Line of Plastic-encased Capacitors is the new Type PLA, a compact tubular electrolytic measuring only 5/8" in diameter and 2 1/8" in length, with working voltages from 25 VDC to 450 VDC.

Sparkling plastic case adds "eye appeal" to the new unit and, because of the inherent dielectric properties of the case, better operating efficiency and improved electrical characteristics are claimed.

Manufactured by the American Condenser Company of 4410 N. Ravenswood Ave., Chicago 40, these new capacitors are described in the circular titled, "3 Star Performers" which will be sent upon request.

New Knob Kits

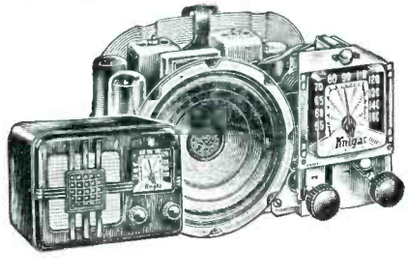
General Cement Mfg. Co. announces that their new knob kits made up of molded plastic knobs of new modern design, walnut and ivory patterns are available now.



For further information and prices—write General Cement Mfg. Co., 919 Taylor Avenue, Rockford, Illinois.

New Radio Kit

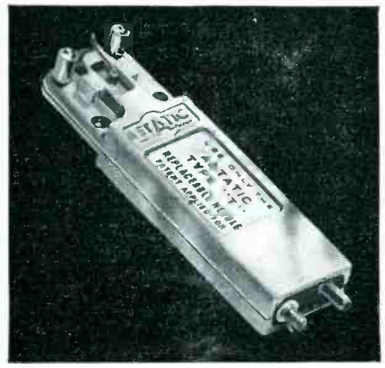
Allied Radio Corp. announces a new low-priced ac-dc superhet kit, the Knight Ranger. The set tunes the broadcast band from 535 to 1620 KC. It is easy to build—directions are simple and clear.



For price and other details write Allied Radio Corp., 833 West Jackson Blvd., Chicago 7, Ill.

New Astatic Cartridge

In an exclusive, modern type "LT" Crystal Phono Cartridge, The Astatic Corporation, of Conneaut, Ohio, has just introduced a new, low needle talk reproducer in the low price field. Out-



put voltage, 1.00 volt, avg. at 1,000 c.p.s.; minmum needle pressure, 3/4 ounce; cutoff frequency, 4,000 c.p.s.; and replaceable Type "T" Needle with "Electro Formed" precious metal playing tip. In the reproduction of high frequencies the "LT" Cartridge is noticeably free from disagreeable surface noise or needle talk.

Set Tester

A new combination tube and set tester, Model MT-12, provides for the checking of 450 radio receiving and allied use tubes. Tests all sections individually of multi-purpose tubes. Also features tube noise and condenser leakage tests. The multi-tester section provides 27 ranges of measurement of voltage, current

and resistance. Entire instrument is housed in a wooden cabinet with removable cover. Cabinet is provided with a separate compartment for the storage of line cord, test leads, etc. Size: 14" x 12" x 6". Weight: 10 pounds. Star Measurements Company, 442 East 166 St., New York 56, N. Y.

Jensen "In-Car" Speaker

Clear, faithful reproduction of screen dialog and music, together with easy attachment to and detachment from the automobile are features incorporated in the Jensen Model RK-51 "In-Car" Reproducer.

Powered by a specially designed weatherproofed 5-inch PM speaker with Alnico 5 magnet, the unit delivers more

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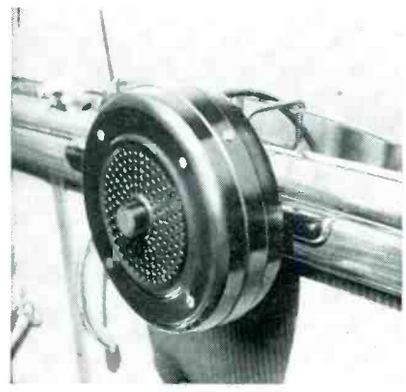


Making better CONNECTIONS quickly and easily

By SAN D'ARCY

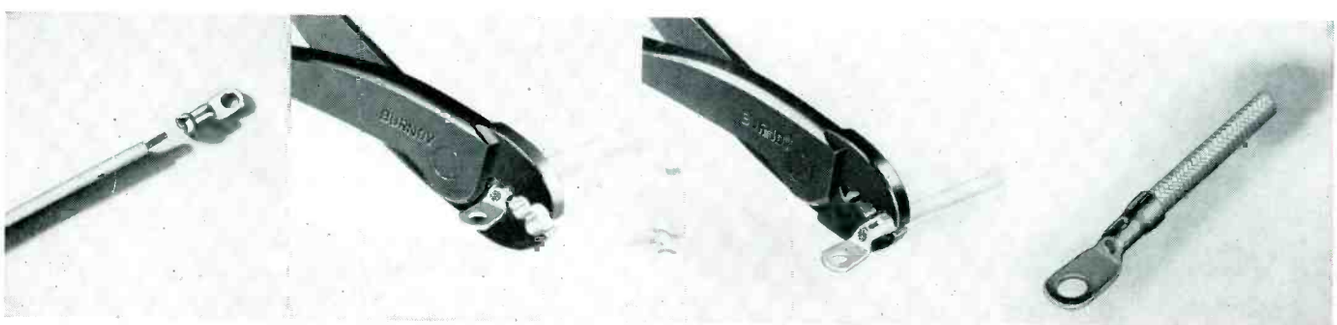
Sure, secure, simple and fast electrical connections, of both permanent and removable types, are achieved by connectors and clips.

MAKING connections of one kind or another is routine in the daily work of all radio, electronic, sound and electrical appliance repairmen. Every bench in almost every service shop has a multitude of tools which make connections and fastenings of some kind possible. There are wrenches, riveting kits, screw-drivers and soldering irons, as well as clips and connectors. These latter are the prime subjects of this article, because clips and connectors serve a great many purposes, but are often not used when they should be. In some respects it might be trite to say their applications are not fully understood by a group of men who are otherwise extremely grasping on technical matters.

Time study experts have discovered that most technicians either use the wrong kind of connection or go about making a connection improperly; so that invariably there is a loss of time and a waste of energy. This consequently results in some loss of money and a reduced profit ratio per job involved.

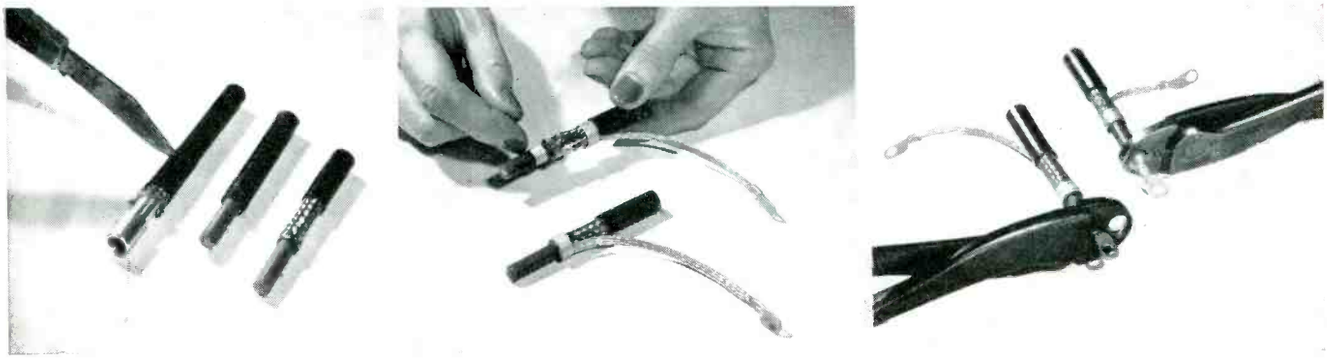
When a radio or electrical circuit develops trouble of such nature as to require the replacement of divers soldered-in components—such as resistors, transformers or condensers—it goes without saying that the normal and proper procedure is to unsolder the defective unit's leads and resolder the replacement. Frequently, however, occasions arise when soldering to make a connection is not the best practice. And there are times when soldering should be avoided because of the difficulty in joining dissimilar alloys, or because a stress and strain factor might jeopardize the joint.

