THERE IS PROFIT IN TELEVISION
CUSTOM INSTALLATIONS
PAGE 46
The quality of RCA tubes is unquestioned.

Most used...by brand and by type...RCA kinescopes are the fast-moving profit makers.

Best Sellers in Picture Tubes...

The largest and most profitable replacement business in television picture tubes comes from the types used in most television receivers...the Best Sellers.

RCA's types are Best Sellers. There are more of them in actual use in TV receivers than any other brand. Industry choice of these high-volume types reflects to your advantage. Inventory and stocking problems are simplified...and you have the assurance of rapid, profitable turnover.

In addition, when you sell RCA kinescopes, you gain from customer confidence in the RCA brand...solidly established by the proved performance of RCA kinescopes in millions of television receivers.

Remember, too, that the quality and dependability of RCA kinescopes mean fewer service failures and fewer costly call-backs. There is, therefore, more profit in every RCA kinescope you sell.

Always keep in touch with your RCA Tube Distributor.
I Will Show You How to
LEARN RADIO-TELEVISION
SERVICING OR COMMUNICATIONS
by Practicing in Spare Time

YOU PRACTICE RADIO SERVICING
You build the modern Radio shown below as part of my Servicing Course. I send you speaker, tubes, chassis, transformer, loop antenna, everything you see pictured and EVERYTHING you need to build this modern Radio Receiver. Use it to make many tests, get practical experience.

NOW! Advanced Television Practice
New, tested TV kits furnished to build high-definition SCOPE... RF OSCILLATOR with 6 kilowatt power supply... complete 4-tube TV SET. Get valuable PRACTICAL EXPERIENCE with new TV wave forms! Locating and correcting TV troubles. Mail coupon for facts and pictures.

January, 1951

I Will Train You at Home with MANY KITS OF PARTS I SEND

I TRAINED THESE MEN


"I accepted a position as Radio Servicing Engineer. Was promoted to head of television servicing department." - L. HAUER, San Bruno, Calif.

"While learning, made $5 to $10 a week in spare time. Now have a profitable time business." - G. L. ARNOLD, Pontiac, Mich.

"When I enrolled, had no idea it would be so easy to learn. Have equipped my shop out of spare time earnings. I am clearing about $40 to $60 a month." - J. D. KNIGHT, Denison, Tex.

"I am clearing about $15 to $20 a week in spare time. Made $5 to $10 a week in spare time." - N. H. WARD, Ridgefield, N. J.

"While learning, made $5 to $10 a week in spare time. Now have a profitable time business." - P. MILLS, Maumee, O.

"When I enrolled, had no idea it would be so easy to learn. Have equipped my shop out of spare time earnings. I am clearing about $40 to $60 a month." - J. D. KNIGHT, Denison, Tex.

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"When I enrolled, had no idea it would be so easy to learn. Have equipped my shop out of spare time earnings. I am clearing about $40 to $60 a month." - J. D. KNIGHT, Denison, Tex.

Do you want good pay, a job with a bright future and security? Would you like a profitable shop of your own? The fast growing, prosperous RADIO-TELEVISION industry is making these opportunities for you. Radio alone is bigger than ever, 50 million home and auto Radios, 3100 Broadcasting Stations, expanding use of Aviation and Police Radio, Micro-Wave Relay, Two-Way Radio for buses, taxis, etc., are making opportunities for Servicing and Communications Technicians and FCC-Licensed Operators.

Television is TODAY'S Good Job Maker
In 1946 only 5,000 TV sets sold. In 1950 over 5,000,000. By 1954, 25,000,000 TV sets will be in use, according to estimates. Over 100 TV Stations are operating in 35 states. Authorities predict there will be 1,000 TV Stations. This means new jobs, more jobs, good pay for qualified men.

Many Soon Make $10 A Week Extra in Spare Time
Keep your job while training at home. Hundreds I've trained are successful RADIO-TELEVISION TECHNICIANS. Learn Radio-Television principles from illustrated lessons. Get PRACTICAL EXPERIENCE experimenting with circuits common to Radio and Television. Many students make $5, $10 a week extra fixing neighbors' Radios in spare time. Special Booklets start teaching you the day you enroll.

Send Now for 2 Books FREE—Mail Coupon
Send for my FREE DOUBLE OFFER. Get actual Servicing lesson. Also get my 64-page book, "How to Be a Success in Radio-Television." Read what my graduates are doing, earning. Send coupon in enclosed 6x4 envelope or pasted on postal. J. E. SMITH, President, Dept. 1AE, National Radio Institute, Washington 9, D. C.

NOW! Advanced Television Practice
New, tested TV kits furnished to build high-definition SCOPE... RF OSCILLATOR with 6 kilowatt power supply... complete 4-tube TV SET. Get valuable PRACTICAL EXPERIENCE with new TV wave forms! Locating and correcting TV troubles. Mail coupon for facts and pictures.

A TESTED WAY TO BETTER PAY...MAIL COUPON NOW

I TRAINED THESE MEN


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Send for my FREE DOUBLE OFFER. Get actual Servicing lesson. Also get my 64-page book, "How to Be a Success in Radio-Television." Read what my graduates are doing, earning. Send coupon in enclosed 6x4 envelope or pasted on postal. J. E. SMITH, President, Dept. 1AE, National Radio Institute, Washington 9, D. C.

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A TESTED WAY TO BETTER PAY...MAIL COUPON NOW
First in radio-television-electronics

JANUARY, 1951

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RADIO-ELECTRONICS

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Use REAL commercial-type equipment to get practical experience

Your future deserves and needs every advantage you can give it! That's why you owe it to yourself to find out about one of the most COMPLETE, practical and effective ways now available to prepare AT HOME for America's billion dollar opportunity field of TELEVISION-RADIO-ELECTRONICS. See how you may get and keep the same type of basic training equipment used in one of the nation's finest training laboratories...how you may get real STARTING HELP toward a good job or your own business in Television-Radio-Electronics. Mail the coupon today for complete facts—including 89 ways to earn money in this thrilling, newer field.

Above: Build and keep a real 16 inch commercial TV receiver. Optional after completing regular training at slight additional cost.

D.T.I., ALONE, INCLUDES BOTH MOVIES and HOME LABORATORY

In addition to easy-to-read lessons, you get the use of HOME MOVIES—an outstanding training advantage—plus 16 big shipments of Electronic parts. Perform over 300 fascinating experiments for practical experience. Build and keep real commercial-type test equipment shown at left.

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If you're subject to military service, the information we have for you should prove doubly interesting. Mail coupon today.

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January, 1951
Smart TV Dealers are

HITTING THE TENNA-ROTOR JACK-POT!

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Over 50 key TV stations demonstrate Alliance Tenna-Rotor to 7 million viewers! Tenna-Rotor is the only TV accessory backed by a powerful, sustained television campaign—national in scope! Hundreds of thousands of Alliance Tenna-Rotors are in use!

Alliance Tenna-Rotor offers faster installation with Alliance 4-conductor "Zip" cable—Works in all weather—Guaranteed for one year—Approved by Underwriters’ Laboratories.

NEW DELUXE MODEL HIR IS FULLY AUTOMATIC!
FORCEFUL CONSUMER ADVERTISING BOOSTS YOUR SALES OF G-E TUBES!

Full-page, eye-catching ads like this appear regularly in

LIFE

THE SATURDAY EVENING POST

HERE'S a tube "first" that will put you first in volume, profits, and neighborhood prestige. Feature G-E tubes on your shelves; display them prominently on your counter. Your G-E tube distributor (better phone him, it's quicker) gladly will help you tie in with this national advertising. Or wire or write Electronics Department, General Electric Company, Schenectady 5, New York.

January 1951
THE initial response to our recent announcement of plans to publish a new Audio Edition of Radio & Television News has been most gratifying. Ever since the publication of our annual audio issues, we have found an ever increasing interest in the many aspects of sound and related audio subjects. In attempting to satisfy all of our readers, we found that not nearly enough space was available, even in an annual audio issue, to adequately cover all of the new developments and techniques that have jelled in recent months.

In a few instances, however, the announcement was received with mixed emotions and a fear was expressed that we were going to discontinue audio subjects in Radio & Television News, placing such articles in the Audio Edition. Such is not our intention at all. Here's the reason:

We know that a large percentage of our 208,000 monthly readers have a common interest in audio, but there are many others whose preference is for service material on radio and television, amateur radio gear and gimmicks, various television subjects, communications, and for a general all-around coverage of radio and television. Accordingly, it is our responsibility to serve all interests to the best of our ability in the regular edition of Radio & Television News. We intend to continue with that policy and no changes are contemplated.

We are not disturbing the format of Radio & Television News. We are simply going to publish a new magazine, designed specifically for the audio reader who wants additional articles on audio and all its facets. This ‘magazine within a magazine’ means economy of production and permits the publisher to produce the material at but slight additional cost to the reader. It will be designed in similar fashion to our Radio-Electronic Engineering Edition, which is available by subscription only to engineers and persons interested solely in engineering subjects. The new magazine, Audio, will not be sold on the newsstands, but will be limited solely to those readers of Radio & Television News who wish the additional magazine, which will be bound within the regular edition.

The foremost audio writers in the country are already preparing material for the new edition. There will be at least five feature articles each month in the Audio Edition. Present plans call for the first edition in March 1951, providing total mobilization or curtailment of paper does not interfere.

We have made arrangements with Dr. Howard Tremaine, of the University of Hollywood, to write a complete column on audio for the first time, which will be a common sense approach to a thorough understanding of all phases of audio. We believe that this series will be most profitable, not only to the student of audio, but to the engineer because of its review value.

Production Threatened by Shortages

The year, 1951, finds the entire television industry facing severe curtailments in production as the result of our defense program and the scarcity of cobalt, aluminum, and other materials and components. This curtailment of production is another real reason for sitting tight until Industry can come up with a compatible television system. As a matter of fact, this period of shortages may actually force the FCC and the Industry to shelve immediate plans for color television.

Copper is high on the scarcity list, and if the CBS System of color television is to hold the green light, many thousands of motors requiring copper in their construction will be required for the color disc scanner. Even now, there is a scarcity of motors of all types. Even though at this writing CBS has stopped from commercial color telecasting, the FCC may eventually win out in its determined effort to give the American public the CBS color television system without further delay. It is also quite possible that as you read this, Industry will have perfected a compatible electronic system that may ultimately win out by sheer competition over the CBS system.

Color or no color, the television industry is in for a tough year and must face many hardships, if it is to continue at an adequate rate of production.

Service technicians, in the year ahead, have their greatest opportunity. Millions of television sets are not giving proper performance in the home, and authorities have estimated that approximately 70% of all television sets now in use are in need of proper realignment and other adjustments in their circuitry. Speaking of shortages, no one will challenge the statement that we still are in need of many thousands of trained television technicians, not only to take care of the 10,000,000 sets now in use, but as replacements for industry technicians called into service. Never before, and perhaps never again, will there be such an opportunity. Yes, 1951 should be a boom year for the technician. . . O.R.
There's Only ONE COMPLETE CATALOG for EVERYTHING IN RADIO, TELEVISION & INDUSTRIAL ELECTRONICS

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But we are telling you something when we say that Raytheon backs its television dealers and servicemen with a complete field service program!

Seven factory-paid service representatives are in the field 12 months of the year, making scheduled calls in every TV community. These service experts call regularly on distributor service departments and, in conjunction with them, schedule regular servicemen's educational meetings.

At these meetings, they explain new techniques and simplified methods of servicing...they franchise Raytheon service agents and supply them with the latest bulletin releases from the factory on new servicing techniques.

In addition to all this, the factory maintains a regular direct-by-mail program going to distributors for their franchised Raytheon service agents only, keeping them completely informed at all times.

THE NET RESULT is a complete, detailed, organized service program designed to simplify the problems of distributors, dealers and servicemen...to provide workable information on installation, service and maintenance of Raytheon TV receivers...and to save them time and money through a thorough understanding of Raytheon products.

For full details, contact your Raytheon field representative or write Service Manager, Belmont Radio Corp., 5921 West Dickens Ave., Chicago 39, Ill.

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Subsidiary of RAYTHEON MFG. CO.

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TELEVISION

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List prices range from $259.95 to $625.00

RAYTHEON TELEVISION NEWS

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You receive all parts, including tubes, for building this fine, modern Superheterodyne Receiver. This and other valuable standard equipment becomes your property.

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Here are just a few of the interesting facts you learn with the FREE SAMPLE LESSON

1. How radio receivers operate.
2. How the antenna circuit is constructed.
3. Converting signal currents into sound.
4. How the R-F transformer handles the signal.
5. How the tuning circuit functions.
6. The Radio "bands."

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[Mail in envelope or post on penny postcard]

[Check coupon below]

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January, 1951
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"BLUE SHAFTS" are small size

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3/8" 3/4" 3"

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Split Knurl

SWITCH TYPE

RADIO & TELEVISION NEWS
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8 Reasons why "Blue Shafts" are better

1. Blue Shaft controls are complete, ready-to-use units — factory assembled and tested including switches. No time lost fussing with assembly — smooth action guaranteed.
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5. Contact Spring gives you double wiping contacts on both resistor and center terminal ring...to insure noiseless operation.
6. Blue Shaft resistors are made of special resistance material bonded to high quality phenolic for smooth operation, low noise level, outstanding humidity characteristics.
7. Insulator's high dielectric strength permits breakdown test at 1000 volts R.M.S. Dust and dirt can't get in.
8. Blue Shaft Controls are produced and guaranteed by Centralab — the company that introduced carbon-type controls to the radio industry 25 years ago!

"Blue Shafts" offer complete range of all values

Service engineers! Centralab's new Blue Shaft controls are an exclusive service item and are available in a complete line of plain and switch types. Resistance ranges from 500 ohms to 10 megohms in a wide variety of tapers and tapped units suitable for any circuit.

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Check These LOW PRICES on Popular Size Controls!

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Ohms Max. Resistance</th>
<th>Taper</th>
<th>Circuit Location</th>
<th>List Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-60</td>
<td>500,000</td>
<td>C-2 (audio)</td>
<td>Volume or Tone</td>
<td>$1.00</td>
</tr>
<tr>
<td>B-60-S*</td>
<td>500,000</td>
<td>C-2 (audio)</td>
<td>Volume or Tone</td>
<td>$1.50</td>
</tr>
<tr>
<td>B-70</td>
<td>1 megohm</td>
<td>C-2 (audio)</td>
<td>Volume or Tone</td>
<td>$1.00</td>
</tr>
<tr>
<td>B-70-S*</td>
<td>1 megohm</td>
<td>C-2 (audio)</td>
<td>Volume or Tone</td>
<td>$1.50</td>
</tr>
</tbody>
</table>

Get More Information... You can get complete information on the entire Blue Shaft line of replacement controls from Centralab's new Bulletin No. 42-106. Ask your jobber or write direct.

CENTRALAB DIVISION OF GLOBE-UNION INC., 910 East Keefe Avenue, Milwaukee 1, Wisconsin

Please send me Blue Shaft Control Bulletin No. 42-106 □ Include new Centralab Catalog No. 27 □

Please!

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City..............................................Zone....State.............

Name..........................................................Company Name........................................
Address..................................................Address..................................................
City..............................................Zone....State.............

January, 1951
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A Rauland "Exclusive"

Speeds Service—Builds Profits

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January, 1951
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THE CHANNEL ISSUE, the original reason for the call of the allocation hearings, which was pigeon-holed for nearly a year by the vexing color debate, finally reached the discussion stage shortly before election day and appeared to be headed for a typical Washington festival of invectives. In the wrangling mill have been dropped such sizzling questions as . . . shall the present bands be continued and in what basis, or shall we rearrange and mix the channels with stations on the higher frequencies, or shall we extend the present bands to the, let us say, 500-megacycle region, now held in part by the military and simply forget the ultra-highs, or shall we add more stations to the present setup, allow less spacing between some stations in some territories and delay the ultra-high program indefinitely, or shall we use the program proposed by the Commission and add 42 channels to the higher bands, allow a specified inter-mixing of high and low bands in some areas, and insist on more separation between stations on the present bands. After several rounds of heated testimony, with ayes and nays bouncing from all sides, confusion in the hearing halls was quite rampant. Oddly enough, the replies offered appeared to have considerable merit. For instance, when Paul Raibourn, proxy of Paramount Television Productions, concluded his commentary, even the government's experts stared and appeared to wonder if an answer could be found. Seems as if Raibourn remembered his legal history very well and recalled that in the early days of AM development, an effort had been made through law by the so-called Davis amendment to freeze the frequencies and classification of stations, including power and hours of operation, into a rigid geographical formula by a system of zoning. Economic support could not be obtained in many of the less populous areas, while the demand for frequencies in the larger markets developed with increasing intensity. Accordingly, on the Commission's recommendations, Congress abandoned this statutory straitjacket, according to Raibourn, and placed upon the Commission the responsibility of insuring an equitable distribution of facilities, based primarily on demand. In the opinion of Raibourn, while it may have been that the pattern of nationwide broadcast coverage would ultimately have been enhanced in some areas if the AM frequencies had been withheld for a decade or more, it is doubtful whether there would have been the fullest development of competitive opportunities had not the more populous areas been permitted to make the fullest utilization of the AM frequencies. It was then pointed out that perhaps the important significance of the experience under the Davis amendment was the fact that the Commission found, in the early development stage of sound broadcasting, that geographical formulas were unduly restrictive. In the present stage of television development, disclosed Raibourn, Paramount felt that the assignment of the ultra-high frequencies would be even more restrictive.

Citing several interesting personal experiences in present band reception, the film executive said that he has been able to pick up signals from Washington, a distance of 245 miles away from his home, the pictures being equal to those from the Bridgeport ultra-high transmitter nine miles away. Pictures from Channel 3 in Philadelphia were also often found to be equal in enjoyment to the upper v.h.f. channels in New York. Adjacent channel interference didn't seem to bother the receivers in his home, Raibourn reported. He felt that existing standards of separation, developed in '45, were still proper and could continue to be used if receivers were made with higher tuning discrimination. The receiver design criteria needed to permit the existing channel allocation to continue were not extreme or difficult, the Paramount official declared.

Describing his views on the higher-band problem, Raibourn said: "As regards the proposed ultra-high allocation plan, and particularly the fact that major economic and population centers were not assigned channels, it is my fear that the u.h.f. as a broadcasting medium will not develop rapidly to the degree of which it is capable. Even when it does, the u.h.f. stations will stand in relation to the entire scheme as the clear-channel stations do now in the AM broadcasting structure."

Somewhat of a contrary view appeared in the testimony of Albert F. Murray, appearing on behalf of Philco, who reported that the residents of
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Bridgeport and vicinity could receive excellent television service a greater percentage of the time from the present ultra-high station than they could from any New York City station and that, in addition, they could enjoy the advantages of much less signal interference, practically no diathermy interference, lower and less-costly antenna structures, and smaller high-gain antennas. However, there were some u.h.f. disadvantages which must be considered, too, he said. For instance, the receiving antenna position is much more critical; swaying due to wind can cause signal variation. The shadow effect is also more noticeable, and the absorption of buildings and trees is greater, too.

Murray disclosed that he used a Philco 48-1001 table model set, equipped with a fixed, cavity-tuned converter and three types of receiving antennas; the usual dipole, a Yagi, and an eight-element stacked a half with a reflector. To connect the antenna with the receiver either of two lengths of 50-ohm RG-9/U coax cable were applicable, one having a 2 db. loss and another a 3 db. loss. A motor-driven rotator served to select the proper pickup point. The directional higher-gain antennas were found to provide the best results.

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Still another opinion on the ultra-high situation was offered by the industry's official association, the TTA, which asked that the Commission assign 70 channels for the higher bands in the entire 470 to 890 megacycle band, so that manufacturers could plan now in their design and production of receivers for the converter.

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Reviewing how they arrived at their proposal, the association declared that they felt that there should be at least four stations in each of the first 140 metropolitan districts, and at least as many stations in each metropolitan district and community as specified by the Commission. Spacing could be determined by considering where oscillator interference would be expected.

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January, 1951

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January, 1951
JOHN WILLIAM WALT, assistant advertising manager of Admiral Corporation since February 1949, has been promoted to the post of sales promotion manager for the company.

In his new position, Mr. Walt will have charge of the general promotional activities for the company including the handling of display advertising, national conventions, and printed matter.

Prior to joining Admiral, he was affiliated with Webster-Chicago as promotion manager for two years and served in a similar capacity with Westinghouse for one year.

During World War II, Mr. Walt served in the U. S. Navy for four years, entering service from the Chicago branch of RCA Victor where he was advertising manager from 1937 to 1941.

I. J. KAYLE AND ASSOCIATES, INC., has been recently formed in Chicago by I. J. Kaluzna and Sol Miller for the purpose of engineering and installing master television antenna systems for apartment buildings and commercial establishments. The company has offices at 1313 West Randolph Street in Chicago. SIGHTMASTER CORP. has announced its withdrawal from the television receiver manufacturing field to devote all of its facilities to the production of television glass... THOMPSON PRODUCTS, INC., of Cleveland, Ohio, has entered the electronic field and will manufacture, sell, and service coaxial switches. The company has long been prominent in the automotive and aircraft parts field... TRAD TELEVISION CORPORATION has acquired control of the WIL-RAY PRODUCTS COMPANY, manufacturers of television cabinets. The new affiliate has been renamed the TRAD CABINET CORPORATION and will continue to produce cabinets at its Marlboro, New Jersey plant... WHOLESALE ELECTRONIC SUPPLY has recently opened its doors at 2800 Ross Avenue in Dallas, Texas to serve radio and television dealers, technicians, and industrial accounts in the northeast Texas area. John N. Leedom and M. B. “Pat” Patterson, both widely-known industry figures, are the principals in this new firm.

NEDA, through its president Arthur C. Staliman, has announced the establishment of an annual award to be bestowed on the person or persons in the electronic parts and equipment industry "whose work and/or activities in our industry directly improve and enhance manufacturer-representative-distributor relations."

Complete details on the award program will be announced following the next meeting of the organization's executive committee.

... C. W. HIGBEE, manager of the electrical wire and cable department of United States Rubber Company, was recently elected president of the National Electrical Manufacturers Association.

Five vice-presidents were chosen in the same election and the following men will serve during 1951: Arthur A. Bernard, president of Ward Leonard Electric Co.; J. H. Jewell, vice-president of Westinghouse Electric Corporation; J. F. Lincoln, president of The Lincoln Electric Co.; R. E. Murphy, vice-president in charge of sales for the I-T-E Circuit Breaker Company; and Alan F. Sheldon, vice-president and general manager of the Kennecott Wire & Cable Company.

L. G. Hall, president of Stackpole Carbon Company, was chosen treasurer.

... JAMES M. TONEY, advertising manager of the RCA Victor Home Instruments Department, has been appointed director of public relations for the RCA Victor Division.

Mr. Toney succeeds John K. West who resigned to join the National Broadcasting Company, an RCA subsidiary, as vice-president in charge of its western division.

The new director of public relations brings to his new position a varied experience in the advertising, publicity, and public relations fields. He joined the company in 1943 as an expeditor in the Purchasing Department, working in the Chicago office. Since that time he has held diversified posts in the sales and advertising departments of the company.

... IVAN S. COGGESHALL, general traffic manager of Western Union Telegraph Company's overseas communications, was named president of the Institute of Radio Engineers for 1951. He succeeds Raymond F. Guy, manager of radio and allocation engineering for the National Broadcasting Company.

Jorgen C. F. Rybner of Copenhagen was named vice-president succeeding Sir Robert Watson-Watt of London in
In a large, modern dial telephone office, 2,000,000 switch contacts await the orders of your dial—and 10,000 of them may be needed to clear a path for your voice when you make a single telephone call. Within this maze of signal paths, faults—though infrequent—must be detected and fixed before they can impair telephone service.

The latest system developed by Bell Telephone Laboratories automatically detects its own faults, detours calls around them without delay—then makes out a “written” report on what happened.

The fault may be a broken wire, or a high resistance caused by specks of dirt on switch contacts. In one second, the trouble recorder punches out a card, noting in detail the circuits involved and the stage in the switching operation where the fault appeared.

Maintenance men examine the reports at intervals and learn what needs attention. Between times they go about their own duties in keeping service moving.

This is another example of how research at Bell Laboratories helps your telephone system operate at top efficiency, so the cost to you stays low.

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Hi-Fi Fans the country over have accepted this challenge—have asked their “soundman” for a demonstration—then, have installed a Permoflux Royal Eight” in their own audio equipment. Now they possess a magnificent speaker at a reasonable price which reproduces sound with superior sensitivity and fidelity as well as tonal qualities which YOU too will want to add to perfect the excellence of your own equipment.

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**RADIO & TELEVISION NEWS**

(Continued on page 137)
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Improving Performance of Older TV Sets

By WALTER H. BUCHSBAUM*

Unlike AM radios, video receivers should be checked at least once a year in order to restore their new-set picture quality.

In 1948 over a million television receivers were sold, and an additional two million sets found their way into American homes in 1949. While the majority of these sets are performing satisfactorily, most of them will require some repairs after the first year of operation. Even if an actual failure does not occur, most viewers realize that their pictures are not as bright and clear as they were when the set was new. Many earlier models feature 10 or 12 inch screens which appear small in comparison with the new full-sweep, large screen models.

In overhauling and improving the performance of these television receivers the service technician will find a source of profit which will grow as more and more "old" sets come up for service. In many instances it will be profitable to include this overhaul and picture improvement in a second year service contract, a procedure already advertised by some enterprising service organizations.

The actual work required depends on the condition of the set and whether a new, large screen tube is to be used, or the sweep on the present tube merely expanded. In the following paragraphs the basic steps of such an overhaul are outlined and finally the problem of inserting a larger picture tube is taken up.

Dim Pictures

The most frequent complaint in the case of dim pictures is loss of brightness. This can be due to any or all of these causes:

1. Dust on face of picture tube.
2. Weak picture tube or weak ion trap.
3. Low high voltage.

The photograph in Fig. 1 is a good example of the dust problem. Because of the electrostatic charge on the face of the picture tube, dust not only collects easily but tends to stick to the glass. Some receivers have a dust-proof space between the picture tube screen and the safety glass but in the majority of the sets, a good coating of dust accumulates on the screen.

Cleaning the face of the picture tube is accomplished easiest by using window cleaning fluid or water and a very soft cloth.

Where a weak picture tube is suspected make sure that the picture tube is at fault by re-adjusting the ion trap magnet first. Permanent magnet types often lose some of their strength and it is therefore advisable to have an extra single and double magnet ion trap on hand. If the ion trap cannot produce a bright enough picture, the d.c. voltages on the picture tube cathode, grid, and first anode should be measured next. Most magnetically deflected tubes should give full brightness with about zero to 8 volts between cathode and grid. First anode voltages usually range from 500 to 250 volts.

If the second anode voltage of the picture tube is low, this will also result in a dim picture. The most dependable way of ascertaining this is to measure the high voltage directly at the picture tube with a high voltage probe and v.t.v.m. unless a special high voltage meter is available. Some service technicians can approximate the voltage by the length of the arc they can draw from a grounded screwdriver to the second anode terminal, but this is not an exact procedure.

Weak Tubes

If the high voltage is lower than about 7 kv. for a 10 or 12 inch tube, one of several components may be at fault. The tubes should be exchanged first. In 1948 and 1949 models the most frequently used horizontal output tube was the 6B6, and this is a likely culprit. The 6W4 or 5V4 damping diodes are the next likely offenders and the 1B3 high voltage rectifier the least likely. Occasionally the horizontal oscillator tube may be weak and sometimes the trouble is due to low "B plus" voltages caused by an aging rectifier tube.

Weak Components

If tubes and operating voltages appear to be correct, the flyback transformer might have changed, due to a change in the powdered iron core. Since the circuits seem to function but are merely weak, a resistor or condenser failure is not likely, with one exception. In most receivers a 1 meg-ohm resistor is used in series with the high voltage lead, and a high voltage condenser connects to one side of this resistor.

The high voltage condenser is rarely at fault, but the resistor may change in value or develop a very high resistance. This results in low second anode voltage and very poor regulation.

* Author of the recently published book "Television Servicing, Principles and Practice" (Prentice-Hall).
9.5 kv. is applied. Expense of tube life. A 10BP4, for example, will never last as long if operated at 13 kv. than if the prescribed 8000 ohms, 5 watts. When the screen is dark, the high voltage, check to see if the terminals appear badly corroded. If the same tube type is used for substitution it is rarely necessary to realign the i.f. coils. In some instances, however, a complete realignment will greatly improve the performance of the set. A complete alignment should be done only with the manufacturer's alignment instructions and the proper instruments, including a sweep generator, marker, and oscilloscope. The improvement in performance of a properly aligned set is well worth the extra time and work.

When pick-up from distant stations appears good, but the crispness of the black and white portions is lacking, the video amplifier tube may be weak. Occasionally a video peaking coil opens up, which results in smearing of the image from left to right.