Connectors, clips and terminals that can be crimped onto leads and then sub-



Wire ready for lug. Tool crimps lug to wire. Tool fastens braid. Finished assembly.

Lugs may be crimped to wire more quickly than soldered and the braid is prevented from unraveling. There is no electrical loss and the strain factor is the same. Connectors like these have low electrical resistance to assure circuit stability.

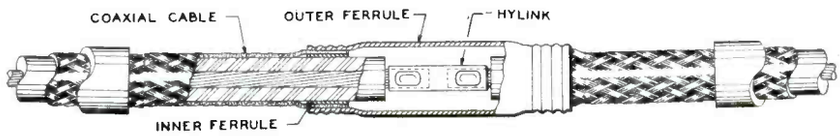


Coaxial and Shielded Cable Tap-offs

Step 1—stripper aid tool is inserted beneath the outer conductor and the wire braid to prevent damaging either. Then, 1/2" to 3/4" of the outer and inner insulators are stripped off. Conductor is not laid bare yet.

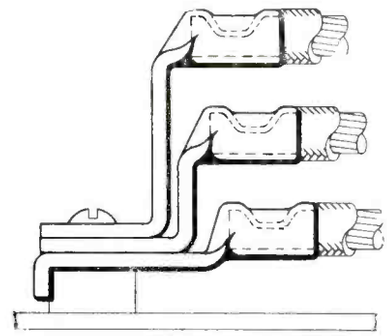
Step 2—the outer ferrule of the jumper is slipped over the outer insulation and the inner ferrule is inserted under the wire braid. After aligning both ferrules they are crimped to semi-finish the assembly.

Step 3—A lug of proper size and type to handle the wire and its insulation is selected and in the regular manner is affixed by two easy crimping motions. The connection is made and the job finished.



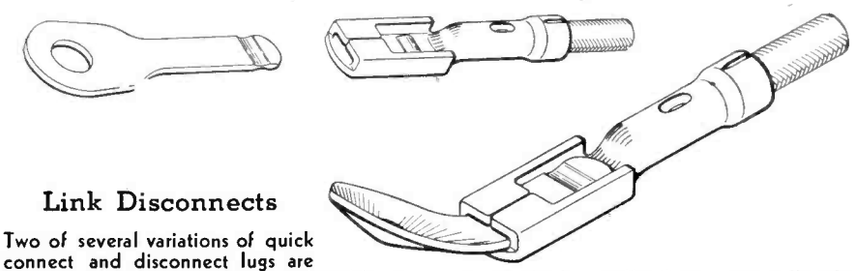
Splicing Coaxial Cables

By means of a standard Hylink plus two short and one longer outer ferrule a coaxial cable splice of extreme strength can be easily and neatly effected.



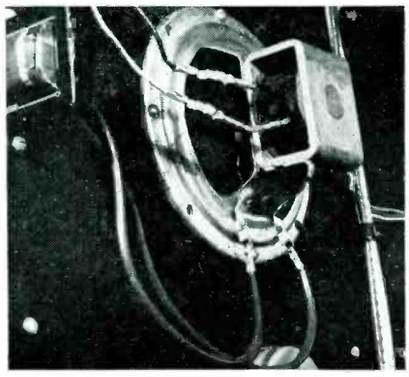
Multi-lug Connections To A Single Terminal

For neatness and positive electrical connections, select the lug sizes required, then stack them properly as shown and fasten in a group to the terminal.



Link Disconnects

Two of several variations of quick connect and disconnect lugs are shown. They are particularly adaptable in PA and industrial applications where portability and simplicity of making electrical connections saves time in setting up and breaking down a rental installation.

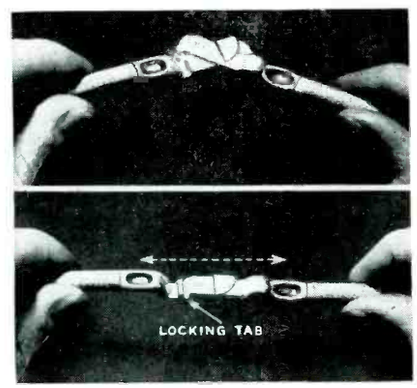


Illustrating how loud speakers may be rigged up for portable field use. The simple to affix connect-disconnect tabs make the installation flexible in that as many speakers as may be required can be almost instantly added to or removed from any installation.

sequently be utilized are generally the correct way to make such a connection. This is especially true when flexibility is desired as in temporary connections to a line, or where speed is required and the time element needed, as in soldering, can be reduced by making a "dry" joint.

In a case where a component has been moved from one position to another, or where after repairs are effected, it is discovered that the remaining leads are too short—rather than unsolder and discard the short lead, (replacing it with one of greater length), and then resoldering the two leads, the better procedure would be to simply add an additional lead of required length to one short end by an easy crimping operation. Then but one solder operation is needed. Figure it out for yourself on a "motion required" basis, as time study experts do! The obsolete method requires two unsoldering operations, the discarding of the two short leads, then

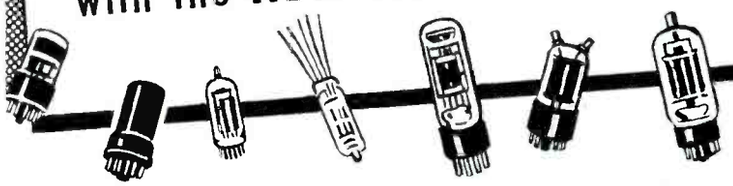
[*Continued on page 44*]



Connecting Links

Portable equipment of different types requires wire leads of varying lengths. Rather than continually waste wire, and instead of taking time to splice and tape short lengths, the use of connecting links like these saves time and avoids wire waste.

Protect Your Tube Testing Investment with the NEW Precision Series 10-12



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*PEG. PEND. U. S. PATENT OFFICE

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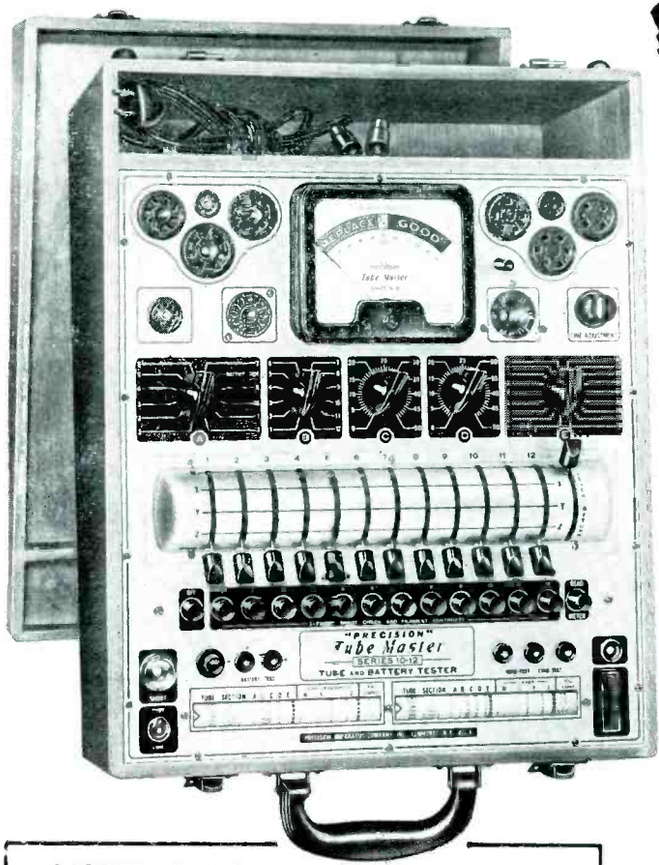

MODEL 10-12-P: (Illustrated) in sloping, portable hardwood case with tool compartment and hinged removable cover. Size 13¾ x 17¼ x 6¾" **$86.15**
Also available in modern counter and standard rack-panel mountings.

Testing a tube for just one selected characteristic does not necessarily reveal its *overall performance capabilities*. Electronic tube circuits look for *more than just Mutual Conductance* or other single factor. In the Precision MASTER Electronamic Tube Test Circuit, the tube under test is subjected to appropriately phased and selected individual element potentials and is electrodynamically swept over a complete *Path of Operation*, on a sinusoidal time base. Encompassing a wide range of plate family characteristic curves, this complete *Path of Operation* is automatically integrated by the indicating meter in the positive, direct and non-confusing terms of Replace-Weak-Good.

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- ★ ISOLATES EACH TUBE ELEMENT REGARDLESS OF MULTIPLE PIN POSITIONS
- ★ DUAL (HIGH-LOW) short check sensitivity for special purpose tube selection.
- ★ INDIVIDUAL TESTS OF MULTI-SECTION TUBES including F.M. and A.M. cathode-ray tuning indicators.
- ★ Simple, direct Ballast Unit Tests.
- ★ Battery Tests under dynamic load conditions.
- ★ Built-in Double Window, brass-geared roller chart.
- ★ 4½" Full Vision Meter, 1 MA sensitivity.
- ★ Panel-Mounted Extractor Fuse Post.

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Eliminating Cathode Heater Hum From Audio Amplifier Circuits

by **ALBERT LOISCH**

Electrical leakage between an a-c operated heater and cathode of a vacuum tube can introduce low frequency voltage into audio amplifier circuits and cause objectionable hum when considerable gain follows this part of the circuit.

High frequency circuits are also subject to hum, if they allow the low frequency voltage to modulate the signal. The principal cause of this hum is a minute leakage current which flows between heater and cathode. The flow of this current through the self-biasing resistor or the parallel combination of resistor and by-pass condenser applies a hum voltage between the grid and cathode of the tube. The path taken by the leakage current when one end of the heater is grounded, is shown in *Fig. 1.*

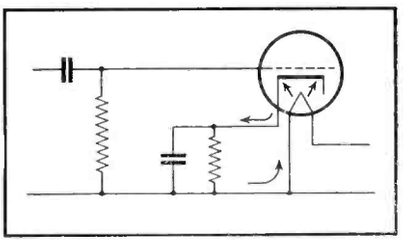

Figure 1

Here the voltage across the heater, especially that between the high voltage end and ground, causes the current to flow. Series operating conditions, with the heater not at ground, are shown in *Fig. 2.* The voltage across the other heaters between the tube and ground adds to the voltage causing leakage current to flow.

It is known that heater cathode leakage current is essentially a thermionic emission phenomenon and that the flow of current is due to the emission of negative charges (electrons) and positive charges (positive ions) from the insulation coating on the heater to the cathode sleeve. The capacitance between heater and cathode, being of the order of 10 $\mu\mu$f, is too small to constitute a leakage path. If the heater varies in potential with respect to the other electrodes, the same phenomenon can cause hum, by emission of charges to these electrodes. Hum from this effect occurs most frequently in a-f amplifiers having a grid-bias that is less than the highest voltage between heater and ground. To overcome hum troubles heaters should not be operated above rated voltage, as hum doubles with only a 6% increase in heater voltage.

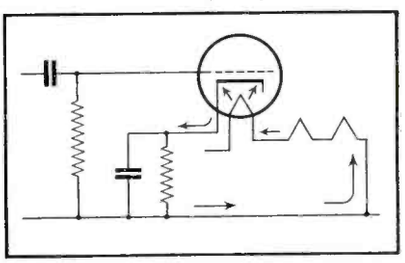

Figure 2

If self-biasing circuits are used, the 60-cycle impedance should be as low as possible. This is attained by the use of low cathode resistance and high capacity

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(finest in radio)

...it's a **Jensen** SPEAKER

(finest in sound)

FM and Television — latest refinements in the electronic art — are bringing to the radio listener new and undreamed-of realism and fidelity in program quality. Listening enjoyment has been increased a hundredfold for him whose receiver is capable of these lifelike programs.

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12-Inch P12-SH F12-NH P12-QH P12-NH F12-SH

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*See Catalog 1010 for complete listing of single-radiator and Coaxial extended range speakers, reproducers and systems, ranging in price from $5.00 to $1,500.

by-pass condensers and is particularly important in the early stages of a high gain a-f amplifier. Use of fixed bias avoids this source of hum. Tubes having comparatively small leakage, used as biased detectors, frequently hum as the cathode resistor is necessarily high and practical conditions require a small by-pass condenser. The most satisfactory method of avoiding this difficulty is to arrange the circuit to ground the cathode of the detector. In series heater operation, the tube most critical to hum should be placed nearest ground. This is usually the detector tube in a-c/d-c receivers. The next tube to be given the preferred position near ground is the converter, as this avoids modulation hum (not caused by heater cathode leakage).

When a transformer is used, hum will be reduced by grounding the center of the heater winding. Hum can be reduced to a negligible value by use of sufficient bias between heater and cathode to prevent the net voltage reversing. This condition occurs in infinite impedance detectors and certain cathode loaded circuits. Hum, resulting from emission of charges from the heater to other electrodes, is reduced by decreasing heater temperature by keeping the impedance of the electrode circuits low, and by keeping the electrodes constantly biased with respect to the heater. Balancing or bucking hum in a radio receiver is sometimes resorted to in minimizing total hum. Heater cathode leakage should not be given a part in hum balancing systems as it is too variable.

Recharging Wet Battery Portable Sets From An Auto Battery

G. E. suggests the following procedure for recharging portable receiver storage batteries by means of the car battery when the 115 volt house current is not available, such as when travelling or camping.

1. Determine the polarity of the terminals on the storage battery.

2. Open the rear door of the radio. Two prongs will be found mounted on the chassis near the tuning capacitor. Plug C of the charging cable should be pressed fully on these prongs with the larger prong fitting into the larger hole of the plug.