The tubes in the front end tuner are also likely to deteriorate after a year or so of service. While replacement of the r.f. amplifier and mixer tube rarely troubles any trouble-tube is often very critical. In the RCA Model KRK-2 tuner, for example, the 6J6 oscillator tubes were hand-picked for each unit and not every 6J6 will work as an oscillator on all channels. In any event, when the oscillator tube is replaced it usually means that the oscillator coils must be realigned for all channels. Tuning the local oscillator can be done on a station signal from the air, provided the sound and picture i.f. sections are aligned correctly. Adjust the oscillator coil's slug position. Add a second 500 μfd. high voltage condenser. Then go to a halfway point when adjusting the oscillator. Check and recheck all available stations for good sound and picture, in each case making certain that the fine tuning knob is in a center position.

Poor reception from distant stations and intermittent reception on any channel are often due to corroded antenna connections. These connections of the lead-in to the antenna elements are subject to all kinds of weather conditions and naturally tend to corrode and oxidize even if all parts are aluminum or brass. It is very difficult to judge the connections by their appearance. Measuring d.c. resistance as shown in Fig. 3 is often the quickest way. If the terminals appear badly corroded they should be replaced.

Changes For Increased Sensitivity

If it is desired to increase the sensitivity of a particular receiver, several different steps are possible:

a. Substituting higher gain tubes. If the receiver uses 6AU6 tubes as i.f. amplifiers, 6BC5's or 6C56's may be used. It should be noted, however, that these tubes have different tube capacities and their use will mean realigning of the i.f. section. The 6BC5
is different from the 6AU6 in that the suppressor grid is connected to the cathode internally. This means that pin #2 on the 6AU6 must be disconnected from ground and remain unconnected if a 6BK5 is to be used. The 6CG6 is a higher gain tube than the 6AG5 or 6BC5 and its suppressor grid is not internally connected to the cathode. By using higher gain tubes as outlined above, the increase in sensitivity may be as much as two times.

b. For the reception of Channels 7 to 13 it may be advisable to use a 6AK5 r.f. amplifier in place of the 6AG5 used in the Standard Coil and similar tuners. If a 6J6 or other triode is used in the r.f. stage it cannot be replaced by a higher gain tube.

c. In some receivers it is possible to increase the i.f. and r.f. gain by connecting these tubes to a higher "B plus" point. Usually the "B plus" voltage is about 125 to 150 volts. If the plate and screen resistors are returned to a 200 or 250 volt point instead, additional amplification will result.

d. As a last resort the i.f. response curve may be changed so as to bring the picture on the i.f. carrier to the top of the slope and narrow the over-all curve down to obtain more gain. This should only be attempted if a sweep generator, marker, and oscilloscope are available and the technician is thoroughly familiar with i.f. alignment procedure.

**Increased Width**

Occasionally the customer complains of insufficient width or else the width problem comes up when the second amplification stage is raised. In such instances the technician wants to improve the picture size by substituting a new, full sweep screen cut-out in place of the old rectangular mask, or a new picture tube is used which might require more sweep. Barring weak tubes or a deteriorated flyback transformer or deflection yoke, it will be necessary to change the circuit to obtain more width. Two different approaches are possible, either the drive on the horizontal output tube can be increased or else the high voltage can be lowered.

**Lowering High Voltage**

a. Shunt the width coil with .05 to .1 µfd condenser.

b. Connect a 100 to 500 µfd, mica, 1000 volt condenser from the plate of the damper tube to ground.

**Increasing Drive**

This depends on the type of horizontal oscillator used. Steps a. and b. will help with all types of oscillators.

a. Increase screen voltage of the 6BG6 up to 300 volts above cathode by changing the screen resistor. Do not exceed the screen current of 15 ma at 300 volts.

b. If the vertical oscillator and output tube obtain their "B plus" voltage from the horizontal boost voltage (point A in Figs. 2, 4, and 5) connect them to the next highest "B plus" point instead. This will cause the boost voltage to increase and produce more sweep as well as more high voltage.

c. The circuit in Fig. 5, is typical of receivers like the RCA 630 and many similar models. To increase the drive on the 6BG6 change R, to 1 megohm, R, to 470,000 ohms, and C3 to 2000 µfd. Changing C1 to 330 µfd. and R6 to 10,000 ohms may also improve the width.

d. The circuit shown in Fig. 4, is used in later models and is today probably the most widely used horizontal oscillator. To obtain more width change C3 to 2000 µfd., C4 to 1500 µfd., and R6 to 10,000 volts.

e. The phase detector type of horizontal oscillator shown in Fig. 2, is used in such receivers as the Admiral 20A1 series and many recent, low cost models. To increase the width, C4 can be either increased to 30 µfd., or reduced to 10 µfd., depending on the individual receiver. C4 can be changed to 390 µfd., C5 reduced to 220 µfd. and R6 can be made 10,000 ohms, 2 watts, with the electrolytic C4 replaced by a paper, .25 µfd., 600 volt condenser. This provides a higher voltage for the oscillator and reduces the loading at point A at the same time.

**Increasing Height**

As in the preceding two sections, the picture tube, and the transformer are the most likely reasons for insufficient vertical sweep. In some receivers additional sweep can be obtained by returning the red, or "B plus," lead of the vertical output transformer directly to the highest available "B plus" point. When sufficient high voltage and width are present the red lead from the output transformer may be connected to the boost voltage (point A in Figs. 2, 4, and 5) through a 3300 ohm decoupling resistor. An 8 to 30 µfd. electrolytic condenser should be connected in series with the transformer "B plus" to "B minus" or ground. To increase the height further, the resistor in series with the vertical linearity control, usually about 560 ohms, can be reduced to 100 ohms. The 1 megohm series resistor in the height control circuit can be reduced to about 220,000 ohms, permitting a wider range of height adjustment.

**Improving Sound**

If the set has been completely re-aligned, the sound i.f. and discriminator will have been checked and tuned for best sound quality. The sound amplifier stages rarely require attention other than replacement of weak tubes. In the event that the set has not been realigned it is often advisable to retouch the sound i.f. and discriminator transformers.

In the photograph in Fig. 6, the retouching of the ratio detector transformer in a Westinghouse 12 inch table model is illustrated. The receiver is (Continued on page 96)
With the exception of the input stage, these sound systems are essentially the same as any conventional audio amplifier.

With the tremendous strides taken in the audio-visual education field in the past few years a new service that can be rendered by the radio technician has developed. Servicing the 16mm. sound projector is a field of its own; but the servicing of the sound and minor mechanical adjustments can be handled by the average technician. Fortunately, most of the 16mm. machines are equipped with instruction manuals, complete with schematics of the amplifier, etc. You will also find that many manufacturers are very cooperative when it comes to supplying service information as well as up-to-date service bulletins at a very moderate cost. You will also find that a few companies prefer to service their own equipment and these few will be reluctant, if they do not flatly refuse, to cooperate when you indicate your intention of servicing their machines.

With the exception of the input stage, there is essentially no difference between the sound system of a projector and that of any conventional audio amplifier. This input stage has a tendency to throw the old "seat of the pants" technician off his balance though for this first stage is capable of giving a remarkable imitation of many common amplifier troubles; such as open or shorted coupling and bypass condensers or even motorboating filters. Learning to spot these ailments can save the technician many hours of tedious labor.

This input stage is more mechanical than electronic in its operation and it is very important that everything in this stage be working properly. Before we go into the operation of this stage in detail, first let us examine its function.

Although there are several methods of achieving sound-on-film, the 16mm. field has narrowed itself down to either a variable density or variable area system of recording that is very satisfactory. On the edge of the film, opposite the sprocket holes (see Fig. 1) there is a continuous strip on the film that is not divided by the framing lines; this is the sound track. This sound track varies in density in direct ratio with the audio intelligence it represents. A bright light is focused on this film in the form of a very narrow rectangle at right angles to the edge of this film. As the film passes in front of this light, a photoelectric cell on the opposite side of the film from the light source picks up the resultant variations in light intensity. These variations are translated into minute electrical currents by the photoelectric cell. This cell is coupled to the amplifier and from there on, the problems usually encountered are no different from those developing in any normal audio amplifier.

Simple as all this sounds, there is plenty that can go wrong at this point without looking any further and right here is the stumbling block for most uninitiated technicians. In Fig. 3, we see a typical input stage. This stage is made up of film guides, a flywheel and drum, exciter lamp, optical system, and photoelectric cell. These components function as follows: The film guides control the lateral positioning of the film over the stabilizer drum. These guides, in most machines, can be adjusted and do occasionally go out of adjustment. This can be recognized as a motorboating effect in which the framing lines of the picture interrupt the exciter light as it passes to the photoelectric cell. This is easily spotted by the fact that this thumping will be in step with the flow of film over the drum and only exists while the film is in motion. Another effect will be a "hissy" type of distor-
tion and very low volume as the bulk of the light bypasses the sound track on its way to the photoelectric cell with only a small portion picking up the sound track.

The flywheel and drum form a stabilizer which insures that the film is kept taut and moving at a constant rate as it passes in front of the exciter light. Trash on this drum will produce a thumping noise that is easily recognizable because this noise is produced only while the drum is in motion and is not dependent on the film being threaded up. This trash can be so minute that it is difficult to see, even so small an object as a bit of hair will upset the entire operation. It is very essential that this drum be perfectly balanced and moving very freely. The slightest touch should set it in motion. If this drum is not rotating freely, the film will not ride smoothly, instead, it will have a tendency to ride in and out causing distortion, not unlike that of an open screen bypass condenser in extreme cases, or more usually a flutter or wow.

The exciter lamp is the heart of the entire system since it supplies the light that actuates the photoelectric cell. This lamp is usually a low voltage, high current device and in most cases this supply is furnished by a high frequency oscillator. If the customer's complaint is "no sound" and an ohmmeter check proves the lamp to be OK, investigate the oscillator circuit. A word of caution; the fact that the lamp is not burning while the amplifier is working does not necessarily mean this circuit or the lamp is defective. Many machines have the circuit so arranged that the exciter supply is not fully operational until the projection lamp, motor, and amplifier are on! Be sure the machine is in full operation before you decide this is the trouble. If the bulb is burned out, make certain that you replace it with exactly the same type of lamp. The placement of the filament of the exciter lamp is very critical and the base of the bulb is so arranged that no move can be made here. It is necessary that the filament of the exciter lamp line up perfectly with the tiny slot in the optical system to get proper operation. Be sure the lamp is secure in its base. A loose base that can shake with motor vibration will cause plenty of grief. The varying intensity of the light on the photoelectric cell will create some peculiar noises! Question your customer closely to insure that he hasn't replaced the burned out lamp with the wrong kind. Remember this, only the proper lamp will work in a given machine. It might light up all right, but the filament may be lateral instead of vertical or vice versa. Another thing to remember: if the filament is "low volume" and the exciter lamp does not produce a good, full brilliance, you have probably discovered the trouble.

In many cases the volume of the projector sound is controlled by varying the intensity of the exciter lamp. Don't fly into the exciter circuit with-
are servicing the amplifier, always remove the photoelectric cell and wrap it carefully in cloth or tissue to protect it from bright light. This is, of course, assuming you are servicing a set which has the photoelectric cell mounted right on the amplifier chassis. The photoelectric cell operates with a plate supply that varies from about 43 to 50 volts. This is a very stable d.c. If the customer’s complaint is low volume, insufficient photoelectric cell voltage may be the reason. In some machines, this cell supply is lowered in conjunction with other volume controlling devices; so make sure you have the volume control well advanced when measuring this voltage. If the voltage control has two decks, it is usually a good clue that one of them is controlling the photoelectric cell voltage and the other is controlling the current to the exciter lamp. Sometimes this cell pot is located elsewhere on the chassis and can be adjusted with a screwdriver. Be careful when advancing this control that you do not have too much voltage applied to the cell. This will be apparent if the photoelectric cell takes off in a high pitched squeal or a motorboating sound. Many models of machines don’t have this pot and the photoelectric cell supply is a fixed voltage.

For perfect reproduction, the film should pass the optical system at a uniform rate of 24 frames-per-second. For perfect synchronization with the picture, the sound track should lead two work together in such a way as to insure that no light will get from the lamphouse to the film while the film is in motion. As soon as the claw starts to pull the film past the aperture, the shutter closes off the light until the film is at rest again and the next frame is ready to be flashed on the screen. Shutters vary in different machines but their effect is the same. Some models have the shutter interrupt the film more than once during the time the film is at rest in the aperture. Always make certain that this switch, if the machine has it, is in the “Sound” position before attempting to service the sound.

As I have attempted to point out, the servicing of the sound in these machines is not at all difficult if you fully understand what is supposed to happen when the machine is operating correctly. Fortunately, most of the components are readily available and unless something serious, such as a broken lens, worn film guides or a burned out oscillator coil is the trouble, you should find all the parts you need at your local wholesale house.

If you have a projector that is mechanically defective, it is best to return it to the factory. The majority of cam and shuttle arrangements used in the operation of the claw and matched movements and expensive; so there is no advantage in tackling the replacement of this type of unit when the factory or an authorized service depot can do a much better job. However, there is still plenty that you can do to these machines to keep them going in operation; providing the trouble isn’t too serious. Briefly, let’s discuss how motion pictures work. The fact that the human eye is lazy and has a persistence of vision, is the only reason that movies work at all. Movies as they appear on the screen are nothing but a series of still pictures flashed on the screen in rapid succession. Each of these still pictures is called a frame. The secret of the entire operation lies in the action of the claw and shutter. These two work together in such a way as to make sure that no light will get from the lamphouse to the film while the film is in motion.

Fig. 4. Threading diagram for the 16mm. Ampico “Premier 20” sound-on-film projector.
DIELECTRIC HEATING

By ED BUKSTEIN

IN THE induction heating system, the metal to be heated acts as a secondary of a transformer, and the currents induced in the metal produce the heat. When the material to be heated is a nonconductor of electricity, dielectric heating is employed. In this system, the material to be heated is used as the dielectric of a condenser.

The principle of dielectric heating is illustrated in Fig. 2. An r.f. voltage is applied to the condenser so that its plates are driven alternately positive and negative. The positive plate of the condenser exerts an attracting influence on the electrons in the dielectric, and the negative plate repels these electrons. As a result, the electron orbits in the dielectric are distorted first in one direction and then in the other, millions of times per second. The power consumed in the process of altering the electron orbits manifests itself as heat in the dielectric.

One advantage of dielectric heating is that the work heats uniformly throughout its mass. When other heating methods are employed, the outside of the work heats first, and the heat slowly penetrates to the interior. Not only does this produce nonuniform heating and distortion of the material, but also causes the surface to become overheated or even charred before the temperature of the interior is raised sufficiently. Actually, when dielectric heating is employed, the interior of the work heats slightly faster than the outside due to heat radiation from the surface. This, of course, can be easily controlled, but when desired, the material can actually be heated from the inside out.

Dielectric heating time is measured in minutes instead of the hours required by older heating methods. Consequently, production time and cost are considerably reduced.

Dielectric Equipment

The equipment used for dielectric heating is similar in design to that used for induction heating. The dielectric heating unit consists essentially of a self-excited oscillator, its associated power supply circuits, and an automatic process-timing device. Colpitts, Hartley and other conventional oscillator circuits are common in this application.

In many cases, the same unit is usable for either induction or dielectric heating. The r.f. output is fed to a heating coil for the former application, or to a pair of plates for the latter.

In dielectric heating, the amount of heat developed in the work is in proportion to the number of times per second the electron orbits are distorted. Dielectric heaters therefore normally operate at higher frequencies than induction heaters. Frequencies ranging from 1 mc. to 100 mc. have been used, but the 5 mc. to 30 mc. range is most common. In some cases, frequencies extending up into the microwave region have been employed. Dielectric heaters normally generate powers ranging from 2 kw. to 100 kw.

Applications

The medical profession has for many years employed dielectric heating (diathermy) to warm the tissues of the body and to produce artificial fever.

The woodworking industry has long been harassed by the time delay produced while waiting for glue to set. Dielectric heating has attacked this problem with the result that glue setting can now be accomplished in seconds instead of hours. This high speed glue setting also obviates the necessity of providing the additional storage space formerly occupied during glue setting.

Fig. 4 illustrates the bonding of plywood by dielectric heating. Laminations of plywood are glued, stacked and placed between the plates. Former methods of glue setting involved the use of steam heating or hot plates and often damaged the surface of the wood. In addition, the heat dehydrated the wood and caused it to become excessively dry. Dielectric heating overcomes both of these disadvantages. In the first place, the heating is uniform and charring of (Continued on page 92)
The compressor is of the logarithmic type and features a meter calibrated directly in decibels of compression. The monitor indicates negative peaks by means of flasher lamp and a dial calibrated in terms of modulation percentage.

The average phone operator is usually in a receptive frame of mind when he hears about a gadget that will help him increase the communication effectiveness of his rig, or add to the operating convenience of his station.

Described here are two such gadgets combined in one small package. One of them is a low-distortion (relatively speaking) logarithmic type speech compressor and its companion-in-arms is a peak-indicating modulation monitor of considerable accuracy.

If conditions at the receiving end of the conversation are unfavorable to your transmitted signal the compressor, when used intelligently, may give you a very decided boost in readability.

In the unit described here, a compression-level meter, calibrated directly in decibels, has been provided for its invaluable assistance in obtaining optimum performance from the system.

A filter network effectively reduces the amplitude of frequencies above about 3000 cycles, eliminating the compressor high-order distortion products and keeping the radiated signal narrow. Low frequency attenuation, below about 300 cycles, has been provided to maintain a good frequency balance with regard to maximum intelligibility, and to remove the power consuming bass frequencies.

The modulation monitor will give a positive indication of negative peaks that are too short in duration to be easily seen on an oscilloscope under usual viewing conditions. These short peaks may still cause overmodulation if they are allowed to exceed their proper amplitude for 100% modulation.

The Compressor

The basic circuit of the compressor has been ably presented in an earlier article, to which the reader should refer for important background information. The major difference between the original circuit and the circuit presented here is the addition of the calibrated compression level meter. A parallel-T, 60-cycle hum filter has also been included for an additional 20 db. of attenuation at the a.c. supply frequency. Many operators prefer dynamic microphones and with the extra gain of the compressor in use stray magnetic fields around the operating position frequently induce annoying hum voltages into the microphone. A small unavoidable amount of hum is also introduced in the first stage of amplification since the tube heater is supplied with alternating current.

T. (secondary winding unused) may be nearly any small replacement type, push-pull plates-to-voice coil output transformer. It should not be mounted near the power transformer or filter choke. The actual limiting circuit consists of R. and Rect., connected as a voltage divider from the center tap of T., to ground. The back-to-back copper oxide instrument rectifier acts as the non-linear element of the voltage divider, producing an approximate logarithmic shaped transfer characteristic.

With sine wave input, the compressed waveform from the output jack of the unit very closely resembles the original waveshape. Under the same conditions a conventional clipper would have produced almost a square wave output with its much higher percentage of distortion and high frequency cross modulation products. The sharp cut-off LC filter necessary to satisfactorily eliminate these high frequency components introduces serious distortion of its own from the shock excitation and resulting "ringing" effect from the square wave input signal. The copper oxide rectifier,
being a non-linear device, also introduces distortion but of a much lower magnitude. In fact it is so much lower that a simple RC filter does an excellent job of removing the higher frequency distortion products. No 'ringing' effect in the filter is possible and the phase shift characteristics within its passband are excellent.

Tube V1 is an isolation amplifier and provided in its plate circuit is the output level control and a voltage divider proportioned so that a normal level voltage may be fed to the input jack of the regular speech amplifier. Although one section of V1 is not in use, the circuit application is conveniently served by the characteristics of the type 12AT7 tube.

The lead connected between J1 and J2 is the microphone push-to-talk relay circuit, wired through the compressor. The compression level meter is simply an audio frequency vacuum tube voltmeter connected from the center tap of T1 to ground. It is a simplified version of a circuit previously described by the writer and is well suited for use in this application.

The Modulation Monitor

The basic circuit of the modulation monitor has also been previously described in detail1 and again the reader's attention is directed to that article for the basic theory of operation. Several changes have been made in the circuit for use in the present instrument.

Modulated r.f. to operate the unit is taken from a two or three turn link placed near the final tank coil in the transmitter. The coupling should be no closer than necessary for about 10% modulation of the carrier. The "Set Carrier" control, Cm, is tuned through resonance. A length of coaxial cable connects the link to the input binding posts at the rear of the monitor. Another short piece of coax is run from the binding posts to the 3-turn link, L1, on the Miller Type 74002 shielded plug-in coil. L1 consists of 57 turns of No. 18 enameled wire closewound on the coil form immediately above L1. Taps are brought out at 8 and 13 turns from the ground end of the coil to permit band-switching the monitor for the 75, 20, and 10 meter phone bands.

Demodulation is provided by a 1N34 rectifier. It is important that r.f. not be allowed to get into the grid circuits of V2, or V1, as serious inaccuracies would result. The a.f. monitor jack permits listening to the detected signal. The carrier-shift meter, Ms, has been "red-lined" at half scale to serve as a convenient reference point for adjusting the input r.f. voltage level, although proper operation of the monitor does not depend on a critical reference setting. Around 2½ ma. of current through the meter gives about the right volume level in the monitoring headsets. Plugging in the head-set does not affect the calibration of the monitor.

As stated in the original article, the monitor operates on a bias cancellation scheme by comparison of the a.c. and d.c. voltage components that result from diode detection of a modulated carrier. The a.c. component is proportional to the modulation percentage and is equal to the d.c. component when the carrier is modulated 100%, the relationship being independent of carrier strength.

By use of a resistance bridge, or accurate ohmmeter, Rb and its dial may be calibrated directly in percentage of modulation. Reference to Fig. 1 will show the dial calibrated in 5% steps, with the 10% steps lettered in. The dial is marked according to the percentage of resistance between ground and the moving contact. The actual resistance of the stock "50,000 ohm" linear potentiometer used in our unit was 51,500 ohms. The 90% calibration point was then 46,350 ohms, etc. The potentiometer should be of the wirewound type if it is to hold calibration satisfactorily.

Potentiometer R1 adjusts the restoring bias of V2 to the proper operating point. Potentiometer R2 performs an identical function for V3.

The energy stored in condenser Cw, which has been charged through a high resistance, Rm, furnishes operating plate voltage for V2. When the tube is triggered Cm discharges rapidly through Rm, the flasher light RL, and of course the tube itself. The time constant of the discharge circuit has been made such that the filament of the 113-volt flasher lamp has time to reach full brilliance and produce a bright red flash through the one-inch diameter smooth jewel. The flasher is able to operate two or three times per second, and if V1 is triggered before Cm has reached full charge the flash will still occur but will be of shorter duration.

The power supply makes use of gaseous voltage regulator tubes to provide the degree of voltage stability necessary for maintaining calibration of the modulation monitor. The dual filter condenser, Cw+Cm, should be mounted on an insulating plate so that its negative terminal (the can) may be connected to the power transformer high voltage center-tap and filament center-tap leads with insulated wire and grounded at one common point on the chassis. This prevents the circulating condenser current from flowing through the chassis and introducing hum voltages into the low level audio circuits.

Construction and Adjustment

The entire unit is constructed on a 7 x 9 x 2 inch chassis and housed in an 8 x 10 x 10 inch utility box. As a further aid in reducing hum and r.f. pickup a bottom plate is used on the chassis. The r.f. section of the modulation monitor is built on a sub-chassis placed at the left end of the main chassis (viewed facing the panel). The remainder of the monitor components are on another sub-chassis mounted

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over the power supply components. Each sub-chassis is formed from thin sheet metal, with the seams and corners soldered. Their shape and location on the main chassis may be seen in Figs. 2, 3, and 7. A shielded lead is run from RFC on the r.f. sub-chassis to Cm and Rm on the other sub-chassis. A shielded lead is also used from M1 to J1, as this wire must pass near the "Set Carrier" control, Cm. About the only shielding required in the compressor wiring is the leads from "In" switch to J1, as this wire must pass near the "Set Carrier" control, C1. A shielded lead is also used from M2 to C and Rn on the other sub-chassis. RFC in Figs. 2, 3, and 7. A shielded lead is run from RFC, on the r.f. sub-chassis in Figs. 2, 3, and 7. A shielded lead is also used from M2 to C and Rn on the other sub-chassis.

Several different relays were tested in the unit and a representative type is noted in the parts list. Potentiometers Rm, Rm, and Rm are slotted for screwdriver adjustment. R3 is located on the main chassis beneath the plug-in coil. Rm and Rm are located behind their associated tubes on the sub-chassis. M1 is used for the S, and Rm controls. Discs of white Bristol board were cemented to the metal dial plates to take the calibration lettering.

After the wiring is completed and voltage checks made, the compression meter is ready for unitation. Connect a constant sine wave input signal to J1, of about microphone level, say 30 millivolts, and set R12 for maximum output. Set R0 for maximum output. Now measure the output signal voltage from the upper pin of J1 (Fig. 4) to ground (S, at "In" position). Note the voltage measurements and repeat the procedure, continuing to advance R1 each time so that the voltage from T1 to ground-tap to ground increases in 50 millivolt steps until 1 volt has been reached. From this point the voltage is allowed to increase in half-volt steps until about 5 or 6 volts has been reached. We should now be well beyond the 10 db. point. Some normal variation in characteristics should be expected between copper oxide instrument rectifiers (Conseal Type BH160) and selenium rectifiers.

The voltage readings obtained are now plotted on regular graph paper, the T1, center-tap to ground provided the desired 10 db. of compression.

The voltage readings obtained are now plotted on regular graph paper, the T1, center-tap to ground provided the desired 10 db. of compression. Fig.
5 shows the actual results from our compressor. Since $N_{db} = 20 \log_2 (E_i / E_o)$, we have at hand the information necessary to calculate the decibels of compression. We simply obtain the decibels of increase in voltage along each axis of the graph and take the difference between the two to learn the number of decibels of compression. If we solve the formula, always setting $E_o$ equal to the minimum voltage on one axis and letting $E_i$ equal any other voltage on the same axis, we will have the number of decibels of voltage increase for those particular voltage values. The same thing holds true for the other axis. Now if we select a point on the $x$-axis, say 4.5 volts, we may read the corresponding $y$-axis voltage by use of the curve. We then figure separately the db. increase in voltage for each axis and take the difference between the two values. This figure is the number of decibels of compression for an input voltage of 4.5; in our case it was 10 db.

Since it is convenient to have the meter calibrated in even steps from 1 through 10 db, we select by the trial and error method other voltages on the $x$-axis less than 4.5 volts so that the final calculated result is a desired calibration point, 1, 2, 3, 4, etc.

Potentiometer $R_{m}$ is now set so that the value of the $x$-axis voltage, as monitored by the external v.t.v.m. from $T_i$ center-tap to ground (which represents 10 db. of compression), produces full scale deflection on $M_i$. Continue to monitor voltage with the external v.t.v.m. and adjust the compression control, $R_{m}$, so that the proper voltage is applied to produce 10 db. of compression. Mark this point on the scale of $M_i$, and proceed in this manner until all desired points from 1 to 10 db. have been marked on the $M_i$ scale. These may now be inked in and the calibration is complete.

After connection of the unit into the transmitter, and with the compressor switched out of the circuit, adjust the regular speech amplifier gain control for 100% modulation. Then, with the compression control set for the desired decibels of compression as indicated on the meter, the compressor may be switched in and the output level control advanced until 100% modulation is again obtained. The compressor may now be cut in or out at will with no further juggling of controls necessary.

The modulation monitor is best calibrated with the aid of a sine wave signal source and an oscilloscope. With no r.f. signal present at the input of the monitor, adjust the 2121 bias control, $R_{m}$, so that the flasher light just does operate. If the flasher refuses to operate, $T_i$ is probably connected so that a negative pulse is being sent to the $V_4$ grid, driving the tube further beyond cut-off. To correct this, reverse the primary or secondary winding of $T_i$ (not both).

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**Fig. 5.** Compression curve showing the decibel meter calibration points.

**Fig. 6.** Under chassis view. The a.c. wiring should be twisted and kept away from low level audio circuits used in the unit.

**Fig. 7.** View of the modulation monitor sub-chassis. Note $T_i$ behind the r.f. link terminals in "well" of the r.f. sub-chassis.
A Low Cost Square-Wave Generator

By SMITH HARRIS

The utility of a square-wave generator for checking audio amplifiers is too well known to require comment. Unfortunately, commercial generators cost more than many audio enthusiasts, technicians, and experimenters care to invest. The generator described in this article, however, can be built at a very nominal cost largely from junk box components and is entirely adequate for checking the frequency response and characteristics of an amplifier from 60 to 20,000 cycles. It consists essentially of a simple audio oscillator and amplifier followed by the clipper developed by Louis E. Garner, Jr. (March and July, 1950, issues of Radio & Television News.)

The entire unit can be housed in a standard 6"x6"x6" utility cabinet, such as the Bud C-1798.