3. Insert plug A into the receptable B which is installed on the dashboard. Two wires connected to the storage battery will serve the same purpose. See *Figs. 1-a, b, and c.*

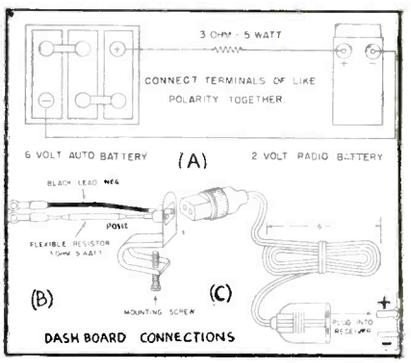

Figure 1

4. With the receiver switched to the *charge* position, a completely discharged battery will in most cases be fully charged within 20 hours. After the red ball in the radio battery has risen, chekcs should be made every two hours to determine the degree of charge. When both indicator balls are visible, the charging should be discontinued.

5. If the receiver is switched to the ON position, it can be operated while the battery is being charged. However, since the receiver will be consuming power at about the same rate as the radio battery is being charged, little or no improvement in the condition of the radio battery will result.

CAUTION: If the positive terminal of

All the features of a tube tester plus a complete VOLT-OHM-MIL-AMMETER

Look at that picture again. There are twenty-three distinct features to give you everything you need in a combination tester.

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Note the complete Volt-Ohm-Mil-Ammeter—18 ranges on a large 6" meter to cover all your requirements. With Model 3480 you've got a tester that's good for dozens of jobs, beautiful...*and a standard for accuracy.* Buy it at your jobber. Or write for bulletin No. 3480. Address Dept. P117

***Model* 3480**
Combination Tube Tester and Volt-Ohm-Mil-Ammeter

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Triplett

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the automobile battery is grounded, avoid contact between the metal of the receiver case and the metal of the car.

SHOP NOTES

Neon Sign Interference

Neon signs and their associate equipment, if properly installed and serviced, will not cause radio interference.

Radiation of interference through power lines and by electrostatic and electro-magnetic coupling is an indication of abnormal conditions. Trouble may be caused by loose contacts, an ungrounded transformer case, leaky bushings, flickering tubing, defective electrodes, transformer voltage too low so that the ionization point of the gas is just barely below maximum voltage, or corona discharges due to long leads and the proximity of metal objects. Whenever radio interference is encountered, check nearby neon sign intallations for visible or audible discharge between or from high voltage components.

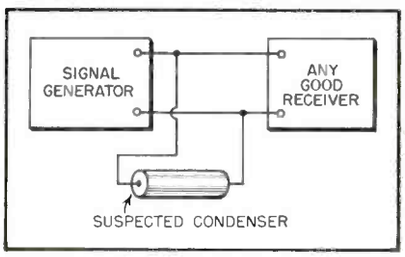
If the discharges are discovered, their correction can be had by better spacing. If a discharge cannot be found, disconnect the tubing at the transformer terminals and operate the transformer, first with the secondary shorted, then with no load. This will indicate whether the transformer is leaking. With the secondary shorted, no interference should be present. If the disturbance still persists, operate the installation at reduced primary voltage to determine if there is an ample margin of safety from the flickering point. The tube should not flicker when the line voltage is reduced 15 per cent.

$1.00 to $5.00 PAID for "SHOP NOTES"

Write up any "kinks" or "tricks-of-the-trade" in radio servicing that you have discovered. We will pay from $1 to $5 for such previously unpublished "SHOP NOTES" found acceptable. Send your data to "Shop Notes Editor," RADIO SERVICE DEALER, 342 Madison Ave., New York 17, N. Y. Unused manuscripts cannot be returned unless accompanied by stamped and addressed return envelope.

Testing Old and New Condensers for Intermittent or Unstable Internal Contacts

Intermittent and noisy condensers probably cause more trouble to the radio serviceman than any other component. A simple procedure for testing suspected units is illustrated in the accompanying diagram. Connect a signal generator directly to the antenna and ground posts of a good radio receiver. With the receiver and signal generator operating, tune the signal generator to some spot on the receiver dial. Use an unmodulated signal. Connect the condenser directly across the antenna and ground terminals and turn the receiver volume up, listening for frying or crackling noise. Condensers which are continuously noisy will show up by this method. Snap the fingers against the condenser and roll it slightly on its leads between the fingers. If cracking or frying is heard the condenser almost certainly has intermittent or unstable internal contacts. This method is applicable to mica, paper, oil and electrolytic types.



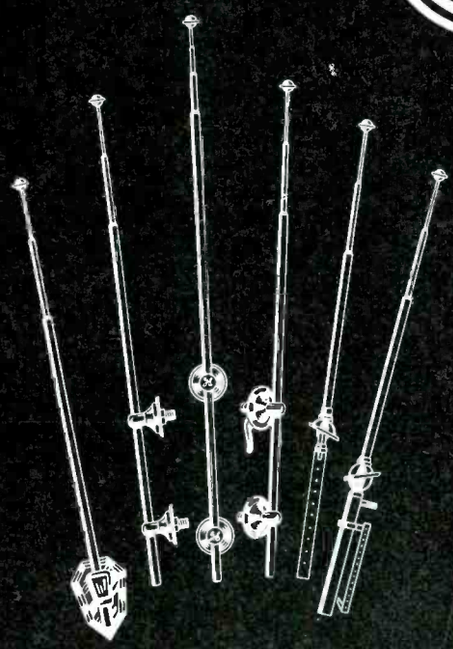
A Simple Condenser Tester

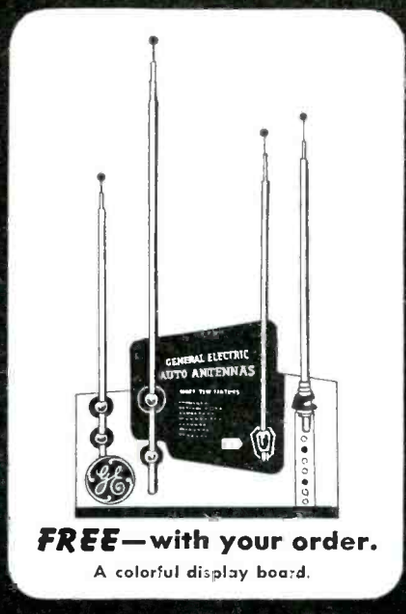
For the serviceman just starting out in business for himself, an excellent and inexpensive service shop accessory is a

[*Continued from page 41*]

CAR OWNERS ARE LISTENING for this suggestion —

A NEW GE AUTO ANTENNA





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2. Provision is made for quick, easy installation.
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4. With your order—a colorful display board that does a swell selling job every minute.

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For additional information on General Electric Universal Parts write: *General Electric Company, Electronics Park, Syracuse, New York.*

GENERAL ELECTRIC

169-F9

ELECTRONIC ANALYZER

[from page 23]

30/120/300 1200 volts. Resistance measurements are 2000/20,000/200,000 ohms top mark and 20/200/2000 ohms at center scale. The Electronic Analyzer ranges are available with a 120 volt a-c supply. The electronic resistance ranges are 2/20/2000 megs. full scale and 2000 200,000/20,000,000 ohms at center scale. Only a 3-volt potential is applied on all resistance ranges and there is, therefore, no danger of damaging equipment by high voltages. The electronic d-c voltage ranges are plus or minus 3 12 30/120/300/1200 volts. The d-c input is through a probe containing a 3-meg. isolating resistor allowing d-c potentials to be measured electronically in the presence of HF, RF, or AF voltages.

The a-c VTVM has ranges of 3/12/30/120 volts which can be measured when this a-c is superimposed on as much as 500-volts d-c. The a-c accuracy varies somewhat with the frequency of the potential being measured, plus or minus 5% from 50 cps to 150 mc, plus or minus 12% (direct reading) from 150 to 300 mcs and plus or minus 8% with a correction curve from 150 to 300 mc.

Suggested Uses of A-C Probe

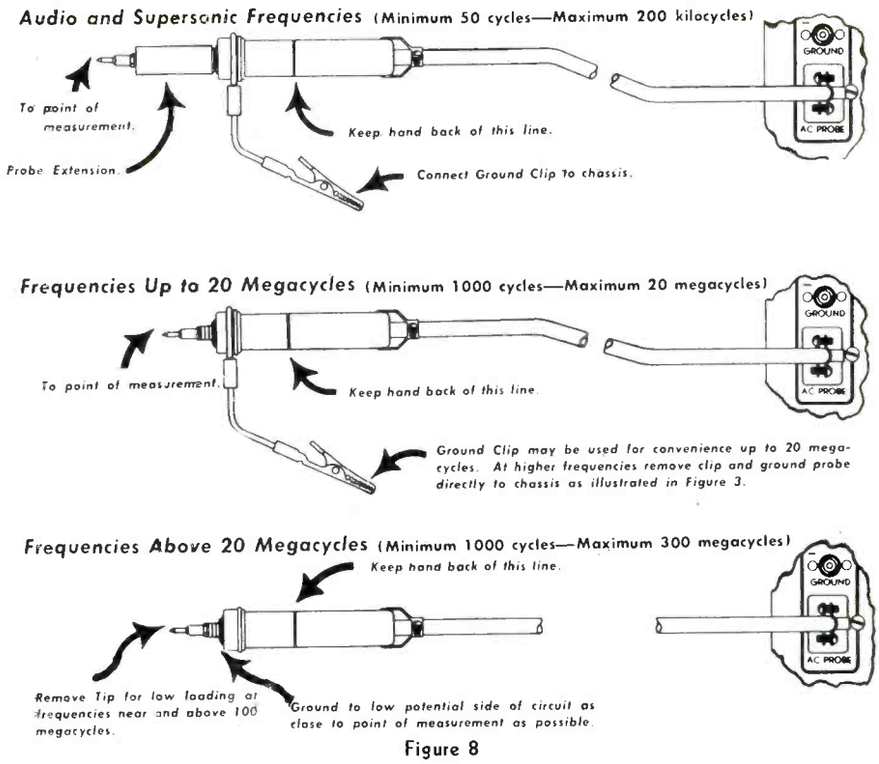

Figure 8

The Probe

The a-c probe is extremely compact. To make it so small a proximity fuse type tube is used. The type selected after exhaustive tests has a resonant frequency well above 1000 mc. A small

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NEW 64 PAGE BOOK

64-page illustrated book describes many fascinating jobs Radio, Television, Electronics offer, shows big kits of Radio parts I send you, tells how I give you *practical* experience building real Radio circuits at home in spare time, how you make *extra* money fixing Radios while still learning; contains letters from many men I trained, telling what they are doing, earning. FREE. Mail Coupon below!

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I will also send you my Lesson, "Getting Acquainted With Receiver Servicing," FREE, to show you how practical it is to learn Radio at home in spare time. It's a valuable Lesson. Study it — keep it — use it — without obligation! Tells how "Superhet" Circuits work, gives hints on Receiver Servicing, Locating Defects, Repair of Loudspeaker, I.F. Transformer, etc. 31 illustrations. Mail Coupon below!

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Do you want a good-pay job in Radio—or your own money-making Radio Shop? Mail Coupon for a FREE Sample Lesson and my FREE 64-page book, "How to Be a Success in RADIO—Television, Electronics." See how N.R.I. gives you practical Radio experience at home—building, testing, repairing Radios with BIG KITS OF PARTS I send!

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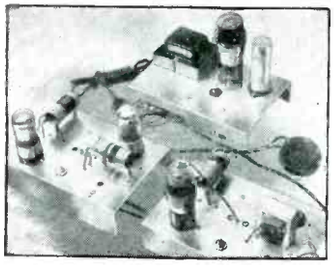

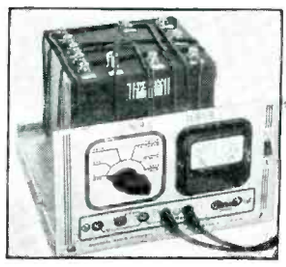

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MR. J. E. SMITH, President, Dept. 7MJ5
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button-type ceramic condenser is mounted at the base of the pick-up tip; the tube is directly behind this coupling condenser and soldered in place to assure positive contact. The top of the tube is held in bakelite and the probe can take considerable abuse without harming the tube or any of the other component parts. The design of the probe is such that it has a resonant frequency of over 600 mc and an RF hand limit that is less than two inches from the coupling condenser. Its input capacity is about 5 $\mu\mu$fs and the resistance 5 meg. *Fig. 8* shows how the probe may be used for divers tests.

Germanium Crystal Diode

A new germanium crystal diode, with a safe forward current of .05 amps and a safe back voltage of 60 volts for radio and television receiver and other equipment applications, is announced by the Specialty Division of the General Electric Company's Electronics Department. Feature of the new diode, which is the point-to-plane contact between a microsharp platinum wire and the face of a specially-processed germanium crystal. G-E engineers say the new diode will handle higher voltages than any of its type.

Weighing several grams with a body length of twenty-three sixty-fourths of an inch and diameter of seven thirty-seconds of an inch, the high back-voltage germanium crystal diode furnishes an interelectrode capacitance of approximately .2 mmf and has a life performance of at least 3000 hours.

The new diode's low forward resistance and high back-to-forward resistance ratio is especially desirable for this unit's rectifier application. It will withstand an inverse voltage of at least 60 volts and return to normal after the application of excessive voltage. Its very low interelectrode capacity and high forward conductance permitting a low resistive load make the diode useful in FM and television applications. In addition, the property of relatively high back conductance upon breakdown lends itself to the possibility of its use as a voltage regulator.

Developed by the Research Laboratory of the company at Schenectady, N. Y., following wartime research with germanium, the new diode is reported to be extremely sturdy. Units have been dropped 10 successive times to a hardwood block from a distance of 30 inches without impairment of performance.

Further information on the new diode may be obtained on request to the Specialty Division, G-E Electronics Department, Wolf Street Plant, Syracuse, N. Y.

[from page 36]

neon lamp gadget which can be used to test condensers. The type you need is about the dimensions of a 50 watt lamp globe. Leaking condensers can be readily detected by applying D. D. to the condenser in series with the lamp. Leakage is manifested by intermittent flashing of the lamp, the rate of the flashes indicating greater leak and steady glow indicating shorted condenser. A. C. of course will go through a condenser; therefore use A. C. to test for open or intermittent operation.

These Shop Notes were contributed by Albert Loisch.

HANDIE-TALKIE

[from page 27]

and static and other electrical disturbances interfered and the message did not always get through. Tests were then made of the comparative advantages of using FM and AM sets with FM eventually getting the signal Corps' approval. It was revealed that FM had a range advantage 4 to 3 above AM in intelligibility while at medium range FM was 3 to 2 over AM in intelligibility.