The power supply is conventional. Current and voltage requirements are: 3 ma. at approximately 350 volts, 1.05 amperes at 6.3 volts, and 2 amperes at 5 volts. Any power transformer with a secondary producing from 250 to 350 volts a.c. can be used.

The audio oscillator employs a 3:1 interstage transformer and half of a 6SN7. While the transformer used by the author was a Stancor A-63C, any similar transformer may be used. In wiring up the Stancor transformer, either of the grid leads may go to pin 1 of the 6SN7 while the other lead is not used. The lead marked "CT" goes to ground. Temporarily connect one of the primary leads to pin 2 and the other to R, and after the generator is completed, reverse them should oscillation fail to occur. R, is a linearity control and is used to correct any slight differences in width that may exist between positive and negative halves of the final square wave and to disable the oscillator as explained later. The oscillator frequency is varied by shunting the primary of the transformer with various values of condensers by means of a rotary switch, S.

Only three frequencies are normally needed to cover the entire audible range, namely 20, 200, and 2000 cycles-per-second, as a square wave contains strong harmonics through at least the tenth. Thus these three basic frequencies could be used to check the response of an amplifier from 20 through 20,000 cycles-per-second. It is convenient, however, to employ five or six frequencies within this range in order to more easily determine the exact point at which some change may take place in the response. The lowest frequency at which the transformer used by the author could be made to oscillate was approximately 150 cycles-per-second. Sixty cycles is obtained from the power line, therefore, and fed directly to the clipper through S1 and C1, to obtain a low frequency test wave. Although the response of an amplifier may extend below this frequency, a good, clean response at 60 cycles will give adequate low-frequency reproduction for normal listening.

The other half of the 6SN7 is used as a voltage amplifier. In order to obtain a good square wave, the amplitude of a sine wave applied to the clipper should be at least 75 volts. As it is impractical to obtain this value in a single-stage amplifier, the values of R8, R9, and R10 are different from those recommended by him, but were chosen to give the best results in this particular application. Si allows either 60 cycles obtained from the power line or any frequency generated by the oscillator to be fed to the clipper.

The phasing control following the clipper was added to correct a severe phase shift of the lower frequencies (low frequencies leading) occurring in the author's oscilloscope. It should not be necessary if the oscilloscope used with the generator has a good low frequency response.

Selection of the proper values of the

Two views of the home-built square-wave generator. The front panel view shows correct location of controls. The shunting choke, mentioned in the text, is mounted on the front panel just above oscillator transformer and is visible in the side view. If enclosed cabinet is used vent holes must be provided.

This test instrument can be used to check frequency response of audio amplifiers from 60 to 20,000 c.p.s.
condensers shunting the primary of \( T \) is easily made. Turn on the generator and feed its output into an oscilloscope. Throw switch S, to obtain a 60 cycle figure and adjust the controls of the oscilloscope to obtain one complete square wave on the screen. Turn off the generator, as the primary of \( T \) is "hot," and temporarily connect a condenser across the primary with one position of switch S. Then, turn the generator back on, set switch S, to the oscillator position, and without changing the setting of the oscilloscope controls, observe the number of complete cycles appearing on the screen. If, for example, three complete cycles are seen, the frequency of the generator is three times 60 or 180 cycles; if six are seen, the generator frequency is 360 cycles and so on. The size of the test condenser is varied until the approximate frequency desired is produced. The other condensers are selected in the same manner. It will probably not be possible to arrive at the exact frequency desired except by using odd values of capacitance obtained by tedious paralleling, but this is not necessary. If one of the frequencies desired is 500 cycles, a frequency of 480 or 540 will do just as well. The frequencies used by the author were 60, 180, 480, 720, 900, and 2000 cycles-per-second obtained as follows:

- 60 cycles: obtained from power line
- 180 cycles: \( C_1 = .05 \text{ afd.} \)
- 480 cycles: \( C_1 = .005 \text{ afd.} \)
- 720 cycles: \( C_1 = .001 \text{ afd.} \)
- 900 cycles: no condenser used, see below
- 2000 cycles: no condenser used, see below

The values of \( C_1, C_2, C_3 \) will be different if a transformer other than the one specified is used or if other frequencies are selected.

The distributed capacity of the audio transformer together with its inductance will result in its having a natural resonant frequency above which it will not oscillate. Should this frequency lie below the highest frequency desired, it will be necessary to shunt the primary on one position of switch S, with an added inductance to reduce its inductance and hence raise its resonant frequency. The resonant frequency of the Stancor transformer specified is approximately 900 cycles. To obtain a top frequency of 2000 cycles, it was shunted with a 10 henry, 25 ma. choke. This choke is visible in the photographs mounted against the rear of the front panel just above the rotary switch. If the frequency obtained in this manner is too high, it may be lowered by paralleling the choke with a condenser of suitable value.

Unless S, possesses a very low capacity, the oscillator frequency may jump it when the switch is set to the 60 cycle position and be superimposed on the latter frequency. Should this condition occur, disable the oscillator by turning the linearity control (R,) until there is zero resistance between the grid of the oscillator tube (V,) and ground.

To use the generator to check the response of an audio amplifier, feed its output into the amplifier while observing the resulting pattern on an oscilloscope connected to the amplifier's output. Interpretation of various patterns is beyond the scope of this article. This matter has been covered in previous articles in this magazine, most recently by Mr. Garner in the two articles cited. It is advisable to become familiar with the response of your oscilloscope before condemning the generator or the amplifier if results are below expectations. That loss of highs, as indicated by the rounding of the leading edge of the square wave, can very well be due to poor high frequency response of the vertical amplifier of the oscilloscope.

Under chassis (left) and top chassis views of generator. The SY3 is at lower left while the 8SN7 appears at the upper right.
CUSTOM-BUILT for PROFIT

An abundance of custom radio and TV equipment now makes custom work easy and very profitable.

CUSTOM installation, once considered a novelty confined to a select few persons in the upper income brackets, is rapidly becoming an important factor in the radio, television, sound, and home intercommunications market.

And this is deservedly so, for service technicians and home owners alike find in this relatively new field an outlet for their originality in installation, in design, and in home decoration which gives electronics a new place in modern living.

Some enthusiasts in this new medium compare custom installation's progress with that of home heating—which began with open fireplaces, then changed to bulky living room stoves, to fancy baseburners, and eventually to the furnace and the heating unit hidden away in the basement or utility room. They claim that radio-television and other home units will undergo the same development, and ultimately will be recessed and built in.

Whatever may be its ultimate development, however, custom installations have caught the public's fancy, and the manufacture of chassis designed to be built into cabinets, bookcases, and paneled walls has grown five-fold in the past three years, it is estimated.

One advantage of the custom installation is the fact that the sound units can be placed anywhere in the room to achieve maximum acoustical benefit. With remote control devices, the units themselves may be built into any advantageous spot, regardless of accessibility for dialing or operating.

This new field has found instant favor with an increasing number of radio technicians, partly because it offers almost unlimited scope for originality and technical skill, and in addition presents a lush market, not only for single installations, but for multiple unit sales, ranging all the way from a single TV set to combination radio-AM-FM radio, and a Milwaukee Stamping Co. record player. The bottom drawer may be used for storage or a tape recorder. A Talk-A-Phone "Chief" intercom tops the extra cabinet unit.

Many installers claim that once the home installation bug bites a customer he will stay up nights figuring out new and more novel ways to build in electronic devices. One of the biggest attractions at the recent Chicago Furniture Mart was a multiple section cabinet which housed a 16 inch TV set, an AM-FM-short wave radio, a record player, a tape recorder, special speaker, and a twelve station intercommunications unit which connected all the bedrooms, living room, dining room, kitchen, basement, garage, and front and back doors to a single master control—the ease-loving housewife's dream, since it did away with the necessity for half the trips that make up a woman's day in the home.

And of course interior decorators and home designers are having a field day with the new custom-built electronics idea. By the simple addition of wall cable and lead-in wiring, the new homes are being equipped to carry an ambitious allotment of electronic devices. One new home on Chicago's North Shore is being designed to do away with all cords for toasters, mixers and other kitchen aids, by the simple device of a plug panel, table-high along one entire wall of the kitchen. A toaster, mixer, or waffle iron can be literally plugged into the wall at any place on the kitchen work table, a plug having been substituted for the cord on each kitchen device.

An ingenious architect has come up with the idea of an open wall between living and dining room, so that a built-in television set can be swiveled into view of every range for youngsters whose meal time coincides with their most popular TV program. Another parent has placed a television set in his children's room, with remote control to the living room, so that he enforces a TV curfew each night by simply shutting off the set.

But aside from the novelty aspect of custom-installation, the idea of integrating TV and radio into the decor and design of a home is growing rapidly, with its accompanying opportunity for service technicians and installers to find new markets, and for householders to utilize these new media of entertainment in the home.
A Flexible RECORD-REPRODUCE SYSTEM

By OLIVER READ
Editor, RADIO & TELEVISION NEWS

In Part 1 of this present series (November, 1950 RADIO & TELEVISION NEWS, page 42) we listed and described briefly the basic equipment used in this system. The discussion pointed out why certain components were selected in order to meet our own requirements.

Our first requirement was a combined preamplifier and equalizer in order that a choice of program circuits could be made by means of a selector switch and this program material amplified and equalized before being passed to the line amplifier. Fig. 2 shows the block diagram of the combined preamp-equalizer. Note that the volume control is a tandem-connected unit which affords smooth control of gain over two stages rather than the conventional single stage control.

The circuit arrangement (Fig. 3) provides complete freedom from impulse types of distortion and a stable feedback circuit permits full adjustment of either the treble or bass controls without amplifier instability. Bass boost of approximately 20 db. and bass attenuation of approximately 13 db. is available and is independent of the treble control. Likewise the treble boost of approximately 15 db. and a treble cut of approximately 20 db. is independent of the bass control.

A switch is provided which makes possible the selection of either 300 or 600 cycle turnovers at a 6 db. per octave rate for channels 3 and 4. In addition, separate adjustable gain controls are provided for the tuner and crystal pickup inputs so that the program level may be preset for these two channels.

Typical curves for the preamplifier are shown on the graph of Fig. 6. These provide more than adequate equalization for nearly every listening condition, and are also highly useful in the recording of sound on disc where treble frequencies must be accentuated during the recording process at slow speeds and at inner diameters.

The output of the preamplifier connects to a plate-to-line transformer as mentioned in Part 1 of this series. The output, therefore, becomes 600 ohms, unbalanced. The 600 ohm line from the preamplifier output matching transformer connects to the jack field. This line feeds through two pairs of double jacks and is "normalized" to the input of the line amplifier, as shown in Fig. 5.

The Line Amplifier

The circuit for this amplifier is entirely conventional and is used in several manufactured units. It was homebuilt with components on hand and meets the requirement for approximately 40 db. gain at extremely low distortion. The 600 ohm input terminates in a triode (½ of a 12AY7) voltage amplifier with a gain control in the grid circuit.

The 100,000 ohms shunted across the secondary of the transformer provides sufficient loading to reflect an impedance of 600 ohms back into the primary. The primary of the triode output employs the other section of the 12AY7 and is coupled with a plate-to-line output transformer. The primary is 15,000 ohms when so connected. The secondary is 600 ohms which is standard for all lines used in this system.

In order to reduce heat and to make the line amplifier more compact the symmetrical layout of this two-bay assembly is also practical electrically.

Part 2. Continuing the discussion on a record and playback system as used by the author for studying performance of audio equipment and accessory items.
usual rectifier tube was eliminated and instead a full-wave, bridge-type selenium rectifier employed. The 100 ohm potentiometer shunted across the filament secondary of the transformer is used to balance out hum in the filament circuit. The entire unit is mounted on the 8½" relay rack panel which is shown directly below the jack field. The schematic diagram of the line amplifier is shown in Fig. 7 (see page 134).

The Jack Field

All program circuits terminate in the jack field as described in Part 1 of this series. For those who do not understand the functioning of the patch system, the following will serve to illustrate the advantages to be gained by such a system. Fig. 8 shows how the jacks would appear when connected between the preamplifier output transformer and the input transformer of the line amplifier.

In audio circuitry it is common practice to eliminate return or ground circuits from diagrams (except the program circuit). To simplify the understanding of the workings of the jack system, reference to Figs. 7, 8, and 9 will show how a pair of double jacks is "normalled" to the following circuit. The jack (Fig. 10) consists of the "swinger" which is the long spring actually making contact with the tip of the plug, the frame of the jack (which is grounded), and the normal spring which, in this case, is normally in contact with the swinger. When a plug is inserted into the jack, contact is made with the swinger which raises it away from the normal spring and breaks the circuit; hence, when the plug is removed the swinger returns to place in contact with the normal spring and the circuit is completed as shown.

The system commonly employed in the jack field makes use of what is known as a "double jack." Here both
Fig. 4. The jack field comprises one single and one double jack strip. Note separation of low and high level circuits. Connector on center panel is for the high-impedance microphone.

Sides of the circuits are connected to the swingers of the jacks and the normal springs connect to other circuits where connection of that sort is indicated. The construction of a typical double plug is illustrated in Fig. 11. It is good engineering practice in audio work to ground only one end of the shield of the connecting cable. This is necessary to prevent ground loops.

Inasmuch as all of the jack frames are at ground potential there will be proper grounding of the plug when it is inserted into any of the jacks, but (Continued on page 194)

Fig. 5. Simplified block diagram of complete system described in this series. Many combinations can be made with patch cords. Separate leads to a grounding bus prevent "ground loops."

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January, 1951
Applications for THYRITRE RESISTORS

A non-linear component that can be used to perform special functions, alone or in conjunction with tubes.

By RUFUS P. TURNER, K6A1

Disc-type Thyrite resistors are supplied in diameters ranging from \( \frac{1}{4} \) inch to 6 inches and thicknesses of 0.03 to 0.25 inch, depending upon power rating. Further discussion of Thyrite resistor specifications appears near the end of this article. Fig. 2 shows four shapes in which Thyrite resistors are supplied.

Electrical Characteristics

In common with other non-linear resistance materials, Thyrite is not "ohmic." When a voltage is applied to a Thyrite resistor, the current flow does not obey Ohm's Law but is proportional to some power of the applied voltage. This effect is more pronounced in some Thyrite resistors than in any other simple 2-terminal non-linear resistance. Thus, for the Thyrite resistor:

\[
I = kE^n
\]

where: \( I \) = the instantaneous alternating or direct current through the Thyrite
\( E \) = the instantaneous a.c. or d.c. applied voltage
\( k \) = amperes at 1 volt (a constant)
\( n \) = an exponent between 3.5 and 7 governed by the manufacturing process

From this relationship, it is seen that an exceedingly large current change is obtained by doubling the applied voltage, when the exponent \( n \) is high. Conversely, this means also that the change in voltage drop across a Thyrite resistor of high \( n \) value is low when current flowing through the resistor undergoes a large change in value. This latter feature is the basis of a simple Thyrite-type voltage regulator.

Unlike several other familiar 2-terminal non-linear resistance devices, the Thyrite resistor is not a rectifier. Any rectification effects are said by General Electric to be less than 1 percent. Thyrite accordingly may be used in a.c. as well as d.c. circuits. The positive and negative portions of the volt-amperic characteristic curve for Thyrite are symmetrical (See Fig. 3). The non-linear characteristic of the Thyrite resistor extends over a wide current range. The curves in Fig. 4 show the extent of current and voltage ranges for seven Thyrite resistor types.

When a sine-wave voltage is applied to a Thyrite resistor, the current flowing through the resistor is in phase with the voltage and is symmetrical but is distorted by the shape of the conduction curve. From Fig. 5, it is apparent that the current wave contains considerable odd-harmonic components. This ability of the Thyrite...
resistor to generate harmonics is the
basis of a simple frequency multiplier
circuit used principally for tripling or
quintupling the frequency of the ap-
plicated a.c. power loss in the resistor is
expressed as \( E \times I \times \text{pf.} \); where the
loss is in watts, \( E \) is the applied volt-
age in r.m.s. volts, \( I \) the current in
r.m.s. amperes, and \( \text{pf.} \) the power
factor expressed as a decimal.

The electrical characteristics of
Thyrite are stated to be the same for
impulses of a few microseconds as for
d.c. It appears, however, that the
maximum practical operating fre-
quency will be governed appreciably
by the self-capacitance of the resistor.
The dielectric constant of Thyrite is
given as 30 to 100 or more and is de-
pendent to some extent upon applied
voltage. This results in a rather high
capacitance in the larger discs having
parallel metallized faces.

Thyrite resistors are employed in
power circuits as simple 2-terminal
voltage regulators, protectors against
voltage surges, lightning arrestors, as
the sensitive elements in voltagese-
selective circuits, and in potentiom-
eters giving constant voltage output
under varying load conditions. The
electrical characteristics of these re-
sistors make them suitable for use in
portions of electronic circuits where a
non-linear current flow or voltage
drop is desired.

**Thyrite Circuits**

Fig. 6 shows nine simple circuits in-
corporating Thyrite resistors. These
circuits have been selected as typical
of those in which the non-linear resis-
tance characteristic of Thyrite might
be utilized. Elaborations and modifi-
cations of these circuits, as well as
entirely new applications, will sug-
gest themselves to the circuit de-
signer.

In Fig. 6A, the conventional linear
cathode resistor in an electronic tube
circuit has been replaced with a single
Thyrite resistor (or several such re-
sistors connected in series to obtain
the desired resistance). As the applied
signal voltage, \( E_o \), increases, the tube
plate current also increases. This fluc-
tuating plate current flows through the
Thyrite cathode resistor. The
voltage drop across the latter is ap-
plicated to the grid, in the conventional
manner, as negative bias. The cathode
voltage drop cannot alter to the same
extent as the plate current, because of
the non-linearity of the Thyrite. The
result is a more nearly constant
grid bias voltage under varying input-
signal conditions. Use of the Thyrite
cathode resistor may introduce com-
plications in a.c. amplifier stages be-
cause of the harmonic content of the
Thyrite current.

In Fig. 6B, signal output is taken
across the Thyrite cathode resistor in
a cathode follower type amplifier cir-
cuit. This circuit can be used when a
fairly constant output is desired from a
varying grid signal voltage. As in
6A, the voltage drop across the cath-
ode resistor will contain relatively
high odd-harmonic distortion. Means
must be provided for suppression of the
harmonics when they are not de-
sired in the output voltage.

The harmonic-generating property
of Thyrite is utilized in the simple
frequency multiplier circuit shown in
Fig. 6C. Because of the predominance
of odd-numbered harmonics in the
Thyrite current, this circuit is most
effective for multiplying the input fre-
quency by 3 or 5. Condenser \( C \) and the
transformer primary inductance must
resonate at the desired multiple
frequency. It should be noted that a
frequency multiplier of this type is not
an amplifier, but on the other hand
consumes power. The output power
always is less than the input. In spite
of this disadvantage, there are many
applications in which such a simple
frequency multiplier will be desirable.

The 4-arm bridge circuit in Fig. 6D
contains both linear resistors and Thy-
rite resistors. Since the resistance of
the Thyrite units varies with voltage,
the bridge will be balanced only at one
value of applied voltage. At this point,
the output voltage accordingly will be
zero. As the applied voltage is in-
creased beyond the value required for
null, the output voltage will increase.

(Continued on page 157)
CRYSTAL CONTROLLED TWO-METER CONVERTER

By HARRY G. PRATT, W2SEA

Much interest has been shown in recent years in improved equipment for the higher frequency amateur bands. Crystal controlled transmitters have been accepted as standard equipment on 2 meters; however, little consideration has been given to increasing receiver stability. The converter described in this article has been designed to provide good sensitivity, stability, and at the same time, ease of operation.

As the design is a bit unconventional, the following explanation is given. Most 2 meter converters are built as shown in Fig. 3A, following the pattern of a conventional low frequency receiver front end. The r.f. and detector tuned circuits must track with the oscillator and produce a fixed output frequency, which is fed into the communications receiver.

Considerable simplification can be achieved by using bandpass circuits for r.f. and detector, as shown in Fig. 3B. Here no tracking problem is encountered as only the oscillator is tuned. With careful design the bandpass r.f. amplifier can be made to operate as well as the tuned r.f.

Both of the systems in Fig. 3 require the use of a communications receiver which is fed with a fixed frequency input. The front end of the receiver, which may be capable of tuning from 1 to 30 mc., is then used as a glorified i.f. amplifier, set at one predetermined frequency.

There is a popular misconception among many amateurs that a broadband amplifier is more noisy than the conventional tuned type. This is not true in the case of an application such as this since the i.f. in the receiver used actually determines the bandwidth and, consequently, the noise level is no greater than that of a tuned converter.

One disadvantage of a converter of this type lies in the possibility of signals from services in the tunable i.f. range getting directly into the front end of the receiver.

With modern, well-designed receivers this is not a serious problem if reasonable precautions are taken to shield the lead from the converter to the receiver and if a cabinet is used on the converter. The lead from the converter to the receiver should be kept as short as possible.

With the arrangement shown in Fig. 2, better use is made of the communications receiver, and at the same time the converter is greatly simplified. Bandpass circuits are used in the r.f. and detector, while the oscillator is operated at a fixed frequency. Using the 130 mc. oscillator as shown, incoming signals between 144 and 148 mc. are mixed in the detector to produce output signals in the range of 14 to 18 mc. The receiver may then be tuned over this range to select the desired 2 meter signal. Thus no tuning controls are needed within the converter and, in effect, it is connected into the antenna line and all operation carried on from the communications receiver.

An oscillator frequency of 130 mc. was chosen so the converter could be used with a BC-348 receiver, which does not cover above 18 mc. Placing the oscillator below the signal frequency and using an even multiple of 10 for the oscillator frequency allows for easy interpolation of the receiver calibration. With the 130 mc. oscillator, 14 mc. at the receiver corresponds to 144 mc., 15 mc. tunes to 145 mc., etc. Other frequencies could be used to match a particular receiver. For example, with the oscillator at 120 mc., the receiver would be required to tune from 24 to 28 mc.

Use of a fixed frequency oscillator facilitates stabilization. A self-excited oscillator may be used; however, series mode crystals are available which allow operation in this frequency range without additional multiplier stages.

As shown in Fig. 4, an 8.66 mc. crystal is operated on the 5th mode in a cathode-coupled circuit using a...
12AT7 twin triode. This gives output of 43.3 mc. at $L_n$, which is fed back to the cathode follower section to sustain oscillation. Now if an additional tank is connected in the plate circuit of the cathode follower, it may be used as a multiplier. In the circuit shown the tank, $L_n$, is tuned to 130 mc. or the third harmonic of the crystal output.

Crystals intended for harmonic operation are made with small electrodes plated at the center of the crystal. They are available on special order at a corresponding price. However several conventional AT cut crystals from surplus sources have been tried and found to operate well in this circuit. The cathode-coupled oscillator works well at the third or fifth mode, and the multiplier can be used to double, triple, or quadruple. Thus the crystal may be some frequency other than 8.66 mc. For example, a 6.5 mc. crystal-operated fifth mode, and multipli- ered four times in the cathode follower plate circuit will produce 130 mc. output.

Use of the harmonic mode crystal is not only desirable from the standpoint of attaining a high frequency output with a minimum of tubes, but almost a necessity to reduce spurious responses. If the 6 or 8 mc. crystal was operated at its fundamental and followed by several multiplier stages, spurious responses or “birdies” would be found every 6 or 8 mc. By operating the same crystal at 30 or 40 mc. the chances of birds within the tuning range of the receiver and converter are greatly reduced.

R. F. Amplifier

The r.f. amplifier consists of a neutralized triode-connected 6AK5, and one-half of a 12AT7 connected in the now popular “cascode” circuit. Bandpass of 144 to 148 mc. is required in all coupling circuits from antenna to detector grid. Input coil, $L_n$, is loaded by close antenna coupling to provide optimum operation of the input stage. With the tap located as indicated in the coil data the bandpass is in excess of 4 mc. when fed from a 50 or 72 ohm cable. $L_n$ is broadbanded by virtue of the low input impedance of the grounded-grid stage and by shunting this coil with $R_n$.

Coupling between the grounded-grid amplifier and detector is through bandpass transformer $L_1$ and $L_2$. It is essential that this arrangement be used instead of a loaded single-tuned circuit, to actually limit the response to approximately 4 mc. Without inductive neutralization, signals at the receiver frequency (14 to 18 mc.) may pass through the converter and cause interference.

Detector

One half of $V_1$ is used as a triode first detector. Oscillator output is coupled directly to the grid through the 2 µfd. condenser $C_6$ producing some grid-leak bias. This bias may be read at Test Point #2 ($J_2$), which is included as an aid in tuning the oscillator as described under “Initial Adjustments.”

The detector plate circuit must also have a bandpass of 4 mc., in this case from 14 to 18 mc. Capacity coupling as shown was used to provide flexibility, so the converter could be used with different communications receivers. It is capable of matching a wide range of receiver input impedances and has been used successfully with the BC-348, SX-28, and HQ-129 receivers. The capacity of the connection cable from converter to receiver becomes part of the circuit, and should represent approximately 25 µfd. To obtain this capacity, a two-foot length of RG-62-U low capacity cable was used. If another type of cable is used, the length should be cut down to maintain essentially the same capacity.

Power Supply

Power requirements are 6.3 volts at .775 amp. and 150 volts at 18 ma. which can be taken from the supply of most receivers, or a separate supply may be used if desired. In either

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**Fig. 4.** Complete circuit diagram covering the crystal controlled, 2-meter converter.
case, the plate supply should preferably be regulated with a VR130.

The converter shown in Figs. 1 and 5 was built on a 3x5x1$\frac{1}{2}$ inch chassis. Brass was used in preference to aluminum so that the shields could be soldered in place. Good shielding and careful placement of parts is required, as in any 2 meter equipment.

Fig. 5 shows the under chassis layout. Shields were placed between each tube socket as shown, and feed-through condensers used where power leads pass through shields. Incidentally, all necessary holes should be cut in these shields before they are soldered in place. The shield between $V_1$ and $V_2$ has an opening on the center line for $C_3$, $C_7$, and $R_5$ as well as holes at one end for feedthrough condensers $C_{1n}$ and $C_{10}$. The shield between $V_1$ and $V_2$ requires openings for $C_{1n}$, $C_{10}$, and $C_s$.

It was also found necessary to install a shield between pins 1 and 3 of $V_3$ to shield the input from the output of the grounded-grid amplifier. This shield consists of a small plate approximately 1 inch square, which is soldered in place vertically, starting at the center post of the tube socket and passing through pin 2, which is grounded.

For purpose of alignment, it is desirable to provide means of decreasing coupling between $L_5$ and $L_6$. For this reason, $L_5$ was mounted in a slot, such that at maximum coupling the coils are spaced $\frac{3}{8}$" between centers, while the coil at the far end of the slot, the coils are spaced approximately 1 inch.

Initial Alignment

With power applied, the oscillator should be tuned first. A high impedance voltmeter is connected from Test Point #1 ($J_1$) to ground and a small negative voltage will be observed. As $L_7$ is tuned through resonance, this voltage will increase. Proper adjustment is slightly higher in frequency than the crest of this peak, as in tuning a conventional crystal oscillator. The purpose of this slight detuning is to insure starting of the crystal which may be checked by turning plate voltage off and back on again and observing that the test meter returns to the same reading. Using a Simpson Model 260 meter on the 2.5 volt scale, off-resonance deflection was approximately .25 volt, which increased to .45 volt at resonance. Wide variation may be expected with different crystals; however, there should be a definite rise as $L_7$ is tuned through resonance.

The multiplier plate coil ($L_m$) may now be tuned. Connect the test meter from Test Point #2 ($J_2$) to ground, and a similar negative voltage will be observed. When $L_m$ is tuned through resonance, this voltage will rise. As this is a multiplier tuning adjustment, proper operation is at the crest of this rise.

The r.f. alignment can be made using a sweep generator and scope, in which case the over-all response is adjusted for a bandpass of 144 to 148 mc. Fortunately for most of us, alignment can also be made with only a signal generator, using the following procedure.

Set the receiver to the center of the tuning range, in this case 16 mc., with receiver antenna trimmer at center of its range. $C_r$ is also set at about one-half of maximum capacity. Now a good hefty 16 mc. signal is applied to Test Point #2 ($J_2$), and the generator frequency trimmed up to obtain maximum signal at receiver, as indicated on "S" meter, or by using a modulated signal and listening to the audio output of receiver. $L_n$, the detector plate coil may now be peaked. After $L_n$ is peaked at 16 mc. the band ends should be checked by tuning both the receiver and signal generator to first 14 and then 18 mc. At each end frequency, rock the antenna trimmer on the receiver to determine if it may be peaked up. If not, increase $C_n$ return to 16 mc. and repeat the whole process.