NEW PRODUCTS

[from page 28]

than ample signal for satisfactory in-car operation with a minimum of input power.

The speaker's case is of weather-proofed, heavy-gauge drawn steel in hammered finish baked maroon enamel. It has a splash screen within the case. The front of the reproducer has a pattern of extruded holes with volume control knob mounted in its center for easy adjustment. Volume is controlled by a constant input impedance L-pad.

The speaker attaches to the car by means of a heavy wire, rubber-covered hanger, which fits easily over the car door sill when the glass is rolled down. The 6-foot, rubber-covered, 2-conductor cable furnished with the reproducer may be wound around the case when the speaker is stored.

Stromberg-Carlson '48 Line Features FM and Television

The broadest and lowest priced line of FM instruments in its history has been introduced as the 1948 line by Stromberg-Carlson.

Twenty-two models, including the first two post-war television units to be produced by the company are in the line. Table model FM sets are priced as low as $74.95.

JFD Expands Line

The JFD Manufacturing Co. of Brooklyn, N. Y. announces the addition of four new items to their line of radio chemicals. Foremost is JFD "Poli-Wax" used for polishing radio cabinets and other wooden furniture. Also JFD "Contact and Crystal Cleaner" for insuring clean, positive contacts and spotless crystals; "Bakelite Cement" for securing plastic to plastic or to any other material and JFD "Liquid Non-Slip Compound" for preventing dial belts and cables from slipping.

Westinghouse Model H-167

Available in either cordovan or suntan blond finish, the Westinghouse

Westinghouse Model H-167

model H-167 AM-FM phonograph combination console has ten tubes plus rectifier and phono amplifier.

Storage for 36 half-inch albums is provided. The receivers' tuning range is 540 to 1600 kc for AM and 88 to 108 mc for FM.

The Automix 3-second record changer having a permanent Sapphire needle plays any combination of intermixed 10 and 12 inch records.

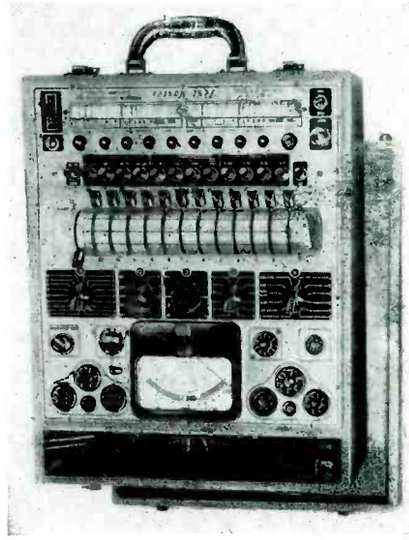
The model gives 15 watts of undistorted output. It is equipped with a 12-inch electro-dynamic speaker, two built-in antennae, and connections for two outside antennae.

The Precision Tester

Precision Apparatus Co., Inc., announces the new Series 10-20 "Electronamic Test Master," particularly engineered for general-purpose radio-electronic and industrial-electronic service work. All standard set testing functions are available at only two polarized tip jacks. It has a large, easy-reading 400 microampere, 4⅝" meter. All circuits are insulated from the power line. Resistors are 1% wire-wound, matched and metallized. All ranges are self-contained, without any additional panel controls.

The Series 10-20 set tester circuit is push-button operated; has 34 AC and DC Ranges, plus complete radio A, B and C battery test facilities which reveal battery condition under dynamic load test.

Series 10-20 is available as a portable instrument (10-20-P); for counter as 10-20-C or rack mounting as 10-20-PM.

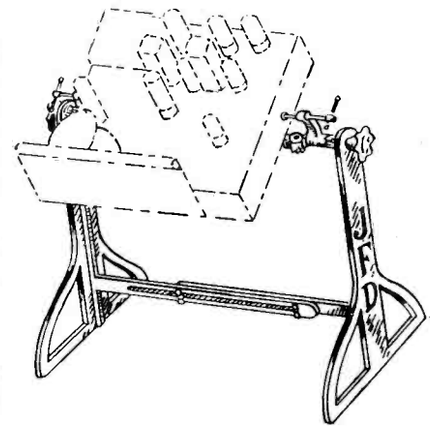


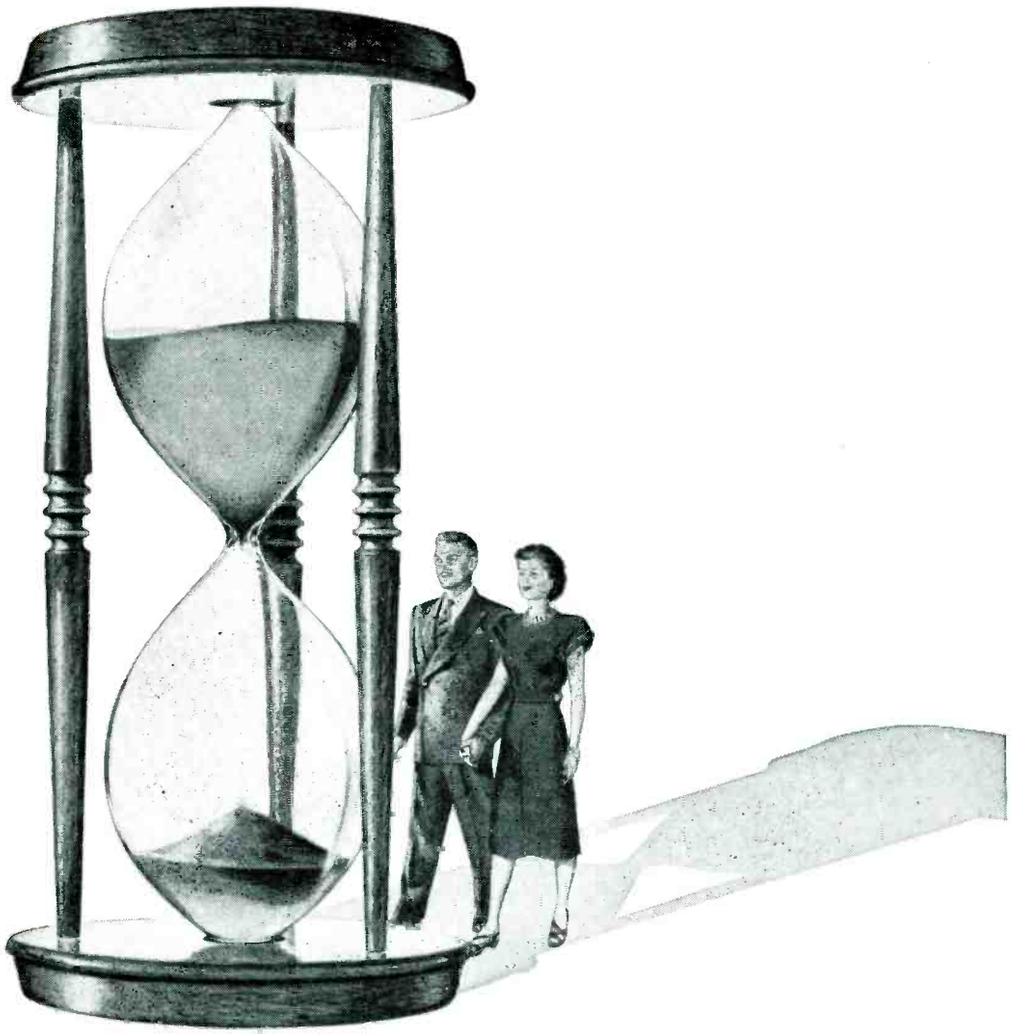
Range Specifications:
Six AC, Six DC and Six Output Voltage Ranges: 0-6-12-60-300-1200-3000 volts
Four Self-Contained Resistance Ranges: 0-1000-100,000 ohms; 0-1-10 megohms (No AC power required)
Six DC Current Ranges: 0-600 microamperes; 0-6-60-300-1200 MA and 0-12 amperes
Six Decibel Ranges from −20 to +64 DB.

For additional information contact manufacturer directly. Write for new 1948 catalog to Precision Apparatus Company, Inc., 92-27 Horace Harding Blvd., Elmhurst, L. I., N. Y.

New JFD Chassis Holder

The JFD Manufacturing Co., Inc. of Brooklyn, N. Y. offers the "Repairack," an all-purpose, cast aluminum radio chassis and phonograph turntable holder. It is excellent for servicemen when assembling and repairing radios or phonographs. With this stand technicians can rotate the chassis through 360° in a horizontal plane, thus making it unnecessary to remove the set until the job is completed. The





The years melt away

(as the years always do)

As your years dwindle down—as everybody's must—you'll need more than affection and companionship.

You'll need a place to live and food to eat. Which means you—not the family next door, but *you*—will need money.

There's only one way for most of us to get money—that's to save it. And for most of us, too, the best way to save money is through U. S. Savings Bonds.

Because U. S. Savings Bonds are the most widely and easily available investment to every citizen. Every bank sells them. Every post office sells them.

AND—most important—you can buy them *regularly* and *automatically* . . . which helps overcome human inertia and reluctance to save.

To do so, you just sign up for the Payroll Savings Plan where you work, or for the Bond-A-Month Plan at the bank where you have a checking account. Then they really pile up.

Of course, there are other reasons for buying U. S. Savings Bonds.

They're SAFE. Backed by the credit of the United States, that's all.

They're PROFITABLE. You get 4 dollars out for 3 put in, after 10 years.

They're LIQUID. Like water. You can get your cash out of them at any time . . . in a few minutes . . . without penalty.

Remember those words "melt away." They say better than a volume of statistics that you have less time than you think, to save.

Save the easy, automatic way—with U.S. Savings Bonds

Contributed by this magazine in co-operation with the Magazine Publishers of America as a public service.

"Repairack" is sturdily made to hold the heaviest chassis and phono turntables. For additional information write to the JFD Manufacturing Co., Inc., 4117 Fort Hamilton Parkway, Brooklyn 19, N. Y. Request Bulletin No. 5479.

Nine Pin Sockets

The Hickok Electrical Instrument Company of Cleveland, Ohio, has announced the availability of the nine pin socket which may be adapted to any Hickok tube tester at small cost. Conversion may be made by merely drilling a larger diameter hole where the present socket is now retained.

Masco Musical Amplifier

Because of the need for a medium powered musical amplifier for touring professional entertainers, small orchestras, and soloists, Mark Simpson Manufacturing Co., Inc., of Long Island City, New York has brought out a 12-watt portable self-contained amplifying system in a smart, two-tone fabricoid covered carrying case. It is called Model MAP-120.

Two inputs for microphone and instrument are conveniently accessible on the top mounted control panel. Separate on-off switch, safety fuse, and Pilot light are among its many features.

New Electrolytics

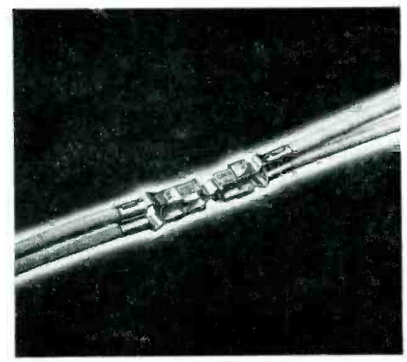
THE addition of high-capacitance low-voltage units to the well-known line of Type PRS or midget-can Dandee electrolytics, is announced by Aerovox Corporation, New Bedford, Mass.

The new units are available in six low-voltage ratings: 6, 12, 15, 18, 25 and 50 volts d.c. working. The high-capacitance ratings are: 100, 250, 500, 1000, 1500, 2000, 3000 and 4000 mfds., in different voltages. These high-capacitance electrolytics are used mainly in electric fence assemblies and for other applications requiring very high capacitance at low voltages.

MAKING CONNECTIONS

[*from page 30*]

the resoldering of the new lead of proper length. In contrast, a proper and more efficient method would be to simply crimp in between the two leads that are too short a length that fills the gap. Another approved fast system would be



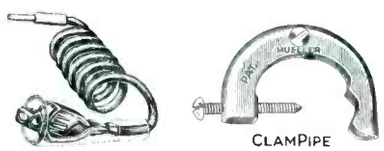
Dual Lead Disconnects

Frequently an application requires that two leads be tied up with two others, or with a single lead. Rather than make the several moves required by stripping wire, twisting it, and then providing a cover, the more practical method, especially in cases where portability is a factor, is to use dual disconnect links such as this. A flick of the locking tie holds the leads in satisfactory electrical connection, or breaks the leads when the connection is no longer required.

to crimp an additional length to one lead and then solder the other end to its terminal point. In any event one can save two or more soldering operations,

Jumpers

The top illustration shows a battery jumper that makes a sure contact to each terminal by means of heavy spring clips that are insulated and explosion proof. Below it is shown a new type jumper called the spike type.

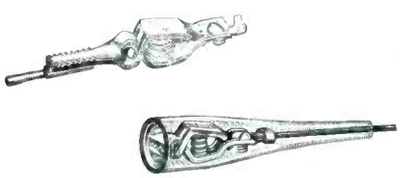


Grid-Clip Assembly & Ground Clamp

The probe and insulated clip assembly is a standard work tool suitable for many uses. The ground clamp is still the most effective method to use in any installation requiring a ground.

General Purpose and Specialty Clips

The jaw type connector is particularly versatile and is frequently used with test equipment because it enables the operator to make fast make and break connections and yet have his hands free. The needle type clip, ideal for telephone work, has a sharp, hard needle that pierces the insulation to make the electrical connection and yet not require that the wire be stripped.



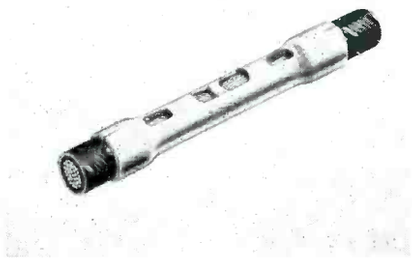
Test Clips

Radio frequency test clips are available with or without the prod type nose and insulated shield cover. They fasten to binding-posts securely, by means of the alligator grip jaws or by means of the prod nose that can be inserted into a binding-post hole.

(and possibly four), by substituting one or two fast crimp joints, depending upon the approved method used.

Scan the illustrations accompanying this article. In one group are found many types of terminals, connectors and

clips.* Their applications and uses are too many to mention. That they simplify, speed up and more efficiently enable a technician in making splices, fixed or removable connections, with a consequent saving of time and effort has been established. The step-by-step methods whereby such connectors and



For making end-to-end connections of wire and cable, crimp connectors which are available in many sizes and types, depending upon the wire and its covering, can be used most effectively.

clips can and should be used for economy of time and effort are outlined under the several illustrations which are used to cover specific applications.