When finished with the detector plate circuit, connect signal generator to converter input and apply 146 mc. Tune the receiver around 16 mc. to locate the signal and proceed to align $L_7$ and $L_5$. This is done by detuning $L_m$ and $L_5$, until the spacing between coils is approximately 1 inch. Both coils may now be tuned and will peak quite sharply. Once they have been peaked, the slugs are locked, and the coupling increased by bringing the coils closer together. With a spacing of $\frac{3}{8}$" between centers the bandpass should be satisfactory.

This leaves only $L_4$, the input coil to be tuned, which is best done by disconnecting the generator from the converter, thus removing the loading from $L_4$. With the generator output lead near $L_4$, the signal is increased until heard in the receiver through the loose coupling. With 146 mc. signal, $L_4$ is tuned for maximum signal and the slug locked.

Over-all operation may be checked by connecting the signal generator to the input jack and comparing the relative sensitivity at 146 and 148 mc. (The generator should represent a 50 or 72 ohm source to load $L_4$ properly.) If any great difference is apparent, it can be flattened out by trimming $L_4$. As this is not a critical adjustment no test equipment has been provided, and trimming is done by spreading or squeezing turns.

Operation and Results

Once the converter has been aligned actual operation is pretty much determined by the receiver in use. Best sensitivity is normally obtained with a.v.c. turned off, audio gain near maximum, and r.f. gain advanced until noise is just noticeable. With a.m. the noise level on one end of the band to the other it will be necessary to repeak the receiver "antenna trimmer" in the same manner as would be required when using the receiver without the converter.

Sensitivity tests of the converter show that the cascode front end performs as well as many enthusiastic users have claimed. With a 30% modulated signal of .1 $\mu$V. applied, the resulting output signal was some 12 dB. above noise level. This would tend to indicate a sensitivity of about .05 $\mu$V. for a 3 dB. signal-to-noise ratio, although no direct measurements could be made at this level due to test equipment limitations.

On-the-air checks also showed the crystal controlled cascode converter to be superior to the conventional pentode front end. This was in part due to the cascode pentode initially due to the fact that with stable first oscillator the receiver i.f. could be operated in a sharper position than would otherwise be possible. In general the results were very gratifying and felt to be well worth the time and effort involved in designing and building the converter.

RADIO & TELEVISION NEWS
A Nondirectional CORNER SPEAKER

Complete details on a sound chamber that can be home-built at relatively low cost. Any speaker can be used.

By DEAN POST

This article deals with a satisfactory and, at the same time, economical answer to the problem of directional high-frequency sound radiation of loudspeakers. The solution also offers a saving in space requirements, plus a realistic physical placement of the sound aperture. Total cost of materials was less than $10.00.

The usual speaker baffle construction places the sound vent relatively close to the floor. This is an exceedingly unrealistic arrangement. Violinists, for example, do not usually play in a prone position. The realism afforded by sound radiating at ear level is well worth the effort required to obtain it.

The enclosure described here largely overcomes the above shortcomings. See Fig. 1. The speaker is mounted horizontally and at the top of the column, where it radiates into a 45 degree reflecting conic section. This device reflects sound over a 90 degree arc. Placement of the box in a corner thus insures that practically all listening positions in the room receive equal amounts of high-frequency radiation.

The totally enclosed portion is one foot square (outside dimensions) and 3 feet high; total height of the unit is about 4 feet. A 7 inch British speaker is used by the writer, but larger units can readily be employed. The size speaker used will determine the total height of the box. Volume is the critical dimension. A 7 inch diameter speaker requires about 3 cubic feet of enclosed space, while a twelve inch unit requires about twice that amount. A box suitable for a 12 inch speaker would thus be about 15 inches square and 4 feet high, with a correspondingly larger reflector.

The lower portion of the baffle is constructed of % inch plywood with edges butted. Interior corner 1" x 1" strips are utilized for screw mounting, since wood screws do not enter plywood edges in a satisfactory manner. Glue would do as well.

Fig. 1. Overall view of sound chamber. Speaker is mounted at top of column and reflector is used to direct sound into room.

Sound absorbent material—rug padding, Celotex, or the like—lines the entire box interior. Even though the box is of columnar construction, no resonance effects have been detected. The exterior is finished by enclosing it with 1 1/4 yards of tapestry. This greatly simplifies construction and finishing problems, and the cost of the cloth is most reasonable.

The top portion is easily constructed. After the speaker cone is located in the center of a 1-foot square mounting board and a suitable hole is cut out, vertical % inch pine boards are cut for mounting in the form of a corner as shown in Fig. 2. The boards are square when measured from the speaker side, and are placed tangent to the hole.

A diagonal cut on each board is made with a hack saw or other thin blade, to a depth of % inch, as indicated by the lines marked D in Fig. 2. This is to hold the edges of the conic section.

A piece of 0.025 inch aluminum should now be laid out and marked as shown in Fig. 3. A compass centered at point O with D as a radius should then describe the arc S. D is the length of the slots, from Fig. 2, and S is equal to 1.57H. The distance S should be measured along the arc. This section should then be cut out and gently formed into a slight curve of a cone. The % inch strip on each side will serve as a retaining and mounting portion.

Now mount the side boards securely on the speaker mounting board, and slide the cone into the slots. A nice (Continued on page 149)
An Easy-To-Build
10 METER RIG

By STAN JOHNSON, W0LBV

This unit uses three tubes, operates from single power supply, and has "clamper tube" modulation.

This neat rig is ideal for beginner or as stand-by for the old timer.

The 10 meter phone transmitter was designed with one thought in mind: to build a compact transmitter which would require an absolute minimum of parts and yet be capable of a reasonable amount of output and be easy to adjust and put on the air. The result is a transmitter which has but two tubes in the r.f. section and a single modulator.

Because the rig uses so few parts—and these parts are all standard values which can be used later in a more complicated rig—the transmitter is ideal for the beginner. And for the old timer the transmitter is an excellent standby unit for use when the big rig is being revamped—or for mobile, portable, or emergency use.

The r.f. section uses a 6L6 tritet oscillator with a fixed-tuned cathode circuit, thus eliminating one variable condenser. The 6L6 plate output circuit (which provides output at twice the crystal frequency) likewise is untuned, being tightly coupled to the grid circuit of the following stage. This stage, using an 829-B (or 3E29) is very efficient as a push-push doubler, and provides the 10 meter output. The tuning transformers in the grid and plate circuit of this stage are the only variable condensers in the set.

Modulation for the transmitter is provided by a 6V6 which is used as a "clamper tube" modulator. This is a now-familiar form of screen grid modulation. The arrangement illustrated is the last word in simplicity—not even needing a modulation transformer or choke. Actually, it is a form of series modulation, which the writer and many others used nearly 15 years ago.

The entire transmitter is built up on a standard 3" by 7" by 13" chassis. The modulator is placed at one end of the chassis to get it as far as possible from the r.f. output end. Down the center of the chassis in a row, starting from the left end, are: the sockets for the crystal; the 6L6 oscillator; the combination plate coil for the 6L6 and the grid coil for the 829-B; the 829-B socket; and the socket for the plate coil in the output circuit.

On the rear of the chassis is a 4-prong socket which is used to provide connection with the 6.3 volt heater voltage source and for the 45 volt "C" battery. A feedthrough insulator is used as a high voltage terminal for the 600 volt power supply. The latter can be any standard supply which will furnish 600 volts at 200 ma. plus 6.3 volts for the tube heaters.

The values chosen for the parts in the rig are all standard. However, some are rather critical so unless you are an old hand at modifying circuits it is urged that you use the parts specified. For example, the writer tried using a single-gang condenser for C. This resulted in a very unstable transmitter which would oscillate without rhyme or reason. Replacing the single gang condenser with the dual condenser whipped the trouble completely.

Another critical spot is the output plate coil. A standard manufactured coil was tried—but it would not work, apparently because paralleled tube plates add enough capacity so that the coil used must be smaller than normal. If you do use a manufactured coil you will have to peel off turns—and further, it is doubtful if the antenna pick-up coil will have enough inductance. For that reason, the writer urges that for this set the builder "roll his own" coils, following the coil specifications given in the parts list.

Getting the set into operation is no trick at all if everything has been wired properly. The first thing to do, of course, is to get the oscillator working, as indicated by r.f. on the grid coil when a standard pick-up loop and flashlight bulb is coupled to it. Then, with an 0-200 ma. or larger milliammeter plugged into the cathode jack, the plate circuit is tuned to resonance.

If the set is working properly so far—the next step is to put it on the air. It is imperative that the antenna loading be heavy—if both good efficiency and good modulation are to be obtained. This means first of all that the antenna should be one which "takes" r.f. readily—one which will overload a standard transmitter if the antenna coupling on it is turned all the way in.

Assuming that a good antenna is available, adjust the slider on R, until the screen voltage on the 829-B reads 150 volts. (If you do not have a volt-meter the setting is approximately the half-way point on the 1000 ohm cathode resistor.) Next, couple up for maximum antenna loading—which should be so "tight" that the resonance dip, as noted on the milliammeter, is very broad. Now, plug in...
the microphone, and speak into the mike. When you really "hit" the mike there should be a very slight upward "kick" of the milliammeter, and total current indicated on the milliammeter should be about 135 ma.

If the transmitter modulates "down" it is an indication that (1.) the antenna coupling is too loose, or (2.) screen voltage is too high. The latter can be lowered by adjusting the slider on $R_v$. However, lowering screen voltage reduces efficiency, so if possible increase the antenna load. This may involve changing the number of turns on $L_v$, or modifying the antenna so that it loads better.

When adjusted, using the procedure outlined, the rig is capable of excellent quality—in fact, to the writer's conformation, a local ham reported that the little rig sounded as good as any transmitter which has Class B modulation, a crystal mike, and all the trimmings. Subsequent checks proved that the local was a trifle optimistic, but quality reports have been uniformly good on both local and long haul contacts.

A gain control for the mike was regarded as an unnecessary luxury—simply "backing off" from the mike originally used kept the gain at the proper level. However, it would be a simple matter to put a 500,000 ohm variable resistor across the output side of $T_1$. A word about microphones. The plentiful T-17 type mikes have relatively low output, so low that they will barely provide enough audio, with very close talking. Their output can be improved a good deal by prying them apart with care, and drilling some extra holes in the front for the sound to enter. Even so, the writer prefers the standard "F" type microphone from a telephone, because it has superior quality and output. Contrary to popular conception, it is not necessary to "scrounge" these—many local phone companies will sell them, providing they recover from the shock of somebody trying to acquire one honestly.

Like any low power transmitter this one will not consistently slug it out in kilowatt alley at the low end of the band, and the user will probably have better luck with it if he operates 29,000 cycles and higher. Also, it is asking too much of any modest transmitter to expect it to perform miracles with a folded dipole or other simple antenna. In fact, the writer has always been a little amazed at the number of folded dipoles in use, considering the fact that a simple beam (such as the two element, end-fire array described in the writer's article "No Space for an Antenna?" in April 1950 issue of Radio & Television News) costs practically nothing to build, takes up very little more space than a dipole, and will give infinitely better results. The beam mentioned, incidentally, has been found to work even better if spaced 6 feet instead of 4 feet as specified in the original article.

One caution—in order to provide tight antenna coupling, the antenna coil is wound of flexible wire so that it can be "poked" into the plate coil. This means that it must have very good insulation—otherwise there is the grim possibility that high voltage will appear on the antenna feeders. The general is obvious—use wire with a high voltage breakdown rating, such as auto ignition wire.

Under chassis view of transmitter shows how few components are required in unit.
A Preamp With TONE CONTROL

By GLEN SOUTHWORTH

This novel preamp features simplified power supply and combination "low-high" frequency boost control.

In recent years an increasing amount of audio equipment has been offered to the public which desires to assemble its own reproducing system. This trend has been reinforced by the recommendations of various consumer organizations and an increasing number of not too technically minded persons are joining the experienced constructor in the assembly of their own equipment.

In many instances the interactions between various sections of the audio setup may be largely ignored, even though careful attention is paid to the selection of highest quality components. Probably the most obvious example of this is the conventional radio phonograph wherein the close proximity of the loudspeaker to the pickup produces electromechanical feedback which, in turn, causes hangs, distorted reproduction, and limited low frequency response capabilities. This problem is often accentuated where microgroove recordings are concerned due to the lighter tracking pressures involved and the fact that some of the lightweight plastic arms have serious mid-frequency resonances, as may be tested by turning up the gain and tapping lightly on the arm. Probably one of the best and simplest solutions to the above problem is to move the record playing mechanism to a distance from the loudspeaker system. As most listeners usually prefer to sit somewhat back from the speaker, it is often desirable to locate the player nearby, together with some means of tone and volume control. To do this almost always requires some form of preamplifier with a relatively low impedance output in order to prevent the capacitance of the connecting shielded cable from seriously attenuating the high frequencies.

A compact preamplifier incorporating cathode follower output as well as a novel power supply and tone arrangements is shown in the accompanying diagram and photographs. The power supply is unique in that only the six volt heater voltage is drawn from the power supply of the main amplifier. This is used for the tube filaments and is stepped up by a small filament transformer which is connected backwards to supply the plate voltage for the preamp tubes. This arrangement has several advantages, prominent of which is the fact that the only power connection required is a single pair of wires carrying low voltage from the power supply of the main amplifier power supply in the event that high gains or a large power output is desired.

With the exception of the tone circuit, the rest of the preamp is of conventional design, using a 6J5 as a stage of voltage amplification and one half of a 6SL7 as a cathode follower output stage. In the event that additional amplification is required, such as for a low level magnetic pickup, the other half of the 6SL7 may be connected for extra gain.

Upon examination it will be noted that the tone circuit used is somewhat similar to the increasingly popular compensation circuits for the Fletcher-Munson effect, in that it boosts both high and low frequencies simultaneously. In principle, its operation is considerably different in that it is intended to be used at high volume levels as well as low to create a form of "Distance Control."

The average living room does not have the acoustic characteristics of a concert hall and, as a result of a combination of factors, home reproduction may sound distinctly unnatural to the listener accustomed to live performances. This difference does not necessarily result from a longer reverberation time in the concert hall, as both acoustic design and the absorption of a large audience can reduce this to a fairly low value, but rather due to the characteristics of binaural hearing.

An interesting analogy is to assume two microphones, connected in parallel, spaced about six inches apart, and placed toward the rear of an auditorium. Under these conditions, sound generated on the stage will reach the microphones mostly in the form of reflections from various angles, except at the higher frequencies where directional effects start to occur. At low frequencies the wavelengths of the reflected sounds will be small in comparison to the distance between the microphones, and little effect will occur no matter from what angle the sound is received. In the region around one thousand cycles the distance between the two microphones will approximately equal one-half wavelength and a large degree of cancellation will result over a considerable angle of reflected sound. Above this point an increasing amount of direct radiation is received in relation to reflected energy due to directional effects and greater efficiency of sound absorbing materials. The resulting frequency response characteristic under these conditions may have an attenuation of six decibels or more in the mid-frequency region.

Although the foregoing analogy does not necessarily hold true for live lis-
tuning, various experiments in listen-
ning and recording tend to indicate that
it has considerable validity. Inasmuch as
many commercial recordings are made
with the microphone placed rela-
tively close to the performer, due to
limitations imposed by the equipment
or acoustics, the resultant reproduc-
tion when played back over a flat sys-
tem in a small room may sound harsh
with excessive middle register. As a
result, a device such as the distance
control, which allows controlled atten-
uation of the mid-frequencies, may be
definitely desirable in obtaining the il-
lusion of concert hall presence.

In some cases the experimenter may
succeed in putting together just the
right combination of audio components
which, together with the room acous-
tics, seem to give nearly perfect re-
production, yet after a period of days
or months the quality may not seem
to sound nearly as good as it did at
first. This, again, is often the result
of the interaction of a number of dif-
f erent factors. Usually electromechan-
ic amplifiers are the worst source of
trouble. Speaker suspensions dry up
and lose their elasticity, phono pick-
ups become defective due to heat from
adjacent tubes, and other sources
cause crystals to go flat or rubber
diaphragms to harden. Similarly, mi-
rophonic tubes, particularly in high
gain preamps, can cause serious dis-
tortions if within range of loudspeaker
radiations, often causing a serious
transient peak somewhere in the high
frequency range.

A number of other factors might be
noted, both for the benefit of the nov-
ice constructor or the technician who
may be called upon to fix a special
system. One of these relates specifi-
cally to unwanted electrical feedback,
especially in the case of audio ampli-
fiers capable of supersonic bandpass.
When a high gain system is used, such
as is increasingly the case, sufficient
current may be fed back from the out-
put of the system to a poorly shielded
input to cause damped or continuous
supersonic oscillations. This can cause
splatter on high level musical pas-
sages and can cause a serious limita-
tion on the undistorted power output
available from the system.

Another source of annoying distor-
tion results from the earlier mentioned
arm resonance problem in phono pick-
ups. This appears to be especially se-
rious where certain crystal cartridg-
es are concerned due to the fact that
these elements may be sensitive to vi-
bration applied at any part of the car-
tridge case. As a result, ringing res-
tortions in the arm, or motor board
noise, is readily transmitted through
the audio system. By isolating the
cardidge case from the tone arm with
foam rubber or similar material a no-
table improvement may be obtained,
particularly in cases where the needle
apparently distorts on certain pas-
sages. Although magnetic cartridgges
appear to be relatively insensitive
compared to the crystal it may be ben-
eficial in some instances to use a

similar treatment. In either case, care
should be taken that the compliance
of the isolating material is not such
to cause or accentuate a serious
low frequency resonance as an arm
resonance of even a few cycles-per-
second can cause fuzziness and modu-
ation of high frequency components.

Loudspeaker Arrangements

Although the choice of a loudspeaker
is of considerable importance in ob-
taining superior reproduction, in gen-
eral, less specific information is avail-
able on this component than about the
other links in the audio "chain." For
the most part, the trend in recent
years has been toward woofer-tweeter
combinations for wide range reproduc-
tion. Although representing one of
the simplest means of obtaining wide
range sine wave reproduction, the high
and low frequency speaker combina-
tion can result in some serious tran-
sient distortions. The transient repro-
ducing ability of a direct radiator ap-
pears to be closely related to the pri-
mary resonant frequency of the
diaphragm. Thus a woofer with a reso-
ant frequency of forty cycles may
exhibit poor transient reproduction
throughout nearly all of its useful
range. The tweeter, on the other hand,
usually has a very light moving ele-
ment with a relatively high resonant
point. The result may be that the tran-
sient response is very uneven and dis-
torted compared to the steady state
measurements. The listening effects
may be of harshness in the upper reg-
isier, due to partial reproduction of
transients in this area, and poorly
reproduced low frequency tones
which contain strong modulations.

A situation that more nearly seems
to fit the requirements of good repro-
duction is to use a number of identical
small radiators with relatively high
resonance frequencies. An arrange-
ment of this nature provides sufficient
cone area to be effective at low fre-
quencies but still maintains sufficiently
low individual mass to provide good
high frequency efficiency. Transient
response of such a setup will tend to
be equal to sine wave response below
resonance and fall off smoothly above
this point, a characteristic which tends
to approximate the audible effects
produced by a room in which the sound
absorbency of the walls and furni-
ishings increases with ascending fre-
cquency, a condition usually found in
studios and concert nalls.

Several problems are to be con-
sidered in setting up a system using a
number of small loudspeakers. Chief

Diagram of preamp which incorporates
distance control and novel power supply unit.

Bottom view of the preamp. The entire unit is built on a single, compact chassis.

January, 1951
described in the author's article, "Au-
speaker damping, either acoustical or
electrical. It is preferable to use some means of
inverse feedback from the voice coil
amplifier with an appreciable amount of
power handling capabilities at both
high and low frequencies as well as
better transient characteristics al-
though the over-all efficiency was
somewhat lower. Conventional four-
ine inch speakers, such as are obtainable
for about one dollar from radio whole-
salers, were used. However, in select-
ing loudspeakers, it is best to endeavor
to obtain units with a relatively
smooth over-all response, even though
this may mean a falling off of re-
response at high frequencies. The for-
goin g is the general characteristic of
a simple piston type direct radiator,
but in some cases the manufacturer
may use special cone treatment to in-
crease the apparent loudness or bril-
liancy of the speaker, with the result
that some of the previously mentioned
transient troubles of the woofer-
tweeter combination may occur.

In the arrangement shown, all of
the speakers are identically phased,
with the exception of the one in the
center. The voice coil leads are re-
versed with this unit, providing a small
amount of acoustical inverse feedback.
A series connection was used for all
nine speakers as this tends to reduce
the effects of impedance variations in
individual units. However, as this pro-
vides a total speaker impedance of
approximately thirty ohms, the con-
structor may prefer to use a series-
parallel arrangement to lower the out-
put impedance.

Due to the superior transient re-
sponse in the low frequency region, it
is wise to pay particular attention to
the loudspeaker baffle used. A rela-
tively heavy cabinet with rigid walls
is preferable in order to prevent spu-
rious vibrations of the speaker hous-
ing itself. Similarly, the cabinet should
be lined with sound absorbent mate-
rial, particularly in the case of a bass
reflex type of enclosure, and all part
of the system should be tightened
down carefully to prevent rattles.

In actual performance, from such
high quality program sources as mas-
ter tape recordings of band and or-
chestral music, the multiple speaker
system described performed very well
with excellent dynamic balance be-
tween high and low frequencies. Re-
production of low frequency transient
tones, such as piano and string bass,
is very good, being comparable to
other systems using horn loading in
the low frequency region. Even at
high output levels no distortion was
observed that was directly attributa-
ble to the speaker system. Even when
used without any inverse feedback or
loudspeaker damping the reproduc-
tion was quite acceptable although
bass response was much heavier and
speaker hangover tended to alter the
tone color of certain sounds.

In conclusion it may be stated that
the use of a group of small loudspeak-
ers appears to have several advantages
that may be of definite importance to
the critical listener. An arrangement
of this nature can be assembled at
relatively low cost, compared to other
high quality speaker systems. It
should further be realized that a de-
sending high frequency response in a
loudspeaker does not necessarily mean
poor power handling capabilities in
this region and under certain circum-
stances it seems definitely desirable to
introduce frequency correction in the
audio amplifier rather than in the
loudspeaker system.

RADIO & TELEVISION NEWS
EVEN the weather seemed to have a sort of hangover from the gay holiday season just passed. There was nothing about the bleak January morning to distinguish it from any other winter day, for it was neither exceptionally cold nor exceptionally warm, exceptionally bright or exceptionally dark. It was just another monotonous stretch of the calendar that had to be passed over on the way toward Spring.

Things were a little in the doldrums at Mac's Radio Service Shop, too. The work, for once, was all caught up, and Barney was taking advantage of this, for once, was all caught up, and way toward Spring. The technicians in the garage areas are getting so much ahead of us in experience that we'll never be able to catch up unless we use experimenting or something to make up for our lack of experience. We seldom have more than a couple of TV calls a week, while many of those birds in the large cities do nothing but TV work. By the time good TV areas are getting so much ahead of us in experience that we'll never be able to catch up unless we use experimenting or something to make up for our lack of experience.

Mac suppressed a grin at the glib way the boy mentioned a piece of unqualified experience. "I feel that I have to do something to keep abreast of this television game. The technicians in the garage areas are getting so much ahead of us in experience that we'll never be able to catch up unless we use experimenting or something to make up for our lack of experience. We seldom have more than a couple of TV calls a week, while many of those birds in the large cities do nothing but TV work. By the time good TV reception does get here, we'll be about as up to date as a stranger to him? Suppose it has a radically new type of tuning mechanism, a sweep circuit that is hot off the drawing board, and a fancy audio detector that he never even heard of before. None of the work he has done previously will help him find his way about these unfamiliar circuits. All he can do is probe around in the dark hoping that sooner or later he may stumble on the trouble. His experience, if he tries to depend upon it, may actually lead him astray, for the fact that one of the new circuits looks a little like one he is familiar with may cause him to waste hours working on the false assumption they are the same. Since he does not know why the various parts

Barney's freckled face screwed up in puzzlement. "This is not one of my bright days, Boss; suppose you drag that past again a little more slowly."

"I mean that while our actual experience with television is likely to be pretty limited for some time to come, there is nothing to prevent our boning up on television theory; and I, for one, believe that in the long run a good sound knowledge of theory is worth more to a technician than any amount of unqualified experience."

"Whoa there! Back up!" Barney exclaimed. "Do you mean to sit there and say that it is better for a fellow to have a lot of theory sticking out of his ears than it is to be so familiar with a set that he can diagnose its trouble just as soon as he lays eyes on it? Why the experienced guy would have the set fixed and the ticket on it before your theory-man could unlimber his slide rule."

"Granted, but what is your learn-by-doing man going to do with the next set that comes in, a set that is a total stranger to him? Suppose it has a radically new type of tuning mechanism, a sweep circuit that is hot off the drawing board, and a fancy audio detector that he never even heard of before? None of the work he has done previously will help him find his way about these unfamiliar circuits. All he can do is probe around in the dark hoping that sooner or later he may stumble on the trouble. His experience, if he tries to depend upon it, may actually lead him astray, for the fact that one of the new circuits looks a little like one he is familiar with may cause him to waste hours working on the false assumption they are the same. Since he does not know why the various parts are connected exactly as they are; he is in no position to judge whether or not those parts are doing the job they should."

"And what will your theory-man be doing with it?" Barney challenged.

"He, too, will be seeing the set itself for the first time, but he has studied the circuits long before this in books and magazines and has made himself thoroughly familiar with the way they operate. Knowing, as he does, why each part occupies the place it has in the circuit, he can quickly determine if it is properly performing its function. His testing will not be a hit-and-miss affair but will be an orderly comparison between actual operation and intended functioning."

"Sounds as though you are trying to fast-talk me," Barney stubbornly contended. "If you think you can get your knowledge from books or you can get it from experience; but what you learn by doing is a lot more dependable and sticks with you a lot better. If that guy had worked on enough sets, he would not be meeting up with new ones. His trouble was simply that he did not have enough experience."

"There just isn't enough experience to keep you from meeting up with new problems," Mac patiently explained. "But let's approach it from another angle: experience is like a set of handmade wrenches that a mechanic has fashioned to take care of the nuts he ordinarily encounters in his daily work. Being handmade each wrench really fits the nut for which it was made and is quick to use. Theory, on the other hand, is an adjustable wrench that must be reset for every different size, but it will fit any nut, large or small. The advantage

(Continued on page 104)
A WIDE-RANGE LINEAR SWEEP

By LOUIS E. GARNER, JR.

FOR a long time gas triode sweep circuits were used almost exclusively to provide a linear time base in both commercial and home-built cathode-ray oscilloscopes. The result has been that the majority of scopes in use at the present time employ this type of sweep circuit.

Basically, the gas triode sweep circuit, shown schematically in Fig. 2, is very good, providing a linear sweep with short "flyback" time over a reasonably good range of frequencies. In operation, a condenser (C to C') is charged through a series resistor (R) and R) from the "B" supply. The gas triode is connected across the condenser and when the d.c. voltage across the condenser reaches the proper value for "firing" the gas triode, this tube conducts heavily and discharges the condenser. As the voltage across the condenser drops to a denser and when the frequency determined by R, C', and R, from the "B" supply, the sweep is in operation, a condenser (C to C') serves to bring the sweep into sync with the observed signal. Unfortunately, this type of sweep circuit, while satisfactory for sweeps up to about 30 kc., cannot be easily used at much higher frequencies. This is due to a number of factors, the most important of which are the tube characteristics themselves—the fact that the tube takes a certain time to discharge the condenser (limiting the "flyback" time), the fact that the tube takes a certain time to "recover" (limiting the frequency of operation), etc.

For the study of wide-band amplifiers, and for controlling the level of the "sync" signal, it is often desirable to observe signals as high as several hundred kilocycles, or more. A 30 kc. sweep would present too many cycles of a high frequency signal on the cathode-ray screen, and thus make close observation and analysis difficult. For this reason, many of the modern scopes as well as the more expensive units, employ a multivibrator type of sweep, permitting sweeps as high as 100 kc. or more.

A suitable wide-range, multivibrator sweep circuit is shown in Fig. 3. This circuit will provide an essentially linear sweep (saw-tooth signal) from approximately 10 cycles per second to 100,000 cycles per second in four ranges. The sweep, as shown, can be added to an existing oscilloscope by building it in a small metal utility box as shown in Fig. 1, or, if preferred, the old sweep can be removed from the scope, and the new circuit wired in place.

In operation, this sweep is somewhat similar to the thyatron sweep previously described. In that the saw-tooth signal is obtained by utilizing a portion of the charge curve of a resistor-condenser combination. The essential difference is that the multivibrator is used for discharging the condenser rather than a gas tube. By doing this, a faster discharge can be obtained, together with a wider range of operation as far as frequency is concerned. The only disadvantage of this circuit is that it is slightly more complex than the gas triode sweep.

Two RC combinations are used in the multivibrator sweep, one for controlling the frequency of operation, and one for the charge-discharge circuit across which the saw-tooth signal is produced. In Fig. 3, with the "Coarse Frequency" switch set as shown, the combination R, C, is charged, while the combination R, C, serves to determine the frequency of operation. Note that the time constant (RC product) of the charge-discharge circuit is much greater than that of the frequency determining circuit. This is necessary to insure a linear sweep. A dual pot is used for the fine frequency or "Vernier" control so that both RC circuits can be varied simultaneously. This serves to keep the output amplitude at a reasonably constant value over any range.

To minimize the number of parts required, and thus to keep both the cost and the size of the circuit down, the condenser used in the frequency determining circuit on one range is used in the charge-discharge circuit on the next higher range.

Synchronization of this circuit can be obtained by applying a negative-going pulse to the grid of the multivibrator. As shown, a pot is provided for controlling the level of the "sync" signal.

This particular circuit, known as a "Potter" multivibrator, is quite popular and has been used, in modified form, in practically all oscilloscopes. As shown, it has been designed to fit into a small metal utility box, and can be added to an existing oscilloscope by wiring it in place at the point where the old sweep unit was connected. A suitable wide-range, multivibrator type unit which has four ranges and covers 10 to 100,000 c.p.s. would present too many cycles of a high frequency signal on the cathode-ray screen, and thus make close observation and analysis difficult. For this reason, many of the modern scopes as well as the more expensive units, employ a multivibrator type of sweep, permitting sweeps as high as 100 kc. or more.

A suitable wide-range, multivibrator sweep circuit is shown in Fig. 3. This circuit will provide an essentially linear sweep (saw-tooth signal) from approximately 10 cycles per second to 100,000 cycles per second in four ranges. The sweep, as shown, can be added to an existing oscilloscope by building it in a small metal utility box as shown in Fig. 1, or, if preferred, the old sweep can be removed from the scope, and the new circuit wired in place.

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form, in a number of the better commercial scopes.

The entire unit can be easily built in the 4x5x6 metal utility box as shown in Fig. 1. When decal labels are applied, a neat professional appearance can be obtained.

Since only one tube is used, power requirements are small, and a terminal strip or plug can be provided on the back of the unit. Power can then be supplied either from a small power supply, or from the oscilloscope itself.

Leads should be kept as short as possible, and small parts should be used to minimize distributed capacities and to prevent "rounding" of the higher frequency sawtooth signals. Otherwise, wiring is not especially critical.

It may be difficult to find the special dual pot required as a stock item at your local wholesalers, but an inquiry indicated that special dual pots could be obtained on order, at regular prices, although there might be a delay of one or two weeks. In addition, it is understood that at least one resistor manufacturer is producing "kits" from which almost any desired dual pot combination can be assembled by the builder.

If it is not desired to build the sweep as a separate unit to be used as an accessory with an already existing scope, but to wire the circuit in as an integral part of the unit, then it is convenient to add the "Sweep-Sync Selector" switch shown in Fig. 5. Again, part numbers and connections refer to Fig. 3.

A 3-pole, 5-position switch is employed to provide a variety of sweep and sync conditions. With the switch in the position shown, the multivibrator circuit is turned on and it is synchronized with the signal applied to the horizontal plates of the scope (internal signal). The shielded lead shown connects to the plate of one of the vertical amplifier tubes in the scope. When the switch is turned to the "Ext." position, the linear sweep is still used, but can now be synced with an external signal applied to the "Sync" terminals.

With the switch in the "Line" position, the linear sweep is still connected, but is now synced with the 60 cycle line voltage.

In both the "H Amp." and "60 Cycle" positions, the linear sweep is turned off. An external sawtooth signal can be applied to the scope horizontal amplifier at the "H Input" terminals when the switch is in the "H Amp." position, while a 60 cycle sine wave provides the sweep in the "60 Cycle" position.

Return trace blanking may be obtained by applying the pulse on pin 6 of the 12AT7 (Fig. 3) to the cathode of the CRT through a 250 µfd., 1500 volt condenser. If the cathode of the CRT is then bypassed, a 100,000 ohm, 1/2 w. resistor in series.

When building the sweep, if you cannot find the capacity values specified at your local supplier, parallel combinations may be used to get the values shown.

If the sweep is built as an integral part of the scope, it is used in the conventional manner. With the "Coarse Frequency" switch in the position shown, the frequency range is approximately 10 to 100 cycles; in the next position from 100 to 1000 cycles; in the next position from 1000 to 10,000 cycles, and in the last position from 10,000 to 100,000 c.p.s. This last range is determined by the adjustment of C9. All values are approximate only, for there is actually an overlap on each range. In addition, the actual frequency will change somewhat with different "B" voltages.

To set C9, turn the fine frequency control or "Vernier" to its highest frequency position. Then the sweep selector is set so that the inter- 

Fig. 3. Complete schematic diagram of the wide-range, multivibrator sweep circuit.

Fig. 4. Method for hooking up sweep unit.

used does not have a wide-band horizontal amplifier, there may be some rounding of the higher frequency sawtooth signals, resulting in a sweep which is non-linear at the ends. The effect of this can be minimized by expanding the sweep to "oversweep" the screen and using only a portion of the sweep for observing signals.

If the sweep circuit is built as an accessory, as shown in the photo (Fig. 1), then the connections to the scope are as shown in Fig. 4. Power can be supplied either from the scope itself or from a separate supply. The sweep selector is set so that the internal sweep is disconnected and a signal can be applied directly to the horizontal amplifier. Once this is done, the sweep controls (except for "H. Gain") are disregarded on the scope, and the controls on the sweep unit used instead. They are operated in a conventional manner, sync being supplied by the input signal.

If the scope with which this unit is
In combining a good, all-purpose, 3-stage audio amplifier and an untuned detector, the author has devised a handy, laboratory-type instrument.

The need for a good, all-around audio amplifier with high voltage gain and a moderate amount of power output for checks in laboratory and radio service shops is not to be disputed. The one herein described meets these requirements admirably, however it was designed primarily as a signal tracer.

The instrument consists of a power supply, a three-stage audio amplifier with wide frequency response, and an untuned detector—the detector being contained in a probe. Of particular interest in the power supply is the filter circuit which is composed of a conventional filter choke and condensers followed by the resistance-capacitance filter circuit described by H. H. Scott in “Electronics” (Vol. 12, No. 8, pages 42 to 48, August, 1939).

As will be seen from the diagram, the high voltage d.c. for the power audio stage is taken from the filter choke. The high voltage d.c., which is supplied to the first and second audio stages, is additionally filtered by the resistance-capacitance filter. Additional filtering is also used on the detector stage.

In the design of any piece of test equipment certain techniques must be followed so that the over-all appearance and the ease with which the instrument may be assembled and wired will not be impaired. A few of these features will be described. First, the over-all appearance of the finished article must be neat and the panel, if one is used, (and most equipment pertaining to radio and electronics will have a main panel) must have a well-designed and finished appearance. This was accomplished in the design of this instrument as shown in Fig. 1. Secondly, the controls, such as gain control, “On-Off” switch, and the input and output connections together with any other items such as the power line cord and fuse must be easily accessible and arranged for the utmost ease in operation. Next, and one of the most important features, is the actual design and layout of parts on the chassis so that when all of these features are combined we have an instrument which will not only have a good appearance but will work to the utmost satisfaction with the greatest of ease. Not to mention, however, are the features in the design and construction which enable the instrument to be easily assembled and wired. Too often little consideration is given to the problem of servicing the instrument and since any piece of electrical or electronic equipment will need a bit of service from time to time as years go by this is a factor which requires attention.

Since this instrument is comprised of a high gain audio amplifier of excellent tone qualities, a detector circuit which is contained in the probe, plus a power supply, it is not likely that it will ever become dated. With this in mind it was decided to design and construct this instrument and then present all the necessary information so that the future duplication of this instrument would be possible.

Although some items could have been omitted and some savings could have been made, such as the panel which could have been constructed of much thinner material, these savings were not considered practical. The probe was made removable so that the audio amplifier could be used alone, and several output connections were made in order to give the user a choice. The whole instrument was housed in a welded sheet aluminum cabinet which was finished in dark gray crackle finish. A handle has been provide on top of the cabinet so it can be carried easily.

With all the design features mentioned and with great thought as to the final product, a check was made on the necessary parts to be used. Wherever possible standard parts were used so that replacements could be easily obtained in the event that they are needed for repairs. The items of particular interest are the General Radio dial plate which is used as a gain or...
volume indicator and the binding posts, made by the same company which are located in the upper right hand corner of the main panel. These items add greatly to the appearance of the finished signal tracer and give the instrument a very professional look. In addition, resistor and condenser mounting terminals were used wherever the wiring called for such. This type of construction is neat appearing and lends itself to cable wiring wherever possible. In addition, such individual groups of resistors and condensers can be placed as to make them easily accessible for checking the circuits. The wires were laced together as shown in Fig. 5. Care should be taken so that none of the parts are arranged in such a manner as to produce unwanted feedback circuits which will cause oscillations. Fig. 3, from left to right, shows the 6SN7, the 6V6, and the 5Y3 tubes. The guide pin on the 6SN7 points to the lower right hand corner, that of the 6V6 points to the upper left hand corner, with that of the 5Y3 in the same direction. This arrangement is conducive to good wiring practice as all coupling condensers and resistors can then be mounted directly on the tube sockets. A voltage curve vs. frequency (Fig. 4) was plotted on a piece of graph paper and shows the gain without the probe. It can be seen from this chart that the gain is nearly constant over the frequency range of from 50 cycles to 30 kilocycles. Since the chart was plotted in volts rather than db, it falls off on either end. The voltage to the input of the amplifier was kept constant and measurements were made across the voice coil winding with a 3.2 ohm non-inductive resistor load.

The Main Panel

The main panel was constructed out of a piece of three-sixteenths inch thick aluminum. A piece of one-eighth inch wire mesh is used to cover the speaker opening in the panel. The panel light is placed to the left and at the top of the panel (Fig. 1). To the right of the speaker and at the top are placed the three General Radio binding posts. Two red and one black binding posts are used, as indicated in the schematic diagram (Fig. 6). The black binding post is used as “common” to the other two for either high or low impedance, for speakers with or without output transformers. At the bottom (Fig. 1) and to the right is the phono-jack which, when plugged in, will connect the speaker without the output tube were also shielded. All wires from the power transformer to the tubes, resistor strips, and probe receptacle wire were laced together to form a neat wiring job.

The Amplifier

The amplifier consists of three stages wired in a resistance-capacitance coupled circuit as shown in Fig. 6. The first two stages are triode voltage-amplifier, followed by a beam power output stage. Cathode degeneration is employed on the input stage, followed by additional degeneration between the second and output stage. The design of this circuit results in low hum, wide frequency range, excellent stability, low distortion, and good phase-shift characteristics, because of the inverse feedback used. The number of tubes was kept to a minimum by the employment of a dual triode in the first two stages of the amplifier. Fig. 5 shows the signal tracer in the position for wiring. All wiring is done before the panel is attached to the chassis, with the exception of the four wires and shield which are visible at the lower left hand corner. These wires go to the speaker and panel lamp and are easy to reach for soldering after the panel is attached.

Again referring to Fig. 5 the two wires which run from the phono-jack to binding posts and speaker transformer were shielded. The wire which leads from the volume control to the tube grid and the plate lead from the output tube were also shielded. All wires from the power transformer to the tubes, resistor strips, and probe receptacle wire were laced together to form a neat wiring job.

The two cutouts in the mounting flanges, as shown in Fig. 5, were made in order to clear the “On-Off” switch and fuse holder, when the chassis is mounted to the main panel. The power output and gain is adequate for all test purposes including reluctance pickups and microphones. The over-all gain and frequency response are indicated on the frequency chart shown in Fig. 4.

The Probe

The probe was made up as follows and is diagrammed in Fig. 7. Nos. 1, 2, and 4 were made from a standard test prod. No. 1 is the phono-needle and No. 2 the chuck. The chuck was cut off, drilled and tapped to take the screw (No. 9) which is a 4-40 machine screw, and just long enough to make a tight fit so that the whole assembly is held together firmly. No. 4 is the insulated sleeve which was cut to a length of one and three-sixteenths inches, drilled out with a one-quarter inch drill and then countersunk to fit the chuck as shown.

January, 1951
Nos. 3, 6, 7, and 8 were parts from a Yazley phono-plug. The plug was taken apart and part No. 6 was cut down, as shown, to fit into part No. 5. Part No. 5 was taken from an Amphenol connector, since it has the same thread inside as the threads on the phono-plug. In Fig 7 looking at Nos. 1, 2, 3, 4, 5, 6, 7, 8, and 9, we have, in order, the assembly of the probe tip. This tip is removable from the rest of the main probe. This assembly results in a tip which is shielded right out to within three-fourths of the end, and which is insulated to prevent shorts in case the probe should accidentally slip when making tests on a receiver. In Fig 7, No. 10 shows the tip assembled and ready to be screwed into the Amphenol microphone connector which is mounted on the end plate of the probe proper. Nos. 12 and 14 are the two end plates of the probe. They are made out of a piece of aluminum. The tube housing of the probe was made out of aluminum tubing and a medium knurl was put on, thus adding considerably to the appearance of the probe. A cable clamp was used, No. 15, to take the strain from the connections inside the probe. Ceramic condensers and one-quarter watt resistors were used inside the probe since space was at a premium. The two sets of spacers also hold the miniature tube socket in place, a length of 4-40 threaded rod couples both sets of spacers together. A small insulated terminal strip with two insulated lugs was soldered to the metal part on the tube socket and serves as a tie point for the "B" positive and plate leads. The two filament wires from the probe cable were connected directly to the filament terminals on the miniature socket, the shield of the cable being soldered directly to the metal part of the socket.

In order to remove the tube from the probe all that is necessary is to loosen the two 6-32 screws on the cable clamp, remove the 4-40 screws that hold the cable clamp to the end plate, remove the end plate and slide it back together with the outer shell of the probe and the tube is easily lifted out of its socket. The material for the outer shell and spacers was procured from a hardware supply dealer. A thirty inch length of four-wire shielded rubber-covered cable and an Amphenol four-contact male connector completes the probe. This unit measures about six and one-half inches long overall and one-quarter inch in diameter, a size which is easily handled and is not too bulky. The slender tip of the probe is easily applied to any part within a radio set. A ground wire and alligator clip were attached to the cable clamp for clipping onto the ground of a radio set when the probe is used.

The power is turned on and the unit is allowed to warm up. With the probe attached several stations will be heard when the probe is touched to the antenna terminal of a radio. The signal can be traced right down to the speaker by touching the probe to various connections within the radio. A general discussion of signal tracing has been published in past issues, so it will not be given here. The three binding posts at the top of the panel are for connecting to a vacuum tube voltmeter or other suitable meter for visual indication and measurements of approximate gain in signal strength. Other uses of this instrument include checking of speakers for tone quality, etc. Microphones and phono-pickups may be checked for quality and output characteristics by plugging them directly into the probe receptacle. The probe tip may be removed and used as an input receptacle. This will increase the over-all amplification as the tube in the probe is also used as a stage of amplification.
THIS month—through the courtesy of Flavio Serrano, ISW DEPARTMENT monitor in Rio de Janeiro, Brazil, we present this data on Mexican radio activities:

Mexico has 95 commercial stations and 4 cultural stations operating on m.w.; there are 14 commercial and 4 cultural stations operating on s.w. Highest-powered station on s.w. (XEW) uses 10 kw., while the highest-powered m.w. outlet (XEX) has 250 kw., reported to be “the world's tops.” Two 500 kw. m.w. stations now are under construction and more than 130 licenses have been issued for the Tropical Band; two TV transmitters—a RCA and a G-E—are under construction in Mexico City, and another TV license has been issued for a location near the Mexico-USA border.


Here are the s.w. calls, local QRA's, and m.w. calls—XEOI, Fomento de Radio, Plaza Santos Degollado 10 (XEOY); XEUX, Independencia 230 (XEUF); XEKW, Aldama 154 (XESP); XETT, Madero 204 Ote. (XEFW); XEUX, Radio Central de Mexico, Reforma 51 (XEFQ); XECC, 2 Norte 803 (XEXC); XEWW, Cadena Radio-difusora Mexicana, Ayuntamiento 54 (XEW); XEJB, Independencia 74 (XETF); XETT, Dolores 17 (XEQK); XEQG, Corporacion Mexicana de Radio, Reforma 51 (XEQR); XEBT, El Buen Tono, Calle del Buen Tono 6 (XEB); XEQQ, Radio Panamericana, Jose Maria Marroqui 11 (XEQQ); XEBR, Serdan 144, (XEBH); XEHH, A.R.S.E., Zempoala 77 Col. Narvarte (XERH); XEJG, Gobierno del Estado de Jalisco, Palacio de Gobierno (XEJB); XEEP, Secretaria de Educacion Publica, Av. Argentina y Gonzalez Obregon (XEOF); XEXA, Radio Gobernacion, Calle de Bucareli (XEDP), and XEYU, Universidad Nacional de Mexico, Calle de Justo Sierra 16 (XEUN).

Anglo-Egyptian Sudan—Radio Om-durman, is again heard nightly on its old frequency of 9.747 with good-to-excellent level at 2315-2345; all-Arabic. (Fargo, Ga.)

Angola—Radio Club de Benguela broadcasts in Portuguese on 4.815 and 9.165 at 0615-0745 (Sun. to 0700) and 1230-1400 (Sun. from 1200); Radio Club de Malange, Malange, can be heard on 7.165 weekdays 0700-0745, 1430-1530, Sundays 0200-0300, 0730-0830; Radio Club da Huila, sa da Bandira, has programs in Portuguese daily 0630-0725, 1300-1500 on 9.024 and 7.755. (World Radio Handbook Bulletin) Radio Club de Nova Lisboa, 11.925, noted 1345 with varied recordings; heard until after 1500. (Pearce, England)

Argentina—At the time this was compiled, LRA, 9.69, the new 100 kw. s.w. outlet, appeared scheduled to North America daily 1800-1900 in Spanish and 1900-0000 sign-off in English. Operates separately from other Buenos Aires international outlets, including LRY, 9.455 which has English evenings also around 2115-0100.

LRA, 9.69, comes on the air 1800 with 5-note chime and announces in Spanish “SIRA, Servicio Internacional Radiofonica Argentina.” (Stark, Texas) Serrana, Brazil, says LRA is the call now used also by former LRY, LRS, and LRU.

LRT, 11.84, Tucuman, noted 1959 with recorded music. (Bromley, Ontario)

Australia—Radio Australia currently is using VLC7, 11.81, to North America daily 0700-1115; news 0715, 0815, 0930.

VLX, 4.897, Perth, Western Australia, heard with news 0645 daily. (Cox, Delaware)

Austria—Salzburg, 9.615, signs on now 2355 with schedule, then carries “Rise and Shine” at 0000. (Cushen, N.Z.)

Azores—CSAQ2, 11.090, Ponta Delgada, heard opening 1500 and closing 1559; good level in North Carolina.

Belgian Congo—OTC2, 9.767, now broadcasts 1100-0100 in French, Dutch, English, and Flemish; English periods include 1400-1500 and 2030-0015. (Neeley, Calif.)


(Continued on page 120)
A Practical Approach

To NEGATIVE FEEDBACK

A review of the advantages of inverse feedback. Several proven circuits on how degeneration can be applied are also included.

By

B. E. PARKER

V.H.F. Eng., Gates Radio Co.

ANY of us have often considered adding a negative feedback circuit to existing audio amplifiers or incorporating it in new ones we may be building. A large amount of material has been published on this subject; however, it has all been on a highly technical level, usually accompanied by long mathematical formulas. Often the net result is that we forget about the whole thing or wind up with an arrangement not at all suited to our needs.

Strangely enough, the application of feedback does not necessarily require struggling with these long complicated formulas and equations. Like most other radio problems it can be attacked quite effectively from the old practical shirt-sleeve approach. A general understanding of what constitutes negative feedback and the factors involved, together with a few proven circuits, can achieve the same results just as effectively.

It would be foolish to say that the approach via mathematical equations is no better than our practical shirt-sleeve approach. To do so would be comparable to saying a wrench is no better for removing a nut than a pair of gas pliers. Naturally the wrench will accomplish the same end result if properly applied. This is a factor most readily appreciated in listening checks. Few laboratories make tests to determine the amount of damping in their amplifiers. This is often the reason two amplifiers having the same frequency response, distortion, and power output may sound radically different when heard side by side. The amplifier having the greatest amount of damping will have "cleaner" sounds. Many readers will recall how clean some of the old amplifiers using 45's and 2A3's sounded. Actual damping will be little more than the damping discussed in the preceding paragraph. Reducing it to a simple example this formidable term becomes far less awesome. The voltage measured across the output terminals of an amplifier operating into a resistive load. Remove the load completely and re-measure the output voltage. If the voltage has increased by a large amount, the amplifier may be said to have high internal resistance. If it has not increased materially, the amplifier has very low internal resistance. This is analogous to measuring the voltage of a dry cell battery with the normal load and then noting the voltage with the load removed. A new battery will change very little as its internal resistance is quite low. The voltage of an old battery almost discharged will change radically between no-load and full-load conditions. Since loudspeakers and most telephone lines do not present a constant impedance to the output of the amplifier throughout the frequency range, it becomes obvious that an amplifier having low internal impedance will outperform one with high internal impedance when operated under conditions of this nature.

Why Use Negative Feedback?

The justifications for using feedback are many and varied. The following, however, represent a good cross-section of the most important reasons:

1. It permits economical reduction of harmonic distortion for a given output. Or putting it another way, it permits increasing the power output of a given output stage for a specified maximum distortion figure. It is not uncommon to be able to increase the power output of a pentode stage for a specified distortion figure of, say, 5% at its rated output of 3 watts without feedback to a full five watts by the addition of feedback.

2. It provides an excellent and economical means of flattening the audio frequency response curve. An amplifier using relatively low cost components and having a frequency response of, say, 100 to 5000 cycles ± 3 db. can often, by the addition of sufficient feedback, extend the frequency response range to 50 and 10,000 cycles. It is interesting to note at this point that it is by means of large amounts of feedback that broadcast and other high quality amplifiers are held to such close frequency response tolerance as ± 0.2 db. from 30 to 20,000 cycles in production runs of large quantities.

3. Damping is considerably increased when feedback is properly applied. This is a factor most readily appreciated in listening checks. Few laboratories make tests to determine the amount of damping in their amplifiers. This is often the reason two amplifiers having the same frequency response, distortion, and power output may sound radically different when heard side by side. The amplifier having the greatest amount of damping will have "cleaner" sounds. Many readers will recall how clean some of the old amplifiers using 45's and 2A3's sounded. This was largely because of the damping resulting from the low plate impedance of the high current triodes used. The popular pentode and tetrode tubes used today have relatively high plate impedance. The use of sufficient feedback can effectively lower the plate impedance, as seen from the loudspeaker end, and increase the damping to a marked degree.

4. The internal impedance of an amplifier may be reduced to a fraction of its former value by the use of feedback. Internal impedance is a formidable sounding engineering term which has been gaining attention in recent months. Actually it is little more than the damping discussed in the preceding paragraph. Reducing it to a simple example this formidable term becomes far less awesome. The voltage measured across the output terminals of an amplifier operating into a resistive load. Remove the load completely and re-measure the output voltage. If the voltage has increased by a large amount, the amplifier may be said to have high internal resistance. If it has not increased materially, the amplifier has very low internal resistance. This is analogous to measuring the voltage of a dry cell battery with the normal load and then noting the voltage with the load removed. A new battery will change very little as its internal resistance is quite low. The voltage of an old battery almost discharged will change radically between no-load and full-load conditions. Since loudspeakers and most telephone lines do not present a constant impedance to the output of the amplifier throughout the frequency range, it becomes obvious that an amplifier having low internal impedance will outperform one with high internal impedance when operated under conditions of this nature.

5. Feedback assists materially in maintaining a constant over-all gain characteristic with tube aging as well as the tube-to-tube variation found even in new tubes. While this is of little importance in the average radio, ham transmitter, or p.a. system, it is of paramount importance in installations where the gain must remain at a fixed value from day to day. Long-distance telephone and broadcast termination equipment do require constant gain for stabilization.

6. Noise of a recurrent nature, such
as hum, may be reduced by the application of feedback around the point of hum origination. No amount of feedback, of course, can reduce hum originating at some point outside the feedback loop. Noise of a periodic nature, such as hum, may be reduced by the application of feedback. This might be stated as: the noise fed back must be of opposite polarity in order to cancel out part of the incoming signal. In other words, the energy fed back tends to cancel a portion of the incoming noise. This is true in practice. As mentioned previously, the phase shift of the output transformer limits the permissible amount of feedback.

Methods of Feedback

Figs. 1 through 6 illustrate several methods of applying negative feedback. These are methods which have been found sound and dependable enough for their incorporation in commercial broadcasting equipment.

Fig. 1 illustrates what is perhaps the simplest form of negative feedback. Voltage is fed back from the plate of the tube to the grid of another amplifier, by means of feedback wiring. Voltage at the plate is approximately 180 degrees out-of-phase with that at the grid. The amount or amplitude of the feedback voltage is determined by the grid to plate coupling condenser, and the circuit may be designed to provide any required amount of feedback. Voltage is fed back in -phase, oscillations in high gain amplifiers.

Fig. 2 is also a modification of Fig. 1. The difference is that C2, the d.c. blocking condenser, is not used. Since the plate of V1 and grid of V2 are virtually in-phase, the feedback voltage may be fed directly from the plate of V1 to the plate of V2. In this event, R8 serves as the feedback resistor limiting the amount of feedback. Obviously, to increase the amount of feedback, it is merely necessary to decrease the value of R8. To keep the BC phase shift to a minimum, the value of the grid-to-plate coupling condenser between the plate of V1 and the grid of V2 should be as large as economically feasible. It is interesting to note that R8 also furnishes another d.c. path for the plate current of V2. This is, as a whole, desirable since it serves to further increase the plate voltage on V2. Fig. 3 is essentially a further variation of Fig. 2. As pointed out earlier, the cathode and plate of a tube are normally in-phase. Then by modifying Fig. 2, by moving the feedback lead from the plate of V1 to the cathode of V2, the same effect is obtained. It is necessary, however, to put C2 in to block the d.c. current which would otherwise flow. This can be an advantage, since this blocking condenser can be used to extend the low frequency response by judicious selection of its value.

It often is as desirable to increase or extend the high frequency response as it is the low frequency response. By the addition of C1, we can gain considerable control over the high frequency response by increasing the amount of feedback at the high frequency end. If completely unby-passed, the circuit will have a high Q at 100 cycles, which makes a definite hump at that frequency.
By J. RACKER and P. SELVAGGI

Part 1. Operational characteristics of several of the popular sync circuits being used in modern TV receivers. Concluding article appears next month.

One of the most common and bothersome troubles encountered in television receivers today is the poor operation of the synchronizing circuits. Many people will tolerate relatively poor definition, some distortion, weak images, but when the picture "rolls," "tears," or shifts periodically—the service technician is sure to get a call. The reason for this is easy to understand. It is possible to enjoy television—if you are not overly critical—even though the quality is not especially good, but it is impossible to watch a picture that is rolling, tearing, or shifting.

This problem is further complicated by the fact that in many cases it is difficult, if not impossible, to correct the trouble due to the inherent characteristics of the particular synchronizing circuit used in the set. One of the major objectives of this article is to show the reader how to modify such a circuit so that good performance can be obtained. Of course before the technician can modify a given circuit he must clearly understand its basic principles and how they affect the circuit's performance.

The author would like to emphasize one point before delving into actual circuit descriptions. The television set manufacturer's engineer is confronted with two problems when designing any circuit. One is to make the circuit as economical as possible—for a given performance specification—and the second is to make one circuit suit as wide a variety of reception conditions as possible.

In order to economize it is frequently necessary to reduce the number of tubes employed. This means that if one tube will meet the requirements of the majority of installations, a second tube will not be used although it is known that it will be difficult to obtain good reception in some localities without its inclusion in the circuit. The second factor usually means that some engineering compromise must be made between two conflicting conditions. For example, the "Q" of a flywheel circuit (to be described later) should be increased to minimize effects of noise and decrease the minimum possibility of picture shift. The manufacturer generally selects a "Q" that represents a compromise between the two.

The technician, on the other hand, is concerned with each installation as an individual problem. If adding a stage to a customer's set saves two or three calls, if a set located in a noise-free area shifts its image frequently, he is justified in modifying the circuit used in the set to meet these individual conditions.

One of the most important functions of a television set is to synchronize and phase the horizontal deflection sweep voltages to the framing and scanning rate of the pickup camera at the transmitter. To achieve this, vertical and horizontal synchronizing pulses are transmitted along with the video intelligence. These pulses are then used to establish the frequency of the vertical and horizontal sweep circuits. The reader can refer to Parts 17, 18, and 19 of the series of articles "Modern Television Receivers" by M. S. Kiver (Radio & Television News, August, September, and October, 1949) for a general idea of the functioning of the various circuits with respect to the synchronizing pulses. The author will assume that the reader is reasonably familiar with these principles in the ensuing discussion.