**Acknowledgement is made to Burndy Eng. Co., manufacturers of Hydent Electrical Connectors and to Mueller Elec. Co., makers of Alligator Universal Clips for the use of their illustrations. (Catalogs available on request.)*

TELEVISION ANTENNAS

[from page 17]

modate 5 wavelengths to a leg step-off 4½ wavelengths from the near end (end to which transmission line will be attached) along the station direction line. At the 4½ wavelength point (to be center of entire rhombic) lay-off a perpendicular line. The proper tilt angle is being used when the end of a 5 wavelength section of line attached to the near end coincides with this perpendicular.

With the above procedure the positions of two points of the diamond shaped rhombic have been located and two poles can be erected. A similar procedure can be used to locate the third point (*Pole 3 of Fig. 24*). The fourth point is now another 4½ wavelengths down the station direction line from the point at which the perpendicular crosses the station direction line.

Single Lone-Wire

A single long-wire is also highly directional off its end if it is 10 wavelengths in length or better, *Fig. 22*. This is readily understandable when we consider that the tilt angle becomes smaller and smaller as number of wavelengths increase. This too is a high impedance line and must be attached to a receiver which has high input impedance facilities.

CIRCUIT COURT
[*from page 24*]

in the grid return of the output tubes. Neither 6SJ7 cathode is by-passed directly to ground, thus equalizing response by degeneration. The first stage, however, has a variable combination of by-pass and feedback to one side of the voice coil. This circuit is provided for tone control purposes.

The output stage is conventional for a triode connected stage, the plates and screens of the tubes being connected in parallel. Bias is obtained across a 390-ohm cathode resistor, un-by-passed.

BOOKKEEPING SIMPLIFIED
[*from page 20*]

tapes and tickets department names (or code numbers), sales clerk names or numbers, and non-cash purchases, then the charge as well as the cash sales should be rung up. At the end of the day, reading of the register tape discloses how much total sales were rung up, who rang them up, and for what merchandise (as indicated by the department number). Entering this information on the control sheet at the end of the day is simple.

Not all cash registers can ring up so much information, however. In that case, a simple sales slip similar to that shown as *Fig. 1* can be devised. It should show whether the purchase was for cash or credit; who made the sale; from which department of the radio service shop it came; and should indicate separately, the amount of the sales tax collected if there is a tax.

At the end of the day, the merchant collects these slips and separates them into stacks representing departments. Then the departmental figures, the total sales, and the cash and credit transactions, and the amount rung up by individual sales persons can be tabulated and transferred to the main control sheet.

At the end of the month, the columns are added and a total sales figure for the month as well as department sales, clerk sales and charge and credit figures are brought out. Besides showing how much business was done, these indicators tell the Service Dealer how his business is going.

Is business as good as last year? Better? A comparison of the figures for two months a year apart tells this. If sales have fallen off, it's a good indication that the merchandising tools must be put to use. Perhaps there was too much of one kind of merchandise, not enough of another and faster seller. Comparing the department sales figures for the two months tells whether sales of

Ad Index

one kind of merchandise have fallen off. If that happens, the obvious course is to carry smaller inventories of the slower-moving line, and heavier inventories of volume sellers.

Knowing where sales are falling off and where they are gaining guides a merchant to stock what his customers want. Accurate sales records will tell him this more accurately than any other method. Sales records, however, are only a part of the picture. There are other things the Radio Service Dealer should know about his business. The next part of this series will show how to find the answers to credit selling questions that must be answered if charge account and term merchandising is to be profitable, and subsequent parts of the series will show how to set up proper records for your various departments, such as the repair department, etc.

In SUN, WIND, SLEET or RAIN

FEDERAL'S 300-OHM LINE

gives Peak Performance

FTR

the Dependable link between Antenna and Receiver

HERE'S an Intelin* transmission line that's really designed to take plenty of punishment—to maintain peak performance of FM and television receivers under even the most rigorous conditions. Federal's K-1046 300-ohm line will withstand the scorching heat of the summer sun, the abrasion of wind-borne dust and dirt, freezing sleet and atmospheric moisture.

Its smooth solid polyethylene insulation resists water, acids, alkalies, oils and abrasion—won't embrittle or age in sunlight. It retains flexibility and demensional precision in hot or cold weather. Elliptical cross section enables it to withstand twisting—prevents accumulation of foreign matter and maintains stable capacity characteristics.

Stock up now to meet the increasing demand for new FM and TV installations. This 300-ohm line, as well as other Federal h-f cables—can be obtained through local distributors all over the country.

DATA FOR 300-OHM LINE

Type Number	Characteristic Impedance	Velocity of Propagation	Capacitance Per Ft.	Attenuation, Db per 100 Ft. Frequency in Megacycles				Physical Dimensions	
				1.0	1.7	3.0	100	Conductor Size	OD over Jacket
K-1046	300 ohms	81%	4.0 mmf	.38	.57	.85	2.0	7/# 30	.36" x .08"

* Reg. U. S. Pat. Off.

NOW—

Available in convenient 1,000-foot spools. Easy to stock, easy to handle, easy to use on the job.

FTR An IT&T Associate

KEEPING FEDERAL YEARS AHEAD... is IT&T's world-wide research and engineering organization, of which the Federal Telecommunication Laboratories, Nutley, N. J., is a unit.

Federal Telephone and Radio Corporation

SELENIUM and INTELIN DIVISION, 1000 Passaic Ave., East Newark, New Jersey

In Canada:—Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors:—International Standard Electric Corp. 67 Broad St., N. Y.

10 reasons why

YOU'RE IN THE LEAD WITH RCA

QUALITY—Quality and dependability generate business. The unquestioned quality and dependability of RCA tubes lead more customers your way.

PRESTIGE—Your identification with RCA lends prestige to your business... brings *more* people to your shop for other things, too.

ENGINEERING LEADERSHIP—The fountainhead of modern tube development is RCA. You can count on RCA for the new tubes that bring you more business.

AUTHORITATIVENESS—RCA tube publications are standard reference works wherever tube information is needed. They spread the popularity of RCA tubes . . . bring more business your way.

PREFERRED LINE—RCA brings you a preferred line of related products for greater sales volume. Radio batteries, component parts, package sound, and test equipment round out your business.

GUIDANCE—RCA brings you seasoned merchandising counsel and guidance through a top-ranking group of field sales representatives, who work to keep you in the lead.

MANUFACTURING—RCA's manufacturing "know-how" works constantly to your advantage . . . producing millions of tubes, hundreds of types, with uniform, dependable quality—day in and day out.

SUPPORT—RCA backs you up with the best in sales promotional aids that apply powerful advertising and display techniques to the job of stopping, reminding, *and selling* prospects.

COMPLETENESS—RCA brings you the widest variety of tubes in the field. Practically every job you service can be re-equipped with *standard available* RCA tubes.

TEAMWORK—"You and RCA" form the hardest-hitting selling team in the field. And, as a member of your team, RCA backs your every play with an array of dynamic business aids that *identify, serve,* and *remind.*

So—push RCA tubes and watch your business grow!

THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

TUBE DEPARTMENT

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HARRISON, N. J.