Blocking Oscillator

One of the simplest and most economical synchronizing circuits is the blocking oscillator. This circuit was used extensively in early sets and, because it has several serious disadvantages, the technician may have many occasions to repair or adjust blocking oscillators. A simplified schematic of the blocking oscillator is shown in Fig. 1. First let us consider the action of this circuit without synchronizing pulses.

The transformer, T, in this circuit has the following characteristics. When the plate current increases it induces a positive voltage in the grid leg; when the plate current stays constant, no voltage is induced; and when the plate current decreases, a negative voltage is induced in the grid leg. When the set is first turned on, tube V begins to draw current which increases a positive voltage in the grid circuit. When the set is turned off, plate current stays constant. The high positive grid voltage draws grid current which charges condenser C negatively. This sequence continues until the saturation current of the tube is reached, at which time the plate current stays constant. The grid voltage therefore drops from some positive value to zero, which reduces plate current. Reduction of plate current causes the grid to go negative, causing a further decrease in plate current. This sequence continues until tube cut-off is reached, at which time a negative voltage is induced across the grid which drives it well beyond the cut-off value. When the tube is maintained at this highly negative value by the charge across condenser, C, which slowly discharges through resistor R. (It should be noted that during the positive cycle, the tube is conducting and hence requires a low resistance so that the time constant is small; however, with the tube cut off the RC constant is large.) As the condenser discharges,
the grid voltage increases until the cut-off value is reached. At this point the tube begins to conduct and the entire cycle is repeated. The waveform of the grid voltage versus time is shown in Fig. 2A. The frequency of this cycle is determined by the RC constant chosen and the cut-off of the tube. In practice, this frequency is made slightly less than the frequency of the incoming sync pulses.

The sync pulses are applied at some time just prior to the return of the grid voltage to the cut-off value and are of sufficient amplitude to raise the grid voltage above cut-off as shown in Fig. 2B. The oscillator begins its cycle exactly at the time that the sync pulse is applied. This process is repeated as long as sync pulses exist and the receiver is now in synchronism with the transmitter scanning rate. The grid voltage at the time that the sync pulse is applied can be varied by adjusting \( R_i \).

The synchronized positive pulses at the output of the blocking oscillator are then used to generate the saw-tooth waveform. The circuit of \( V_i \) is such that a saw-tooth voltage will appear at its output with the flyback time corresponding to the blocking oscillator sync pulse as shown in Fig. 3A. Thus the output of the blocking oscillator is to discharge the condenser in the plate of \( V_i \) and cause the electron beam to go from the extreme right hand side of the CRT to the extreme left before it starts scanning across the tube again.

The disadvantage of the blocking oscillator circuit is that it is extremely susceptible to noise. Two effects may occur. One is that a pulse of noise-voltage will appear at the grid just prior to the sync pulse and cause the tube to conduct. In this case the saw-tooth starts prematurely and a point \( B_i \) which should appear at the extreme left of the picture is shifted to the center. If the noise pulse occurs soon enough, a few cycles may be required for the sync pulse to be in position-to fire the tube. This effect is shown graphically in Fig. 3B.

The other effect that may occur is that the noise pulse will partially cancel the sync pulse and the tube will fire later than it should. In this case the picture is displaced to the left, as indicated in Fig. 3C, and again several cycles may be required to return to normal operation. Both these effects, if they occur for a few cycles only, appear as a "tear" on the picture.

It should be noted that up to a certain point the magnitude of the sync pulse is proportional to the signal input, so that for a strong signal a large pulse is available and a small one for a weak signal. If a large amplitude is available the RC constant of the oscillator can be adjusted so that the pulse appears considerably before the time that the cut-off value is reached. This increases the magnitude of noise voltage required to trip the circuit prematurely. However, if a weak pulse is available, then the time between the sync pulse and natural oscillation must be made closer so that a weak signal will raise the grid above cut-off.

The manufacturer permits adjustment of the synchronizing circuit to meet these divergent conditions by placing a potentiometer in the grid of the blocking oscillator corresponding to \( R_i \) in Fig. 1. \( R_i \) in this circuit affects both the upper and lower limit of the RC constant and when the tube begins to conduct and the end of the blocking pulse, part of the sweep near the peak is blanked and the flyback time is limited to the period between the leading edge of the sync pulse and the end of the blocking pulse. Other synchronizing systems will cause the flyback time to start at the beginning of the blanking pulse thus giving more time for flyback and therefore allowing the deflection circuits to be designed more efficiently as far as deflection sensitivity is concerned.

**Comparison System**

An improvement over the blocking oscillator can be achieved through the use of a comparison circuit which is quite insensitive to noise pulses. In this system a blocking oscillator is also used but in this case its natural frequency is set as close to the sync frequency as possible. The frequency of the blocking oscillator is then compared with that of the sync pulses. If the two frequencies coincide, no action takes place, if they do not, the frequency of the oscillator is varied until they do.

This system is immune to random noise pulses because it is highly unlikely that noise pulses of sufficient amplitude will recur at a frequency near that of the sync pulses. However, as may be expected, correction of the blocking oscillator frequency is not
of the bias provided by the plate of V4. Varying the voltage at the plate of V4 will also vary the frequency of operation.

The voltage at the plate of V4 is a function of its grid bias which, in turn, is a function of the comparison circuit output. To understand the action of the comparison circuit consider the schematic shown in Fig. 5A. E1 and E4 in this circuit are the voltage waveforms shown in Figs. 5B and 5C respectively.

Diode V2 will conduct when E1 is positive and charge condenser C1 to the peak positive value of E1. When E1 starts to decline, the voltage across the diode will be negative, due to the charge in C1, and it will cut off. Since E1 has a high resistance, the voltage across C1 will decline very gradually over the cycle until the next sync pulse recharges it to the maximum value. The voltage across C1 will have the same waveform in the negative direction. These waveforms are shown in Figs. 5D and 5E. Note the voltage across the condenser is of opposite polarity to that of the applied voltage.

The positive voltage across C1 cancels out the negative voltage across C1 so that the voltage at point A will be equal to zero. Now consider the effect of the sync pulses when they do not occur exactly at the center but are shifted to the left as shown in Fig. 6A. In this case C1 charges up to a peak value of -2 volts, while C2 charges up to a value of only +4 volts. The voltage at point A will no longer be equal to zero, but will be approximately equal to -1 volt (one half difference). Similarly, a shift in the sync pulse position to the right will cause a positive voltage to be reflected at point A.

The positive and negative voltage at point A is compared with the saw-tooth voltage, an error voltage is generated which is positive and negative with respect to the saw-tooth. The error voltage is amplified by the amplifier circuit. A positive error voltage causes a change in the plate bias on V4 which is reflected at point A. The error voltage is applied to the grid of V5, which is tied to that of V4, the saw-tooth generator. Thus it is apparent that the frequency of oscillation of this circuit is a function of the RC constant in the grid of V5, as before, and of the bias provided by the plate of V4.

The degree to which the system is sensitive to noise also depends upon the gain of V5. If the gain is high just a few sync pulses will be necessary for a given condenser Cc to cause the oscillator to sync. However this condition makes the circuit more sensitive to random noise pulses. If the gain is low more pulses are needed to synchronize, but by the same token, the circuit is less sensitive to random noise. In this latter case it will take much longer for the circuit to get back into synchronization after it is thrown out of sync by a severe disturbance. The manufacturer usually designs his circuit as a compromise between the two extremes of design to cover the majority of reception conditions. The service technician can, however, modify a particular set that is subject to individual conditions to effect better performance. This is most easily done by varying the value of Cc.

Returning to the over-all description of this circuit, it may be seen that when the sync pulses do not fall at the center of the flyback period or the saw-tooth period, an error voltage is applied to the grid of V5, which corrects the blocking oscillator frequency. Two factors may cause the sync pulse to be off-center. The sync pulse to the blocking oscillator frequencies may be the same, but will be out-of-phase as is usually the case when first turning the set on. In this case an error voltage will be developed across the grid of V5, which increases or decreases, as required, the blocking oscillator frequency until the sync pulse is at the center of the flyback time. This makes the error voltage zero, and returns the oscillator to the starting frequency.

The sync pulse may be off-center due to a difference in frequency between the blocking oscillator and sync. In this case the initial error voltage will change the oscillator frequency so that the sync pulse moves toward the center. The sync pulse will not remain at the center position, however, because at this position the error voltage would be equal to zero, and the oscillator would return to its initial frequency. The sync pulse does not move to the exact center but to some intermediate position. In this condition, shown in Fig. 7, the sync pulse is out-of-phase with the blocking oscillator pulses. This out-of-phase condition is seen on the screen as a shift in the whole picture to the right, left, up, or down, depending upon the polarity of the phase shift and the sweep affected. This can be adjusted manually by varying R5, which changes the blocking oscillator frequency.

(To be continued)
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January, 1951
Twice as much fun with your oscilloscope—observe two traces at once—see both the input and output traces of an amplifier, and amazedly you can control the size and position of each trace separately—superimpose them for comparison or separate for observation—no connections inside scope. All operation electronic, nothing mechanical—ideal for classroom demonstrations—checking for intermittents, etc. Distortion, phase shift and other defects show up instantly. Can be used with any type of oscilloscope. So inexpensive you can’t afford to be without one.

Has individual gain controls, positioning control and coarse and fine switching rate controls—can be used as square wave generator over limited range. 110 Volt transformer/operated comes complete with tubes, cabinet and all parts. Occupies very little space beside the scope. Better yet one. You’ll enjoy it immensely. Model S-2. Shipping Wt., 11 lbs.

The new 1951 Heathkit Push-Pull Oscilloscope Kit is again the best buy. No other kit offers half the features—check them. Measure either AC or DC on this new scope—the first oscilloscope under $100.00 with a DC amplifier. The vertical amplifier has frequency compensated step attenuator input into a cathode follower stage. The gain control is of the non frequency discriminating type—a accurate response at any setting. A push-pull pentode stage feeds the C.R. tube. New type positioning control has wide range for observing any portion of the trace. The horizontal amplifiers are direct coupled to the C.R. tube and may be used as either AC or DC amplifiers. Separate binding posts are provided for AC or DC. The multivibrator type sweep generator has new frequency compensation for the high range it covers. 15 cycles to over 100,000 cycles. The new model 0-6 Scope uses 10 tubes in all—several more than any other. Only Heathkit Scopes have all the features. New husky heavy duty power transformer has 50% more laminations. It runs cool and has the lowest possible magnetic field. A complete electrostatic shield covers primary and other necessary windings and has lead brought out for proper grounding. The new filter condenser has separate filters for the vertical and horizontal screen grids and prevents interaction between them. An improved intensity circuit provides almost double previous brilliance and better intensity modulation. A new synchronization circuit allows the trace to be synchronized with either the positive or negative pulse, an important feature in observing the complex pulses encountered in television servicing. The magnetic shield supplied for the C.R. tube is of new design and uses a special metal developed by Allegheny Ludlum for such applications. The Heathkit scope cabinet is of aluminum alloy for lightness of portability. The kit is complete, all tubes, cabinet, transformer, controls, grid screen, tube shield, etc. The instruction manual has complete step-by-step assembly and pictorials of every section. Compare it with all others and you will buy a Heathkit Model 0-6. Shipping Wt., 30 lbs.
New 1951 • MODEL V-4A
Heathkit
VTVM KIT
HAS EVERY EXPENSIVE FEATURE

* Higher AC input impedance, (greater than 1 megohm at 1000 cycles).
* New AC voltmeter flat within 1 db 20 cycles to 2 megacycles (600 ohm source).
* New accessory probe (extra) extends DC range to 30,000 Volts.
* New high quality Simpson 200 microammeter.
* New 1/5% voltage divider resistors (finest available).
* 24 Complete ranges.
* Low voltage range 3 Volts full scale (1/5 of scale per volt).
* Crystal probe (extra) extends RF range to 250 megacycles.
* Modern push-pull electronic voltmeter on both AC and DC.
* Completely transformer operated isolated from line for safety.
* Largest scale available on streamline 4½ inch meter.
* Burn-out proof meter circuit.
* Isolated probe for dynamic testing no circuit loading.
* New simplified switches for easy assembly.

New
LOW PRICE
$23.50

The new Heathkit Model V-4A VTVM Kit measures to 30,000 Volts DC and 250 megacycles with accessory probes — think of it, all in one electronic instrument more useful than ever before. The AC voltmeter is so flat and extended in its response it eliminates the need for separate expensive AC VTVMs. + or - db from 20 cycles to 2 megacycles. Meter has decibel ranges for direct reading. New zero center on meter scale for quick FM alignment.

There are six complete ranges for each function. Four functions give total of 24 ranges. The 3 Volt range allows 33⅓% of the scale for reading one volt as against only 20% of the scale on 5 Volt types. The ranges decade for quick reading.

New 1/5% ceramic precision are the most accurate commercial resistors available — you find the same make and quality in the finest laboratory equipment selling for thousands of dollars. The entire voltage divider decade uses these 1/5% resistors.

New 200 microammeter 4½" streamline meter with Simpson quality movement. Five times as sensitive as commonly used 1 MA meters.

Shatterproof plastic meter face for maximum protection.

Both AC and DC voltmeter use push-pull electronic voltmeter circuit with burn-out proof meter circuit. Electronic ohmmeter circuit measures resistance over the amazing range of 1/10 ohm to one billion ohms all with internal 3 Volt battery. Ohmmeter batteries mount on the chassis in snap-in mounting for easy replacement. Voltage ranges are full scale 3 Volts, 10 Volts, 100 Volts, 300 Volts, 1000 Volts Complete decade coverage without gaps.

The DC probe is isolated for dynamic measurements. Neat circuit loading. Gets the accurate reading without disturbing the operation of the instrument. RF probe kit comes complete with instruction manual and 10% crystal diode probe kit extends range to 250 megacycles. 300 Volt range. High input impedance makes Heathkit Model V-4A the most versatile electronic instrument ever made.

YOU SAVE BY ORDERING DIRECT FROM MANUFACTURER — USE ORDER BLANK ON LAST PAGE

January, 1951

The HEATH COMPANY
...BENTON HARBOR 15, MICHIGAN
**NEW HEATHKIT**

**T. V. ALIGNMENT GENERATOR KIT**

- New simplified circuit for easy calibration and assembly.
- New 2 band built-in markers cover 19 to 75 Mc.
- New dual speaker sweep motor for long life.
- New blanking circuit gives base line for better alignment.
- New variable oscillator gives high output fundamentals on TV band.
- New standby switch keeps instrument ready for instant use.
- New 6 to 1 slow speed drive on both oscillator and marker tuners.

The new Heathkit TV Alignment Generator incorporates the new developments required for modern TV servicing. An absorption marker circuit covering all possible IF bands and even several of the RF bands. The new blanking circuit provides a basic reference line which is invaluable in establishing proper traces. The new sweep motor incorporates dual spindles in the speaker frame assuring better alignment and long life. The mounting of the speaker sweep motor has been simplified for easy alignment.

The variable master oscillator covers 140 to 250 Mc, thus giving high output fundamentals where they are most needed. Low band coverage 2 Mc to 50 Mc.

A new stepped attenuator provides excellent control of output.

Planetary 6 to 1 drives on both oscillator and marker provides smooth easy control settings.

A standby position is provided making the instrument always instantly available.

Horizontal sweep voltage with phasing control is provided. No other sweep generator under $100.00 provides all these features — comes complete with instruction manual. Model TS-2.

Shipping Wt., 16 lbs.

**$39.50**

---

**Heathkit**

**CONDENSER CHECKER KIT**

Only $19.50

**Features**

- Power factor scale.
- Measures resistance.
- Measures capacitance.
- Checks paper-mica and electrolytics.
- Bridge test circuit.
- Single eye indicator.
- 110 V. transformer operated.
- All scales on panel.

The Popular Heathkit Signal Tracer has now been combined with a universal test speaker to give you increased service and ultimate performance. The high output power transformer and microphone provide a complete high output system.

The Heathkit Signal Tracer Kit will pay for itself in no time.

The Heathkit Signal Tracer Kit will pay for itself in no time.

Features

- High sensitivity.
- Complete set of speaker impedances.
- Tests microphones and PA systems.
- Tests both single and push-pull tank-circuit

The Heathkit Signal Tracer Kit will pay for itself in no time.

---

**TUBE CHECKER KIT**

- Gear driven roller chart gives instant setup for all types.
- Tests each element separately for open or short and quality.
- Beautiful 3 scale meter — reads good — bad and line set point.

Rugged counter type cabinet.

Test your tubes the modern way — dynamically — the simple, yet fastest and surest method — your Heathkit has a switch for each tube element and measures that element — no chance for open- or shorted elements slipping by all the advantages of the manual commutator type without the slow cumbersome time consuming setup.

Your Heathkit Tube Checker has all the features — beautiful 3 color H.D.GOOD meters — complete selection of voltages — roller chart listing hundreds of tubes including the new 9 pin minatures — finest quality Centrabull series switches for each element — high grade bi-chromatic cabinet — continuously variable line adjust control — every feature you need to sell tubes properly. The most modern type tube checker with complete protection against overload. The best of parts — rugged oversized 110 V. 60 Cycle power transformer — finest Mallory and Centrabull switches and controls. Complete set of sockets for all tube types with blank spares for future types. Fast access brass gear driven roller chart quickly locates the settings for any type tube. Simplified switching cuts necessary setting time to minimum and saves valuable service time. Short and open element checks. Simple method allows instant setup of new tube types without waiting for factory data. No matter what the arrangements of tube elements, the Heathkit flexible switching arrangement easily handles it. Order your Heathkit Tube Checker Kit today. See for yourself that Heathkit saves you two-fifths and yet retains all the quality — this tube checker will pay for itself in a few weeks — better assembled it now. Complete with instruction — pictorial diagrams — all parts — cabinet — ready to wire up and operate. Model TC-1. Shipping Wt., 12 lbs.

**$29.50**

---

YOU SAVE BY ORDERING DIRECT FROM MANUFACTURER USE ORDER BLANK ON LAST PAGE
**NEW 1951 Heathkit SIGNAL GENERATOR KIT**

**Features**
- Sine wave audio modulation.
- Extended range 160 Kc. to 50 megacycles fundamentals.
- New step attenuator output.
- New miniature HF tubes.
- Transformer operated for safety.
- Calibrated harmonics to 150 megacycles.
- New external modulation switch.
- 5 to 1 vernier tuning for accurate settings.

A completely new Heathkit Signal Generator Kit. Dozens of improvements. The range on fundamentals has been extended to over 50 megacycles; makes this Heathkit ideal as a marker oscillator for TV. New step attenuator gives controlled outputs from very low values to high output. A continuously variable control is used with each step. New miniature HF tubes are required for the high frequencies covered. Uses 6Ci master oscillator and 6C4 sine wave audio oscillator. The set is transformer operated and a husky selenium rectifier is used in the power supply. The coils are precision wound and checked for calibration making only one adjustment necessary for all bands. New sine wave audio oscillator provides internal modulation and is also available for external audio testing. Switch provided allows the oscillator to be modulated by an external audio oscillator for fidelity testing of receivers. A best buy — think of all the features for less than $20.00. The entire coil and tuning assembly are assembled on a separate turret for quick assembly — comes complete — all tubes — cabinet — test leads — every part. The instruction manual has step-by-step instructions and pictorials. It's easy and fun to build a Heathkit Model SG-6 Signal Generator. Shipping Wt., 7 lbs.$19.50

**THE NEW Heathkit HANDITESTER KIT**

**Features**
- Beautiful streamlined Bakelite case.
- AC and DC ranges to 5,000 Volts.
- 1% Precision ceramic resistors.
- Convenient thumb type adjustable controls.
- 400 Microammeter meter movement.
- Quality Bradley AC rectifier.
- Multi-ohm range for ranges.
- All the convenient ranges 10-20-300-1,000-5,000 Volts.
- Large quality 3" built-in meter.

A precision portable voltmeter-milliammeter. An ideal instrument for students, radio service experimenting, hobbyists, electricians, mechanics, etc. Rugged, 400 wa meter movement. Twelve convenient ranges, precision dividers for accuracy. Easily assembled from complete instructions and parts. An easy to assemble serves one-half the cost. Order today. Model M-1. Shipping Wt., 2 lbs.$13.50

**NEW Heathkit BATTERY ELIMINATOR KIT**

**Features**
- Provides variable DC voltage for all checks.
- Locates sticky vibrators—intermittents.
- Voltmeter for accurate check.
- Has 4000 MFD Mallory filter for ripple-free voltage.

Even the smallest shop can afford the Heathkit Battery Eliminator Kit. A few auto radio repair jobs will pay for it. It's fast for service, the voltage can be lowered to find sticky vibrators or raised to ferret out intermittents. Provides variable DC voltage 5 to 71/2 Volts at 10 Amps continuous or 15 Amps intermittent. Also serves as storage battery charger. Ideal for all radio testing and demonstrating. A well filtered rugged power supply uses heavy duty selenium rectifier, choice input filter with 4,000 MFD electrolytic filter for clean DC. 0-15 V. volt- meter indicator output which is variable in eight steps. Easily constructed in a few hours from our instructions and diagrams — better be equipped for all types of service — it means more income. Model BE-2. Shipping Wt., 19 lbs.$22.50

You save by ordering direct from manufacturer — use order blank on last page.

January, 1951
NEW LABORATORY INSTRUMENT KITS

Heathkit IMPEDANCE BRIDGE as Standard

Features
- Measures inductance 10 microhenries to 100 henries
- Measures resistance 0.1 ohms to 10 megohms
- Measures capacitance .00001 MFD to 1 MFD
- Measures "Q" and power factors.

HUNDREDS OF LABORATORIES USE

$69.50

NEW Heathkit LABORATORY RESISTANCE DECADE KIT

Features
- 1½% Accuracy
- 10 Megohms
- Ceramic Switches
- Covers 1 ohm to 99,999 ohms

The new Heathkit Resistance Decade is a handy tool for laboratory, school, and service shop test setups, calibrating instruments, bridge measurements, selecting multisteps, etc. The finest quality throughout to withstand school usage — heavy aluminum panel — laboratory type binding posts — the ten decades are extremely simple to assemble — complete kit. Model RD-1. Shipping Wt., 4 lbs.

$19.50

NEW Heathkit LABORATORY POWER SUPPLY KIT

Features
- Supplies 6.3 V. AC at 4.5 Amps.
- Heavy duty construction.
- Handy for schools, labs., and service shops.
- Supplies variable DC 50-300 Volts.
- Shows voltage or current on 3½" meter.

This new Heathkit Variable Power Supply Kit fills hundreds of needs — use it for experimenters, to calibrate instruments, bridge measurements, select multisteps, etc. This new Heathkit supplies 50 to 300 Volts continuously variable DC together with an AC filament voltage of 6.3 Volts at 4.5 Amperes. A built-in 1 MA, 1½" meter has proper shunts to read 0-500 Volts and 0-200 Milliamperes. The circuit uses a 5Y3 rectifier, two 1619 tubes as electronic control tubes to vary the output voltage with a single potentiometer. Case measures 7½" x 13" x 1½". Has instruction manual for assembly and use. Model PS-1. Shipping Wt., 18 lbs.

$29.50

HEATHKIT RECEIVER & TUNER KITS for AM and FM

TWO HIGH QUALITY Heathkit SUPERHETERODYNE RECEIVER KITS

Model BR-1 Broadcast Model Kit covers 530 to 1600 Kc. Shipping Wt., 10 pounds.

$19.50

Model AR-1 3 Band Receiver Kit covers 530 Kc. to over 20 Mc. continuous. Extremely high sensitivity. Shipping Wt., 10 lbs.

$23.50

TRUE FM FROM Heathkit FM TUNER KIT

$22.50

The Heathkit FM Tuner Model FM-2 was designed for best possible musical reproduction. The circuit incorporates the most desirable FM features — true FM — ready wound and adjusted coils — 3 stages of 1077 Mc. I.F. (including limiter). Tube lineup: 7E5 oscillator, 6SH7 mixer, two 6SH7 I.F. stages, 6SH7 limiter, two 7C4 diodes as discriminator, 6X5 rectifier.

The instrument is transformer operated making it safe for connection to any type receiver or amplifier. The R.F. coils are ready wound — mounted on the tuning condenser and the condenser is adjusted — no R.F. coils to wind or adjust.

A calibrated six inch slide rule dial has vernier drive for easy tuning. The finest parts are provided with all tubes, punched and formed chassis, transformers, condensers, and instruction manual. Model FM-2. Shipping Wt., 10 lbs.

$69.50

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A calibrated six inch slide rule dial has vernier drive for easy tuning. The finest parts are provided with all tubes, punched and formed chassis, transformers, condensers, and instruction manual. Model FM-2. Shipping Wt., 10 lbs.

$69.50
January, 1951

HEATHKIT AMPLIFIERS

NEW Heathkit 
HIGH FIDELITY 20 WATT 

Features
- Push-pull 6J5's.
- Full 20 Watts output.
- Fully enclosed chassis.
- Provisions for reliance pickup compensation stage.
- Fitted high fidelity output transformer.
- Treble and bass boost tone controls.
- Full range of output impedances 2.2 ohms to 500 ohms.

Price...

$21.50

The finest amplifier kit we have ever offered—check the features. This inexpensive amplifier compares favorably with instruments costing five times as much. Nothing has been spared to provide the best reproduction—an ideal amplifier for the new Heathkit FM Tuner listed below.

Dual tone controls for control of both treble and bass. Bass control is of the boost type for maximum listening pleasure. Optional preamplifier stage for use with G.E. reluctance pickup or microphone. Uses inverse feedback to give excellent response over entire range. Tube lineup: 6SJ7 preamplifier stage, 6J5 phase splitter stage, two 6L6's in push-pull and 5Y3 rectifier. Full maximum gain of 75 db. Response within 3 db 20 to 20,000 cycles. Shipping Wt., 15 lbs. Complete with all parts, tubes and instruction manual.

Model A-5 Amplifier with preamplifier for G.E. cartridges or microphone $23.50
12" 20 Watt Speaker, No 326...

ORDER BLANK

To HEATH COMPANY
BENTON HARBOR 15, MICHIGAN

(PLEASE PRINT)

Quantity
Price

Heathkit Oscilloscope Kit — Model O-6
Heathkit T.V. Alignment Gen. Kit — T-52
Heathkit FM Tuner Kit — FM-2
Heathkit Broadcast Receiver Kit — Model BR-1
Heathkit Three Band Receiver Kit — Model AR-1
Heathkit Amplifier Kit — Model A-4
Heathkit Amplifier Kit — Model A-5 (or A-5A)
Heathkit Tube Checker Kit — Model TC-1
Heathkit Audio Generator Kit — Model G-2
Heathkit Battery Eliminator Kit — Model BE-2
Heathkit Electronic Switch Kit — Model S-2

Price

Heathkit ECONOMY 6 WATT PUSH-PULL AMPLIFIER KIT

$12.50

No. 304, 12" inch Speaker...

This new Heathkit Amplifier was designed to give quality phase inversion tone and push-pull beam power output. Comes completely built and wired. Has tone and volume controls. Instruction manual for new low price. Better build one. Model A-4. Shipping...

On Parcel Post Orders, include postage for weight shown and insurance. (We insure all shipments.)

On Express Orders, do not include transportation charges—they will be collected by the Express Agency at time of delivery.
IMPORTANT FEATURES:
- Newly developed keyed automatic gain control
- Improved Automatic frequency control (synchrolock)
- Voltage doublers produce 14KV for maximum brilliance

TERMS:
25% Deposit with order - Balance C.O.D., F.O.B.
Brooklyn, N. Y.

For all size picture tubes to 20"...

WIRE, PHONE, WRITE or Come in TODAY!
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1845 Pitkin Ave. (near Sackman St.), Brooklyn 12, N. Y.
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RCA VICTOR
Camden, N. J.
Requires Experienced Electronics Engineers

RCA's steady growth in the field of electronics results in attractive opportunities for electrical and mechanical engineers and physicists. Experienced engineers are finding the "right position" in the wide scope of RCA's activities. Equipment is being developed for the following applications: communications and navigational equipment for the aviation industry, mobile transmitters, microwave relay links, radar systems and components, and ultra high frequency test equipment.

These requirements represent permanent expansion in RCA Victor's Engineering Division at Camden, which will provide excellent opportunities for men of high caliber with appropriate training and experience.

If you meet these specifications, and if you are looking for a career which will open wide the door to the complete expression of your talents in the fields of electronics, write, giving full details to:

National Recruiting Division
Box 110, RCA Victor Division
Radio Corporation of America
Camden, New Jersey

Negative Feedback
(Continued from page 69)

passed, the audio input signal would produce a voltage drop across the cathode resistor of V1, varying at an audio rate. Simultaneously the feedback voltage fed through R1 and R2 would "buck" or cancel some of this audio voltage, reducing the effective gain. C1 serves to increase the high frequency response in two ways:

1. All of us are familiar with the way bypassing the cathode of a stage increases the gain. C1 accomplishes a certain amount of high frequency gain by this method since it furnishes a fairly low high frequency path to ground. A .0043 mfd. condenser would not, however, cause any appreciable gain in the middle register around 1000 cycles.

2. Since C1 tends to serve as a low impedance circuit to ground for the higher audio frequencies, it also bypasses some of the feedback voltage. Since the feedback results in reduced gain in the middle audio frequency range and is effectively bypassed to ground at the high frequency end, then it is to be expected that the middle register will be "pulled" down and the high end left unchanged. With the value of parts shown in Fig. 3, used with a good quality output transformer, the high frequency compensation starts at around 7000 cycles, and the low frequency compensation around 80 cycles. The amount of feedback or "pull down" in the middle register is determined by R2. Increasing the value of C1 tends to pull the high frequency "hump" toward the middle register. Increasing the value of C1 tends to push the low frequency "hump" further toward 30 cycles.

Fig. 4 is a modification of Fig. 3. The cathode of V1 is returned to ground through the output transformer secondary winding. The voice coil being in series with this return impresses its full voltage between the grid and cathode of V1. By proper phasing of the two output voice coil wires the feedback is made negative. R1 merely serves as the usual cathode bias resistor with the proper capacity bypassing.

Fig. 5 is a further modification of Fig. 3 in which the output transformer has been so wound as to have a special

PHOENIX
Speed-Mounts
and
Speed-Tenans
Profitable!

Phoenix IN-LINE SPEED-TENNA PAR-3
High gain consisting of director, high and low folded dipoles and reflector. Speed-ant. Lo Loss insulation. Complete with all hardware, less mast.
You've seen television. Now you'll see it in its very finest form—giant projections of special events, transmitted only to motion picture theatres on private wires or radio beams to make movie-going better than ever!

Success of the new system comes from a remarkable RCA kinescope, and something new in projection lenses. The kinescope tube, developed at RCA Laboratories, is in principle the same as the one on which you see regular telecasts. But it is small—only a few inches in diameter—and produces images of extremely high brilliance. These are magnified to 15x20 feet by a “Schmidt-type” lens system like those used in the very finest of astronomical telescopes.

Because of its size and shape, the new projector is referred to by engineers as the “barrel.” It's already going into theatres, where you'll be seeing giant television—shot from a barrel.

See the latest wonders of radio, television, and electronics at RCA Exhibition Hall, 36 West 49th St., New York. Admission is free. Radio Corporation of America, RCA Building, Radio City, New York 20, New York.

Radio Corporation of America
WORLD LEADER IN RADIO—FIRST IN TELEVISION
RADIO V TELEVISION NEWS

25-35 watt driver unit.
mar articulate quality.
eliminates the power-wasting lower frequencies which
throughout transmission range.

Better Response:
tion caused by re-entrant members.

horn mouth; "straight" horn design eliminates .attenua-
higher sound velocity; no sound-absorbing material on

2 db Higher Efficiency:
221/4" w, 131/4" d. Thread is 1/4"-18 for any RACON

grey hammertone over zinc chromate primer. 171/4" h,
vibratory aluminum casting. Finish is weather-resistant

Sturdier Construction:

Crisper Non-"Boomy" Sound:

or high-frequency horn.

sweep of a full 120°. Vertical angle is only 40°. Espe-
concentrating maximum uniform sound in a horizontal

The RACON COB-11 delivers greatest useful power by

PLAYING 10 1/2" REELS!

The HIT of the AUDIO FAIR!

$345.00

CONCERTONE

■ The professional quality tape recorder you have been waiting for!
NAB standards; triodes throughout; 40-15000 cycles at 15", 40-8000 cycles at 7 1/2". Three motors; flutter less than 0.1%; signal-to-noise better than 30 db. Three heads for simultaneous erase, record, playback. Quick change from single to dual track. Write for booklet.

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BETTER SOUND with
37% LESS POWER

New RACON "Cobra" Wide Angle Horn

The RACON COB-11 delivers greatest useful power by concentrating maximum uniform sound in a horizontal sweep of a full 120°. Vertical angle is only 40°. Especially suited for indoors or outdoors where reverberation, echoes and "hangover" exist. In wide-range systems using 2 or 3 loudspeakers, it's excellent too as a mid- or high-frequency horn.

2 db Higher Efficiency: True exponential flare gives higher sound velocity; no sound-absorbing material on horn mouth; "straight" horn design eliminates attenuation caused by re-entrant members.

Better Response: True exponential flare plus "straight" design produces smoother, more uniform response throughout transmission range.

Crisper Non-"Boomy" Sound: The 250-cycle cut-off eliminates the power-wasting lower frequencies which mar articulate quality.

Sturdier Construction: Consists of heavy 2-piece non-vibratory aluminum casting. Finish is weather-resistant grey hammertone over zinc chromate primer. 17 1/4" h, 22 1/2" w, 13 1/4" d. Thread is 1 3/4"-18 for any RACON 25-35 watt driver unit.

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In Canada: Dominion Sound Equipment Ltd. Branches in all principal cities.

ACOUSTICAL EXCELLENCE
Racon Electric C. Inc.
52 East 19th Street, New York 3, N. Y.
THE EYE IS QUICKER
THAN THE EAR

IF YOU SERVICE TV, YOU KNOW THIS!
Customers are quick to see imperfections. Much slower to hear them. Therefore premium-quality Hytron receiving tubes for the tougher TV jobs. At no extra cost! You gain also: Through fewer expensive service call-backs. Better customer satisfaction and confidence. More profits.

How does Hytron do it? By working closely with leading TV set manufacturers. By endless striving to better already superior performance. By improved design...processing...inspection...testing. Try Hytron TV receiving tubes: 1X2A, 5U4G, 6AG5, 6AL5, 6AU6, 6BC5, 6BQ6GT, 6CB6, 6SN7GT, 6V6GT, 6W4GT, 12BH7, 25BQ6GT, etc. Also Hytron rectangular picture tubes: 14BP4, 16RP4, 17BP4A, 20CP4. You pay no more for Hytron. But see the difference yourself...on the TV screen...on your cash register.

THEY COST PENNIES, BUT SAVE DOLLARS!
Order from your Hytron jobber today


HYTRON TUBE LIFTER — 15¢ net. Lift 'em all the e-a-y prybor way: Tubes (GT, G, standard, lock-in, metal). Vibrators and plugs (Jones, Amphenol) — and knobs. A natural for compact auto radios, etc. Slotted end lifts lock-ins, snap-in trimounts...easily, safely. Of stainless steel with comfortable rolled edges.

HYTRON TUBE TAPPER — 5¢ net. Handy combination pencil, eraser and tube fapper. Discovers microphonism, shorts, and opens in tubes, etc. Compact, non-metallic, rugged. Doubles in brass for writing orders, etc.

HYTRON TUBE PULLER — 75¢ net. Pull or insert 7-pin miniatures the e-a-y way. Neoprene rubber puller works by suction and friction on top of tube. Positive grip. Reaches tight spots. Another Hytron time-tamer and money saver.


HYTRON PIN STRAIGHTENERS, 7-Pin and 9-Pin — 55¢ net ea. You merely press tube gently into Hytron Straightener until button base seats squarely. Presto, pins are straight...and...safe. Avoiding one broken tube pays for Straightener twice over. Precise, stainless-steel insertion die. Comfortable knurled aluminum holder. For hand, bench or tube tester use.

HYTRON RADIO AND ELECTRONICS CORP.
MAIN OFFICE:
SALEM, MASSACHUSETTS

January, 1951
McGEE'S "SUPER STORE" OPERATION SAVES YOU MONEY!

100 Molded Plastic Bypasses $1.99

McGee offers you a famous make crystal cartridge. Standard size and shape, but very high quality. When we can, we may use up our remaining stock of the old style 100 Molded Plastic Bypasses. If you want a new set, please order now. Deal Nos. RN-291 to RN-296. Net $1.99.

5 OZ4 TUBE & 5 VIB. DEAL No. RN-292 $8.49

Here's a red hot deal for you fellows that do a lot of wiring. A bundle of 500 vacuum tubes, 100 5 V以色列, 100 5 T, 100 6 F5GT tube. (The end of the probe is segmented.) All are top grade American made vacuum tubes suitable for all amplifier and power tube circuits. "You get 100 each of 5 T, 5 V T, and 6 F5GT tube. This bundle will save you over two and one-half dollars. Deal Nos. RN-297 to RN-307. Net $8.49.

100 600 VOLT TUBULARS $6.49

100 top quality 600 volt tubular push button switches. Made in the United States and guaranteed by the manufacturer to withstand 600 volts without failure. You won't find a better quality tubular push button switch at any price. You'll receive a liberal guarantee, plus 10% on all your returns. Deal Nos. RN-308 to RN-317. Net $6.49.

20 50 x 30 150 Volts $97.50

50 x 30 150 volts. New quality electrolytic. A top quality electrolytic. The last time we were able to carry these electrolytics was during World War II. Now McGee offers you a famous make crystal. Net $4.95. Shipping weight 3 lbs. Net $4.95.

10 WATT PAGING SPEAKER $11.95

McGee offers you a popular paging speaker with a cardboard cone. 5" x 3" x 2". Net $11.95. Deal Nos. RN-318 to RN-321. Net $11.95.

100 600 VOLT TUBULARS $6.49

100 top quality 600 volt tubular push button switches. Made in the United States and guaranteed by the manufacturer to withstand 600 volts without failure. You won't find a better quality tubular push button switch at any price. You'll receive a liberal guarantee, plus 10% on all your returns. Deal Nos. RN-308 to RN-317. Net $6.49.

150 VOLT TRANSFORMER $12.95

150 volt, 10-500va. Widely used for power supplies. Also fits Motorola, American Radios, etc., 50-30 mfd. 450v, 20-25 v. FP cond. 1.25" x 3". Shipping weight 2 lbs. Deal Nos. RN-322 to RN-326. Net $12.95.

5 RED HOT SPEAKER VALUES

Here we are offering our famous "Red Hot Speaker Values." Do not confuse this deal with any other "Red Hot" deal offered by McGee. This deal is strictly for speakers. You are getting the best quality speakers in the world at these low prices. We think you'll want the following items:

- 20 WATT Tube Speaker, 5 oz. $29.95
- 20 WATT Tube Speaker, 5 oz. $29.95
- 20 WATT Tube Speaker, 5 oz. $29.95
- 20 WATT Tube Speaker, 5 oz. $29.95
- 20 WATT Tube Speaker, 5 oz. $29.95

Shipping weight 2 lbs. Deal Nos. RN-327 to RN-328. Net $29.95.

150 VOLT TRANSFORMER $12.95

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RED HOT SPEAKER VALUES

McGee's "Red Hot Speaker Values" are offered to you to show you the savings you can get when you buy from McGee. We have priced these speakers to give you the best possible value for your money. We want you to get your money's worth and we are sure you will. If you have any questions about these speakers, please call us at our toll-free number. We will be happy to help you.

100 600 VOLT TUBULARS $6.49

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January, 1951

IT'S MCGEE'S FOR RADIO-AMP KITS, T.V. PARTS

16JP $24.95
12PLP $17.95

We have a few models of tele-
vision picture tubes available at
terrific prices. All tubes, unboxed,
ally guaranteed for 90 days.

16J$15.95, tube weight 25 lbs. Net price:
$24.95. 12P $8.95, tube weight 10 lbs. Net:
price $17.95.

15" COAXIAL PM $11.95
Only $11.95 buys a 15" coaxial PM speaker...
beans! 15" speaker. 3000 ohm voice
coil. Matches 8 ohm, 1500 ohm or any
458 IF's. Controls: Drive, Car, Bass, Treble.

12" COAXIAL PM $12.95
A $79.50 retail value, 20% off.
A terrific value. 12" coaxial PM spea-
cer. 8 ohm voice coil. Matches any 8 or 458 IF's. All
in put of output of audio or amplifi-
der. Comes in a potted case.

COMPLETE RADIO AND AMPLIFIER KITS

McGee's Super High Fidelity Remote in U.S.A.

OUTDOOR TUNER TRANS. $79.50
Model A-400 High fidelity outdoor trans-
former. Why pay $20 or $30 for an output,
transformer? McGee's Super High Fidelity
outdoor transformer. Complete with tubes.

FM 12 "COAXIAL PM $17.95
 McGee's FC-1200 $39.95

SARKES-TARZAN

TV TUNER $1.95
Sarkes-Tarzan 13-channel tuner. T精子-connec-
tion 105X, 105K, 12P, 12PLP, M-61, all
models identified.

Price list. $7.95, 9 kg., 15 lbs. weight. Stock No. B-115.

SUPER HEAVY DUTY 10" PM $4.95

We made a special purchase on several hundred
10" PM speakers. Deep sound and clear-tongued
voice. Will take any 200 watts of audio, 6 kg. weight.

15" 21/2 LB. PM $5.95

No. K94241. $3.95.

TV BROADCAST AND Rotors

McGee's Super Fidelity Cable In U.S.A.

OUTDOOR TRANSMIT. $79.50

Motorola Remote Controls

G.E. variable re-

corder. Wide range response, up to 8000 Hz. 5000 Hz. Net price.

78 RPM AMPLIFIER RECORD PLAYER $11.95

78 RPM record player. 2 speed, 78 and 45 rpm. Complete with
record changer, 3 station, customer remote controls, 100Y output.

COMPLETE RADIO AND AMPLIFIER KITS FOR SCHOOLS AND CUSTOM BUILDERS

MOTOROLA REMOTE CONTROLS

G E. variable recorder. Controls with separate 15 chan-

Build Your Own $95

Phono-Mike Oscillator Kit

New 16 Watt Utility $14.95

Amp Kit

Kit Model TM-16, push-
pull wide-range 16 watt amplifier kit. Ideal for a high quality record
player, phonograph, or phonograph. A 16" wide-range microphone.

FM 12" COAXIAL PM $12.95

Pre-amp with push-pull wide-range 16 watt amplifier. For a high
quality record player, phonograph or phonograph. A 16" wide-range
microphone.

12" 32 OZ. PM SPEAKER $6.95

$10.95 BUYS ALL PURPOSE 18 WATT AMP KIT

3-SPEED RECORD PLAYER KIT $13.95

Complete two-speed player kit. K-1 to build a 3 speed player.
Heavy 3 speed speaker motors. Universal in use with all parts and
tubes to build a TOLF. $10.95 adds to an attractive
unit case with stand and speakers. Model B-2776, net price $13.95.

Complete radio and amplifier kit. 3-Gang Tuning Complete Kit, $11.95

A complete 9 tube, 3 G a n g t u n i n g kit, with P.S. speaker. When
required, McGee's will make the best possible complete bag for
antennas. Simply plug in and go. Complete bag is designed
for the 3 G a n g t u n i n g kit with an 8" lighted side rule dial. Don't
class this with ordinary tuners, this has
an exceptional 8" lighted side rule dial. A

3-TUBE BROADCAST SUPERNET RADIO KIT $11.95

Model NS-5X 5 tube AC
DC superheterodyne radio kit.
Has loop antenna and 3-Tube
2000 to 1850 KC. Sensitivity
10 microvolts with 500 micro-
amps. Complete with tubes, di-
aphragm, tuning, and 14 tubes:
247, 297, 6F6, 6SJ7, 6BQ5, 6J7, 6F8, 6A9, 6146, 6BQ6, cesca,
6J9, 6H6, 6J10, 607, 607. Weight 7 lbs. Stock No. NS-5X. Net price:
$11.95.

SELF POWERED AC

Broadcast Tuner Kit. 3-Gang
Tuning Complete Kit, $11.95

A complete 9 tube, 3 Gang t u n-
in g kit, with P.S. speaker. When
required, McGee's will make the best
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5-TUBE BROADCAST SUPERNET RADIO KIT $11.95

Model NS-5X 5 tube AC
DC superheterodyne radio kit.
Has loop antenna and 3-Tube
2000 to 1850 KC. Sensitivity
10 microvolts with 500 micro-
amps. Complete with tubes, di-
aphragm, tuning, and 14 tubes:
247, 297, 6F6, 6SJ7, 6BQ5, 6J7, 6F8, 6A9, 6146, 6BQ6, cesca,
6J9, 6H6, 6J10, 607, 607. Weight 7 lbs. Stock No. NS-5X. Net price:
$11.95.
Each and every instrument thoroughly checked and guaranteed to be in normal operating condition when shipped to you. While the following is only a partial list of our huge inventory (available at the time this publication goes to press) bargains like these simply can't last! So act now and avoid disappointment. Wire, write, phone or use the handy coupon, today!

## COMMUNICATION EQUIPMENT

### RECEIVERS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLLINS 75A</td>
<td>with spkr. only $299.50</td>
<td>for TBS-50 Series</td>
</tr>
<tr>
<td>HAMMARLUND SUPER</td>
<td>with spkr. only $100.00</td>
<td></td>
</tr>
<tr>
<td>NATIONAL HROSTAX</td>
<td>with spkr. only $79.50</td>
<td></td>
</tr>
<tr>
<td>NATIONAL NC173</td>
<td>with spkr. only $147.50</td>
<td></td>
</tr>
<tr>
<td>NATIONAL NC183</td>
<td>with spkr. only $210.00</td>
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<tr>
<td>NATIONAL NC240D</td>
<td>with spkr. only $195.00</td>
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<tr>
<td>PILOTUNER FM TUNER</td>
<td>only $14.95</td>
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<tr>
<td>RM50</td>
<td>with spkr. only $89.00</td>
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<tr>
<td>RM55</td>
<td>with spkr. only $57.50</td>
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<tr>
<td>SURPLUS BC348 110V</td>
<td>less spkr. only $49.50</td>
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### TRANSMITTERS

(With tubes and coils for one band)

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
<th>Description</th>
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<tbody>
<tr>
<td>HALLICRAFTERS HT9</td>
<td>only $225.00</td>
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<tr>
<td>HALLICRAFTERS HT19</td>
<td>95.00</td>
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<tr>
<td>HARVEY WELLS TBS50</td>
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<td>HARVEY WELLS TBS50A</td>
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<td>HARVEY WELLS TBS50C</td>
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<tr>
<td>HARVEW WELLS TBS50D</td>
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### CB EQUIPMENT

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<tr>
<th>Model</th>
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<td>MEISSNER ANALYST 9-1040</td>
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<tr>
<td>McMURDO SILVER TBS50</td>
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<td>MEISSNER SILVER TBS50</td>
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### MILLION EQUIPMENT

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<tr>
<td>GON SET</td>
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<td>GON SET</td>
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</tr>
<tr>
<td>MEISSNER EX SHIFTERS</td>
<td>only $59.00</td>
<td></td>
</tr>
<tr>
<td>WITH FM</td>
<td>only $49.50</td>
<td></td>
</tr>
<tr>
<td>Sylvania MOD. METER</td>
<td>only $19.50</td>
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### VACUUM TUBE VOLTMETERS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
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</tr>
</thead>
<tbody>
<tr>
<td>FERRET 730 SIGNAL TRACER</td>
<td>$67.50</td>
<td></td>
</tr>
<tr>
<td>R.C.P. 545 SIGNAL TRACER</td>
<td>$77.50</td>
<td></td>
</tr>
<tr>
<td>DACO 315 SIGNAL TRACER</td>
<td>245.00</td>
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### OSCILLOSCOPES

<table>
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<tr>
<th>Model</th>
<th>Price</th>
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<tbody>
<tr>
<td>DUMONT 1212</td>
<td>5&quot;</td>
<td>only $64.50</td>
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<tr>
<td>DUMONT 208</td>
<td>5&quot;</td>
<td>only $145.00</td>
</tr>
<tr>
<td>DUMONT 214</td>
<td>5&quot;</td>
<td>only $90.00</td>
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<td>245.00</td>
<td></td>
</tr>
</tbody>
</table>

### FREE!

Complete List of Used Test and Communication Equipment...also new 161-page catalog. Send for your list and catalog today!

---

**Walter Ashe Radio Co.**

1125 Pine St. • St. Louis 1, Missouri

Phone Chestnut 1112
AMPTEX RECORDER

Amplex Electric Corporation of San Carlos, California, has recently introduced a new recorder unit, the Model 400. The new instrument provides simultaneous erase, record, and playback and permits the recording of 152 minutes of program material on a single 10" standard reel. The recorder has a range of 15,000 cycles on half-track tape recorded at 7½" per second tape speed.

The Model 400 comes in a single portable case weighing approximately 62 pounds. The same machine is also available in console cabinets and for standard rack mounting.

AUDIO OSCILLATOR

The Electronic Workshop of 351 Bleeker Street, New York 14, New York has announced the availability of a new model audio oscillator, the 510-A. This test instrument has a frequency range of 18 cycles to 210,000 cycles in four decades. It will deliver 10 volts into 10,000 ohms with input constant within .5 db. over the entire frequency range. Distortion at this amplitude is less than .3% from 100 cycles to 15,000 cycles and is less than .2% from 100 cycles to 15,000 cycles. The output control is logarithmic and is calibrated approximately in output voltage. The new unit measures 4"x2"x5½".

Full details are available from the company.

CLARKSTAN PICKUP

A new variable reluctance pickup has been developed by the Clarkstan Corporation of 1921 West Pico Blvd., Los Angeles 64, California. The unit is a "junior" model of the company's well-known Type RV cartridge. Known as the Model 204, the new pickup has several unusual features. The stylus is easily removable and interchangeable so that microphone, standard, and transcription recordings can be played. Stylus are available with ball points for all these various types of records.

The instrument is housed in a crystal clear polystyrene plastic which permits the operator to see the inner workings of the pickup. The cartridge weighs 14 grams. The compliance is adequate for all types of recordings. The instrument is velocity responsive and is essentially flat, by recording playback standards, to above 10,000 c.p.s. The cartridge is 1¼ inches long.

January, 1951

V.T.V.M. KIT

Allied Radio Corporation of 833 West Jackson Blvd., Chicago, Illinois has just introduced a new vacuum tube voltmeter kit which has been designated the "Knight V.T.V.M."

The new instrument, which is low in cost and easy to build, includes 4 milliamperes ranges and 6 capacity ranges in addition to the 20 standard V.T.V.M. ranges. Because of these added features the company recommends this kit as an all-around test instrument for the service technician, experimenter, kit-builder, student, ham, or for industrial or school laboratory use.

The available ranges of the instrument include 7 d.c. volts, 6 a.c. volts, 4 d.c. milliamperes, 6 ohms, 5 decibels, .5% at 30 cycles, according to the company.

The source impedance of the cathode-follower output is 560 ohms. A matching transformer for feeding low-impedance balanced lines is available as an accessory. The total frequency error due to drift and dial calibration is less than ± 2%. The 320 degree dial gives a scale length of over 8". The output control is logarithmic and is calibrated approximately in output voltage. The new unit measures 4"x5½"x4".

You Can't Beat Wholesale Radio for Quality and Price

TV ANTENNAS

For fringe areas: Extensively tested. ALL TV and FM channels. Completely pre-assembled. Three 6 ft. masts and adjustable reflector. Complete with mast. Model AR-29. Less mast........... $15.95

Hi-Lo Folded Dipole Array............ $4.39


Hi-Lo Folded Dipole Antenna........... $4.99

A complete new folded dipole antenna. Two folded dipoles, 6 ft. long, with reflector.

Ey-Hilo Folded Dipole Array............ $7.55

Folded dipole array with 4 lengths of standard dipole. Model AR-26, Less mast.......... $3.95

Folded Hi-Lo Dipole Inline Array. Complete, 2 folded dipoles, 6 ft. long, Universal U Clamp for inside up to 1½". Model AR-27. Less mast............. $4.75

Lowest Price Conical Array

Can be stacked for fringe areas. Has 8 interchangeable elements:
Model XA-44. Complete with mast. XA-44. Less mast........ $9.95

Complete TV-FM band. Hi-cancel 3", aluminum alloy elements. Includes mast clamp for use with poles up to 1½" dia. Can be used with any type load-in 72 to 300 ohms.

TV ANTENNA ACCESSORIES

STEEL EXTERIOR FOLDS................ $1.95

1½" tube, 1½" dia.

Antenna Swivel Base.................. $1.95

Aluminum, 9½" mast mounting.

2000 wire standoff insulators........ $2.35

300 OHM SNAP ON LEAD INSULATORS...... $2.35

Fits 1½", 1¾", and 2½" tubes.

1½" SNAP ON LEAD INSULATORS........... $2.35

Fits 1½" tubes only.

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1½" SNAP ON LEAD INSULATORS........... $2.35

Fits 1½" tubes only.

CHIMNEY MOUNT BRACKETS. Complete with mast........ $3.25

3" 300 OHM SNAP ON LEAD INSULATORS...... $2.35

Fits 1½", 1¾", and 2½" tubes.

Snap on Lead Insulators.............. $2.35

Fits 1½", 1¾", and 2½" tubes.

PLAY & CONDUCTOR LEAD-IN.............. $1.50

For vertical or horizontal mounting.

50 STACKING ASSEMBLY................ $1.95

For use with any polarized type tubes.

PEAK ROOF MOUNTS for all types of antennas........ $1.95

Complete with mast clamp.

Fits 1½", 1¾", and 2½" tubes.

HEAVY DUTY BASE BRACKETS.............. $2.69

Model 2020-D for use with polars.

1½" 2 HD. PARTIAL ROD ARRAYS for twin

48 STACKING ASSEMBLY.............. $1.95

For use with polars.

1½" 4 HD. PARTIAL ROD ARRAYS for twin

48 STACKING ASSEMBLY.............. $1.95

For use with polars.

MAY COUPLINGS 1½" dia. for 1½" mast........ $3.75

1½" dia. for 1½" mast.

1½" dia. for 1½" mast.

TIE RODS for half tap antenna........ $3.75

Universal Style. 1½" dia. for 1½" mast.

Universal Style. 1½" dia. for 1½" mast.

FLAT 4 CONDUCTOR LEAD-IN............. $3.95

Fits up to 18" from wall.

Hi-Low Folded Dipole Antenna........... $4.95

Complete with mast.

Hi-Low Folded Dipole Antenna........... $4.95

Complete with mast.

Hi-Low Folded Dipole Antenna........... $4.95

Complete with mast.
The Viking Tool & Machine Corp. of 2 Main Street, Belleville, N.J. has developed a new type of motor which produces high starting torque, can be reversed, and has variable speed.

Tradenamed the "Magnarotor," the new unit supplies speeds of 1/2 r.p.m. to 100 r.p.m., without reduction gears, in either unidirectional or reversible models operating on 6, 24, 115, or 220 volts, 60-cycle a.c.

At 35 watts input, the starting torque at 1 r.p.m. is 80 inch-pounds. The standard model is supplied in a weatherproof die-cast housing which requires no oiling and will operate at extremely high and low temperatures under extreme weather conditions.

The motor can be remotely controlled in much the same way as a servo-mechanism. The unit can be used as an antenna rotator, for operating radio tuning and direction finding controls, for operating remote controlled rheostats, etc.

Additional details on the new unit are available from the company.

**CRystal Cartridge**

The Astatic Corporation of Conneaut, Ohio, has recently introduced a new crystal cartridge, the CAC-J, which has been especially designed for playing all types of slow-speed records.

The new cartridge is internally equalized to follow Columbia records and provides ideal frequency response for the recording characteristics of the LP records (30 to 11,000 cycles).

The unit has a small, lightweight aluminum housing with standard 5/8" (Continued on page 118)
YOU'RE FIRST IN LINE!
FOR TOP VALUES IN TV, RADIO & ELECTRONICS

TYPICAL CONCORD BUYS

THE MODERN CONTROL MECHANISM

When your name is on Concord's Mailing List you're first to receive news of the Latest and Best Buys in TV, Radio and Electronics Parts and Equipment. This will be especially true in 1951 for Concord is going to issue periodically special BUYER'S GUIDES jam-packed from cover to cover with TV, FM and AM receivers, phonos, high-fidelity sound components, amateur equipment, servemen's supplies, tubes and other critical parts. All listed as they are available and ready for immediate shipment to you.

CONCORD BUYER'S GUIDE IT'S YOUR KEY TO

- Complete Listings of Available Merchandise
- Current Low Prices
- Prompt Expert Shipment
- Satisfaction Plus

PUT YOUR NAME ON CONCORD'S MAILING LIST NOW!

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PUT YOUR NAME ON CONCORD'S MAILING LIST NOW!

When your name is on Concord's Mailing List you're first to receive news of the Latest and Best Buys in TV, Radio and Electronics Parts and Equipment. This will be especially true in 1951 for Concord is going to issue periodically special BUYER'S GUIDES jam-packed from cover to cover with TV, FM and AM receivers, phonos, high-fidelity sound components, amateur equipment, servemen's supplies, tubes and other critical parts. All listed as they are available and ready for immediate shipment to you.

CONCORD BUYER'S GUIDE IT'S YOUR KEY TO

- Complete Listings of Available Merchandise
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PUT YOUR NAME ON CONCORD'S MAILING LIST NOW!
SUPERIOR'S

new model 770

AN ACCURATE POCKET-SIZE

VOLT- OHM MILLIAMMETER

(SENSITIVITY: 1000 OHMS PER VOLT)

FEATURES
★ Compact-measure 3⅛" x 5⅝" x 2⅛".
★ Uses latest design 2½% accurate 1 Mefl.
★ D'Arsonval type meter.
★ Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range.

SPECIFICATIONS
6 A.C. VOLTAGE RANGES:
0—15/30/150/300/1500/3000 VOLTS
6 D.C. VOLTAGE RANGES:
0—7.5/15/75/150/750/1500 VOLTS
4 D.C. CURRENT RANGES:
0—1.5/15/150 MA.
2 RESISTANCE RANGES:
0—500 OHMS 0—1 MEGOHM

SUPER-METER

A COMBINATION VOLT- OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:
D.C. VOLTS: 0 to 7.5/15/75/150/750/1500/50,000 Volts
A.C. VOLTS: 0 to 15/30/150/300/1500/3000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1500/3000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5 Amps
RESISTANCE: 0 to 500/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to .2 Mfd. .1 to 4 Mfd. (Quality test for electrolytics)
INDUCTANCE: 1.75 to 100,000 Henries 0 to 500 Henries
DECIBELS: -10 to +18 +10 to +38 +30 to +58

ADDED FEATURE: The Model 670 includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

SUPERIOR'S new model 670

SUPER-METER

A COMBINATION VOLT- OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:
D.C. VOLTS: 0 to 7.5/15/75/150/750/1500/50,000 Volts
A.C. VOLTS: 0 to 15/30/150/300/1500/3000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1500/3000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5 Amps
RESISTANCE: 0 to 500/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to .2 Mfd. .1 to 4 Mfd. (Quality test for electrolytics)
INDUCTANCE: 1.75 to 100,000 Henries 0 to 500 Henries
DECIBELS: -10 to +18 +10 to +38 +30 to +58

ADDED FEATURE: The Model 670 includes a special GOOD
BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

The Model 670 comes complete with self-contained batteries, test leads and all operating instructions.

SUPERIOR'S new model TV-20

20,000 OHMS PER VOLT MULTI-METER

and TELEVISION KILOVOLTAMETER

The Model TV-20 was designed to provide all the multi-meter measurement requirements of A.M., F.M. and Television. Unlike other recent models, which are actually standard V.O.M.'s converted to test the new Television Voltages, the Model TV-20 is a completely new unit. It provides the sensitivity, ranges and accessories which are needed to service F.M. and Television in addition to A.M. Radio. The High Voltage Probe for example, with a range of 50,000 volts and designed to withstand 100,000 volts, is an integral part of the instrument with a special compartment for housing it when not in use.

SPECIFICATIONS

9 D. C. VOLTAGE RANGES: (At 20,000 ohms per Volt)
0-2.5/10/50/250/500/1,000, 5,000/50,000 Volts
9 A. C. VOLTAGE RANGES: (All 1,000 ohms per Volt)
0-2.5/10/50/250/500/1,000, 5,000/50,000 Volts
5 D. C. CURRENT RANGES
0-50 microamperes
0.5-50 milliamperes
5-500 milliamperes
5-5 Amps
4 RESISTANCE RANGES
0-2,000/20,000 ohms
7 D. B. RANGES: (All D. B. ranges based on
ODR = 1 Mefl. into a 400 ohm line)
4 to +10 db +34 to +50 db
4 to +22 db +42 to +54 db
22 to +34 db +48 to +62 db
28 to +42 db
7 OUTPUT VOLTAGE RANGES:
0 to 2.5/10/50/100/250/500/1,000 Volts

ADDED FEATURE: The Model TV-20 includes an Ultra High Frequency Voltmeter Probe. A Silicon V.H.F. Diode together with a resistance capacity network provides a frequency range up to 1,000 MEGACYCLES. When plugged into the Model TV-20, the V.H. Probe converts the unit into a Negative Peak-Reading H.F. Voltmeter which will measure gain and loss in all circuits including F.M. and T.V.; check capacity and impedance; test efficiency of all oscillator circuits; measure bandwidth of F.M. and T.V., etc.

The Model TV-20 operates on self-contained batteries. Comes housed in a rugged crinkle-finished steel cabinet complete with test leads and operating instructions. Size 5½" x 7½" x 3".

SHIPPING WEIGHT 10 lbs.

USE CONVENIENT RUSH ORDER FORM ON OPPOSITE PAGE

GENERAL ELECTRONIC DISTRIBUTING CO. DEPT. RN-1, 58 PARK PLACE NEW YORK 7, N. Y.
Superior's New Model TV-10

**TUBE TESTER**

**SPECIFICATIONS:**
- Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing-aid, Thyratron, Miniatures, Sub-miniatures, Monaural, etc. Will also test Pilot Lights.
- Tests by the well-established emission method for tube quality, directly read on the scale of the meter.
- Tests for "shorts" and "Leakages" up to 5 Megohms.
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-10 as any of the pins may be placed in the neutral position when necessary.
- The Model TV-10 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
- Free-moving built-in roll chart provides complete data for all tubes.
- Newly designed Line Voltage Control compensates for variation of any line voltage between 105 Volts and 120 Volts.

The Model TV-10 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover.

**MONEY BACK GUARANTEE!!**

Superior’s new model TV-30

**TELEVISION SIGNAL GENERATOR**

**FEATURES**
- Enables alignment of Television I. F. and Front Ends without the use of an Oscilloscope!
- Built-in modulator may be used to modulate the R. F. Frequency, also to localize the cause of trouble in the audio circuits of T. V. Receivers.
- Double shielding of oscillatory circuit assures stability and reduces radiation to absolute minimum.
- Provision made for external modulation by A. F. or R. F. source to provide frequency modulation.
- All I. F. frequencies and 2 to 13 channel frequencies are calibrated direct in Megacycles on the Vernier dial. Markers for the Video and Audio carriers within their respective channels are also calibrated on the dial.
- Linear calibrations throughout are achieved by the use of a Straight Line Frequency Variable Condenser together with a permeability trimmed coil.
- Stability assured by cathode follower buffer tubs and double shielding of component parts.

**SPECIFICATIONS**
- Audio Modulating Frequency: 400 cycles (Sine Wave).
- Tubes Used: 6C4 as Cathode follower and modulated buffer. 6C4 as R. F. Oscillator. 6SN7 as Audio Oscillator and power rectifier.

Model TV-30 comes complete with shielded coaxial lead and all operating instructions. Measure 6" x 7" x 9". Shipping Weight 10 lbs.

**MONEY BACK GUARANTEE!!**

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January, 1951
Dielectric Heating

(Continued from page 39)

the surface is prevented. Secondly, because the loss factor of the glue is greater than that of the wood, the glue heats more rapidly and is set before the moisture content of the wood can be affected.

The plywood may be formed or curved in the same operation. Fig. 1 illustrates this process: In 120 seconds, the glue is set and the panel is formed for curved-front radio cabinets. Each panel will eventually be sawed to produce four cabinet fronts. The completed cabinet contains twenty-eight electronically glued joints, and no nails, screws or other fastening devices are necessary.

Fig. 3 shows a staggered arrangement of electrodes used for edge gluing. In this manner, wide panels are readily and rapidly built up from narrow stock. Raw lumber fed into a continuous edge gluer will emerge as a glued and set panel at a rate up to thirty linear feet per minute.

Dielectric heating is employed in a variety of food preparation and processing operations. It is used, for instance, for destroying larvae in stored grains and for roasting coffee.

Dielectric heating completely eliminates this problem by heating the plastic uniformly. By decreasing production time and increasing mold life, r.f. preheating has established itself as a standard procedure in the plastics industry.

(Continued from page 39)
Jobs are looking for men again!
Qualified Technicians Needed for
TELEVISION and FM SERVICING

TELEVISION SERVICEMEN
$100 PER WEEK
Inside or outside men, with or without car. We pay car expenses. Modern air-conditioned shop. Vacation with paid Group Hospitalization. 10% employee discount privileges. Time and one-half for all overtime work. Wonderful opportunity for advancement.

TELEVISION INSTALLERS
One of Washington's largest television installation companies is offering a thoroughly experienced crew. This is a permanent job averaging better than $100 PER WEEK.

The members of this crew are eligible to receive generous employee discounts, which pay for their own TV equipment.

ADS like these testify to the demand that exists for qualified TV technicians. As one well-informed industry spokesman puts it, "Technicians may soon be as scarce as certain tubes." With the electronics industry expanding, and with growing military demands cutting sharply into the available supply of skilled personnel, now is certainly the time to improve your electronics know-how. And if you're headed for the Armed Services, your improved technical ability can be recognized and rewarded with interesting supervisory work at higher ratings in vital radar, navigation, or communications units.

Anyone already in the field—if he is to get ahead—can't depend on hit-and-miss methods for TV servicing. Practical knowledge is required. CREI home study offers just the practical course you need to qualify for the well-paid technical jobs. Designed by teaching specialists—the same group which has made the CREI Residence School outstanding—this practical course is kept up-to-date through daily contact with CREI's affiliated retail sales-and-servicing stores (one of Washington's largest TV retailers).

Now is unquestionably the time to prepare. If you want promotion, more money, and the kind of training that is respected by industry and the Armed Services, investigate CREI. Send for—and study—the free booklet offered below. The sooner you begin your training, the better off you'll be—in TV servicing work, or in military service. The cost is nominal for this training, the terms easy. Send for complete data—right now!

THE THREE BASIC CREI COURSES:
• PRACTICAL RADIO ENGINEERING
  Fundamental course in all phases of radio-electronics
• PRACTICAL TELEVISION ENGINEERING
  Specialized training for professional radio
• TELEVISION AND FM SERVICING
  Streamlined course for men in "top-third" of field

CREI HOME STUDY
Can help you to better jobs in servicing or Armed Services!

MAIL COUPON FOR FREE BOOKLET
CAPITOL RADIO ENGINEERING INSTITUTE
Dept. 111C, 16th & Park Rd., N. W., Washington 10, D. C.
Gentlemen: Send booklet, "Your Future in the New World of Electronics," together with details of your home study training. CREI self-improvement program and outline of course. I am attaching a brief resume of my experience, education, and present position.

Check Field of Greatest Interest:
  [ ] TV, FM & Advanced AM Servicing
  [ ] Aeronautical Radio Engineering
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  [ ] Broadcast Radio Engineering
  [ ] Practical Radio Engineering
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  [ ] Radio-Electronics in Industry

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CITY .................................................. ZONE ..................................
STATE ..................................................

January, 1951
Olson Radio Warehouse, Inc.

73 E. Mill St. • Akron 8, Ohio

AM-FM RADIO CHASSIS
IT’S A BEAUTY • COMES TO YOU EACH WITH EIGHT TUBES
Stk No. RA-82-85 $49.95

It’s new! Never offered before by any jobber! A high quality, high-sensitivity, AM-FM combination, which is sure to win the hearts of users for its output clarity. You get the motor unit for installation on the mast along dial and shows position of antenna at all times. Equipped with “Mystic Moving Light” which moves from side to side to locate the exact position of your antenna. The antenna will turn automatically and stop when it’s right. Specially built into this set is the “Automatic Control Box” which stands on the floor. This controls all movements, automatically and with a push of a button, the antenna will move to the desired position. Complete with all components, it is ready to be operated immediately. Includes a complete set of instructions and also a brief catalog of all components and accessories. It comes complete with a 125-volt AC plug. Included is a new 5000 watt amplifier and a 12 volt battery. The set is packed in a heavy cardboard box and is ready for immediate use.

V-M TRI-O-MATIC 3-SPEED RECORD CHANGER

Price for Kit

$28.35

Model 950

OLSON’S GREAT VALUE

100% Automatic in operation. Plays 45, 33 1/3 and 78 RPM records. Built especially for Olson Radio Warehouse. Operates at 120 watts, 115 volts AC. Comes complete with built-in amplifier. Plays records at 45, 33 1/3 and 78 RPM. Included in the set is a turntable, record changer, record player, and a built-in amplifier. The set is packed in a heavy cardboard box and is ready for immediate use.

V-M 3-SPEED AMPLIFIED RECORD PLAYER

Price for Kit

$37.98

Model 979

OLSON’S SPECIAL

This instrument consists of the above V-M 3-SPEED AMPLIFIED RECORD PLAYER, speaker, volume control and built-in amplifier. Includes all components necessary for operation. Complete with all accessories necessary for operation. Included in the set is a built-in amplifier, record changer, record player, and a built-in amplifier. The set is packed in a heavy cardboard box and is ready for immediate use.

RIM DRIVE PHONO MOTORS

Price for Kit

$9.95

Model 19

GE RECORD PLAYER

Famous Models! Ideal bargain at these low prices. Complete sets include all components necessary for operation. Included in the set is a built-in amplifier, record changer, record player, and a built-in amplifier. The set is packed in a heavy cardboard box and is ready for immediate use.

RADIO CHASSIS

Price for Kit

$79

Model 44

AM-FM RADIO CHASSIS
It’s a beauty. Comes to you each with eight tubes.

AM-FM RADIO CHASSIS
IT’S A BEAUTY • COMES TO YOU EACH WITH EIGHT TUBES
Stk No. RA-82-85 $49.95

It’s new! Never offered before by any jobber! A high quality, high-sensitivity, AM-FM combination, which is sure to win the hearts of users for its output clarity. You get the motor unit for installation on the mast along dial and shows position of antenna at all times. Equipped with “Mystic Moving Light” which moves from side to side to locate the exact position of your antenna. The antenna will turn automatically and stop when it’s right. Specially built into this set is the “Automatic Control Box” which stands on the floor. This controls all movements, automatically and with a push of a button, the antenna will move to the desired position. Complete with all components, it is ready to be operated immediately. Includes a complete set of instructions and also a brief catalog of all components and accessories. It comes complete with a 125-volt AC plug. Included is a new 5000 watt amplifier and a 12 volt battery. The set is packed in a heavy cardboard box and is ready for immediate use.

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RADIO CHASSIS

Price for Kit

$79

Model 44

AM-FM RADIO CHASSIS
It’s a beauty. Comes to you each with eight tubes.
GREAT SPEAKER VALUES FROM OLSON

PM SPEAKERS

A solid 2 lb. magnet on these PM speakers creates the illusion of live time. These speakers were ordered by Olson while greased and now we pass the savings on to you. Perfect for radio replacement use, to deliver full voltage for prolonged periods. Voce coil 8 ohms. Choice of 2 sizes.

10" Diameter, 20 Watts
Stock No. S-158, each
Swp. wt., 8 lbs.
Special price, 3 for $13.95

12" Diameter, 25 Watts
Stock No. S-159, each
Swp. wt., 10 lbs.
Special price, 3 for $16.45

For 'Talking Out Loud' Order
Famous Olson Trumpets and Drivers

Completely all weather. Made by Famous Manufacturer. 15 Watt Paging Speaker. A popular unit consisting of a 21 watt Trumpet and a continuous 15 watt amplifier. You get the complete unit consisting of an Alnico 3 trumpet unit with Alnico permanent magnet built-in with switch bracket. Bell diameter is 7". Regular list price $29.50. Packed in original factory sealed cartons. Shop wt. +4 lbs.

$119.50

Trumpet and 15 Watt Driver Unit

The most popular combination in the market. This driver and trumpet is perfect for outdoor use. 120 volt, 2000 watts. Made in 1951. Tube assemblies. Highest grade, low loss. Trumpet suitable for sound trucks, churches, etc., guaranteed by Olson and the manufacturer. All Weather Trumpet: 19" diameter bell, equivalent to a 31/2 exponential trumpet. Made of solid brass and aluminum, fully guaranteed. Designed for outdoor use. Driver. Complete unit consisting of an Alnico 3 trumpet unit with switch bracket. Bell diameter is 7". Regular list price $39.50. Packed in original factory sealed cartons. Shop wt. +14 lbs.

$135.00

SPECIAL COMBINATION OFFER

Olson will supply you with a 25 Watt Driver Unit $125.00 and an all weather Trumpet $29.50 at the special price of both for $239.50.

IT'S EASY TO ORDER FROM OLSON'S

Please fill in the columns below with quantity desired, stock number, description and price. Olson is guaranteed as advertised. If you are not more than satisfied, you may return merchandise for cash refund.

Please Min. Order $1.00

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MUSICAL INSTRUMENTS

MONO BACK MIKE: Everyday excellence. Olson guarantees as advertised. If you are not more than satisfied, you may return merchandise for cash refund.

Please Min. Order $1.00

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January, 1951
A top bobsled team—athletes trained to work as one in handling their balanced, ruggedly built sled—can consistently defeat the clock in negotiating the treacherous, one-mile Mt. Van Hoevenberg run.

Likewise, T.E.I. engineers and production personnel work as a unit with a similar goal—the conquering of TIME's deteriorating effects through the building of an ever-stronger picture tube. For Thomas' highly trained personnel, specially designed equipment, and efficient production techniques are consistently increasing the life of Thomas tubes in the contest with TIME.

For the greatest value in today's television picture tubes—for top operating efficiency and truly LONGER life—specify T.E.I. in all popular rectangular sizes, black-face.

T.HOMAS ELECTRONICS, Inc.
118 Main Street
Valparaiso, Ind.

THOMAS ELECTRONICS, Inc

SCHEMATICS—CONVERSIONS FOR SURPLUS GEAR

NEW LIST! MANY ADDITIONS!
Send stamped, self-addressed envelope for list. Send 25c for chart explaining TV terminology. All equipment & parts not subject to prior sale or reservation. Vol. 14, No. 15, June 1951.

R. E. GOODHEART
345/2 N. PALM DRIVE
BEVERLY HILLS, CALIF.

RADIO & TELEVISION NEWS

THOMAS ELECTRONICS, Inc

ANOTHER OUTSTANDING JOBER

R. E. GOODHEART
345/2 N. PALM DRIVE
BEVERLY HILLS, CALIF.

525.95

HAS THE SENSATIONAL NEW

RADIO & TELEVISION NEWS

SCHMATIC—CONVERSIONS FOR SURPLUS GEAR

NEW LIST! MANY ADDITIONS!
Send stamped, self-addressed envelope for list. Send 25c for chart explaining TV terminology. All equipment & parts not subject to prior sale or reservation. Vol. 14, No. 15, June 1951.

R. E. GOODHEART
345/2 N. PALM DRIVE
BEVERLY HILLS, CALIF.

525.95

HAS THE SENSATIONAL NEW

Bigger Picture Tube

Installing a new larger picture tube depends on the physical construction of the chassis and cabinet as well as certain electrical limitations. To substitute a magnetically deflected tube for an electrostatic type requires a complete redesign of the sweep and high voltage sections and is, therefore, not recommended.

Whenever a larger picture tube is installed it is necessary to change the cut-out or mask. Sometimes it is advisable to purchase a standard size plastic mask or else a suitable picture frame with a safety glass insert can be mounted in front of the screen. The picture tube, deflection, and focus coils, can be fastened either to the cabinet or chassis, whichever is more convenient. Before proceeding to drill or screw things on, however, the actual physical dimensions of the new tube should be checked again.

The electrical characteristics of all magnetically deflected tubes are not the same and deserve some consideration. Table 1 lists the most important electrical differences between present day cathode ray tubes.

Picture tubes having a 63 to 70 degree deflection angle require a special deflection yoke and to obtain the high voltage necessary, either a voltage doubler or a high-efficiency flyback transformer must be used. Most of the tubes listed use either a single or double pole ion trap. Either can be tried and the one giving the brightest picture used.

Undoubtedly there are many other circuit changes possible which will improve the performance of older television receivers. Whatever steps are taken, the technician should make sure that the customer is well satisfied with his overhauled set. One of the shortcomings of many technicians is their lack of neatness and cleanliness in finishing the job. A few extra minutes spent in finishing the job right will leave a good impression and will add to the customer's satisfaction in your work.

Borrowing the vacuum cleaner to clean the inside of the chassis and cabinet as well as the rug surrounding the working area shows your tidiness and thoroughness. Polishing the cabinet lightly with furniture polish or lemon oil after the chassis is in the set and cleaning the glass one last time leaves that good impression as well as no fingerprints.

-30-
2-Band Operation With Folded Dipole and Ribbon

Ordinary 300 ohm twin-lead wire is used as an antenna for operation with 2-band transmitter.

By
WALTER S. ROGERS, W1DFS

SO MANY hams have benefited from the convenience and efficiency of the two-wave, 300 ohm ribbon (twinn-lead) antenna that it seems too bad that more amateurs do not use it. Because it is usually just a one-band antenna, many hams shye away from ribbon antennas. This is unfortunate since it is light, easy to string, and gets out with the greatest of ease.

Back in the fall of 1946, the author started doing something about two-band operation. His first thought was to write W9SZ, an OM capable of the high frequency band, 40 meters in the early spring of 1947 the first two-band rig, as shown in Fig. 2B, was erected at North Falmouth on Cape Cod. This antenna was rather low by "ideal" standards but an average of 20 feet was the best that could be managed with this temporary lashing-up around an old Cape Cod house. With his encouragement, several types of two-band antennas were tried with sufficiently good results to warrant telling other hams about them.

In the early spring of 1947 the first two-band rig, as shown in Fig. 2B, was erected at North Falmouth on Cape Cod. This antenna was rather low by "ideal" standards but an average of 20 feet was the best that could be managed with this temporary lashing-up around an old Cape Cod house. With his encouragement, several types of two-band antennas were tried with sufficiently good results to warrant telling other hams about them.

The center folded dipole was cut for the high frequency band, 40 meters in this case, and lengthened, in accord-

Fig. 2. (A) Mechanical details of 20-75 meter antenna and (B) the 40-75/80 meter antenna.
the Volt-Ohm-Milliammeter
that needs no introduction!
DO YOU HAVE B-A's?
FREE CATALOG?

Include 33 PAGES OF DOLLAR-SAVING BARGAINS!

Complete Guide to the Latest Products! Top Makers in Radio, TV, Sound and Recording Fields

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To Ambitious Young Men Who Want Profitable Careers

- RADIO
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CREI Residence School Trains You for Vital Industry...

...qualifies you for better jobs in the Armed Services too!

Whether you're seeking a career in the electronics industry, where critical shortages of trained men exist, or planning on entering military service, one thing is sure: If you are qualified in electronics, you're qualified for the better jobs. Radar, communications, guided missiles, and television work not only offer present employment at high pay—they are keys to lifetime careers.

Residence School training in Washington, D. C., at CREI arms you with a priceless asset—electronics know-how!

CAPITOL RADIO ENGINEERING INSTITUTE
An accredited technical institute founded in 1927.

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High Quality
AUDIO AMPLIFIER

All Low
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Plus
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made
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Finest Audio Quality you ever listened to
Listening Fatigue Plus
High Quality at extremely low volume
Plus
High quality at the full loudness of a band or symphony

"You can believe your ears when you
Listen with a Brook Audio Amplifier"

Write TODAY for FREE Technical Bulletin
and Detailed Descriptive Analysis

BROOK ELECTRONICS, Inc.
Dept. RA-1, 34 Delhart Place • Elizabeth, N. J.

Fig. 3. Methods for feeding the antenna.
(A) Unbalanced and (B) balanced methods.

There were losses with this arrangement but on these frequencies repeated tests, using the whole antenna system against ground, indicated that the dipole was superior. With the limited power available (the Navy rated these sets at 25 watts output c.w. and 10 watts phone) it was possible to maintain many skeds and have a good time keeping in touch with friends. It was impossible to feel any heat along the line. Despite the disadvantages of the dipole, it was still preferable to using the whole antenna system.

It was another story when W1DFS was to go on the air in Melrose, Massachusetts. I was anxious to get on 20 as well as 75/80. The antenna for operation on these bands was cut as shown in Fig. 2A. This setup worked very well on these two bands with inputs up to 500 watts, but usually at low power. Here again repeated tests using the system against ground showed that the folded dipole was superior in every respect.

On this particular antenna there are three half-waves on 20 and one on 75 and it loads up less efficiently than it would if it had been cut for that 75. These dipoles are really rather broadband antennas.

Both of these two-band folded antennas have been given a good workout in the open and tests indicate that they may be good antennas for emergency or portable use where more than one-band operation is a desirable feature.

An antenna which will give satisfactory results in restricted space is shown in Fig. 4. The coil at the center of the antenna should resonate with the condenser used at a somewhat higher frequency than the operating frequency. Either direct coupling by means of variable taps or link coupling may be used.

Fig. 4. Center-fed capacity and inductively loaded low frequency antenna for use in operating on the 75 meter phone band.
The coils at the end of the antenna, together with the "capacity-hats," serve to add to the electrical length of the antenna. In one experimental setup the "capacity hats" consisted of the window screens at opposite ends of the room.

No exact dimensions can be given for an antenna of this type due to the many variables. With the dimensions shown it is possible to obtain satisfactory performance on the 75 meter band. In one exceptional case, an 18-foot length of wire was loaded to 105 kc. with good results.

Of course, one of the ever-present threats to operation with a folded dipole is the possibility that it may come down during really rugged weather. The 300 ohm line is light in copper and insulation and unless one secures a factory-molded job it is not easy to make a good electrical and mechanical connection capable of taking the strain and bending to which these antennas are subjected.

The first try at licking this particular problem involved the construction of a light ½" bakelite "sandwich" which was made by bolting the center splice as shown in Fig. 5. This unit, as suggested by W1DBM, proved to be larger than the hand-milled version shown in Fig. 6. Hams who have access to a machine shop have a decided advantage in making this unit although the job can be done reasonably well with a hand grinder. Use ½" phenolic stock for each piece. The squeeze, which can be further regulated by the use of friction tape if required, should be sufficient to hold the ribbon securely without having to depend on the light copper wire as a supporting member.

For terminal pieces with the ribbon

Have "deals and whispers" on tower prices got him so confused he's decided to solve it all by jumping off one of the d----d things? No--this is just our screwy way of illustrating the fact of the matter: To get to the bottom of the tower price situation, you have to go to the maker of the top tower... the Penn Teletower.

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Penn Teletowers

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Lancaster, Pa.

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Lancaster, Pa.
Fig. 7. One of each of these pieces is required in order to clamp ends of 300 ohm twin-lead. To be made from 1/16" brass, 6/32 brass bolts and washers are employed.

folded dipole, a pair of brass pieces about 3" long were cut and drilled as shown in Fig. 7A. One of the 6/32 brass bolts goes through the webbing and pinches the whole ribbon while the second bolt is around a soldered loop in the line and is equipped with the necessary washers to hold it firmly. The outboard bolt holds the 14 gauge antenna trim section of the folded dipole. A further improvement was made at a later date by bending one of the larger side pieces in order to center the ribbon positively in position, as shown in Fig. 7B.

In about two years of weathering the antenna the author built didn't break once.

NEW SOUND TAPE TESTING SERVICE

The Minnesota Mining and Manufacturing Co. of St. Paul, Minnesota, maker of the “Scotch” brand recording tape, has recently set up laboratory equipment that can test the performance characteristics of sound recording tape, recorders, and playback units in a matter of minutes. This new equipment and the staff to operate it is being supplied by the company as a service to the industry.

The three racks of laboratory equipment, plus recorders and speakers, permit measuring such performance characteristics as output at any frequency, uniformity of output at any frequency, signal-to-noise ratios, dynamic range, wow, flutter, intermodulation, and modulation noise.

Included in the equipment are an AM-FM tuner, oscilloscope, wow meter, Ballantine voltmeters, dual-channel oscillograph with associated d.c. amplifiers, two high-fidelity audio amplifiers, two professional-type recorders that operate at any speed from 33 1/3 to 15 inches-per-second, and a sonic analyzer for measuring distortion and frequency response and for showing noise spectra.

A special bias circuit was built into the recorders to permit introducing wide variations in bias.

Over-all view of the new sound tape testing laboratory set up by Minnesota Mining.
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<table>
<thead>
<tr>
<th>Tube</th>
<th>Voltage</th>
<th>Amperage</th>
<th>Price</th>
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<td>6.3V</td>
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<td>6.3V</td>
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January, 1951

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that 'Experience' gains in working on familiar material is lost when an odd-sized nut for which he has no wrench is encountered and he has to stop and make a whole new wrench just for that one job.' 

"You mean that theory is more flexible than experience," Barney said slowly. "Could be, at that. I suppose a lot of the stuff a guy had to learn at the very beginning of television is of no use at all to him now. But where is a man going to get this theory without going back to school?"

Mac waved a hand at the shelves carrying books and magazines at one end of the service shop. "You are practically standing up to your chin in it all of the time," he declared. "Anyone who can read has every opportunity to be right up to the minute on every aspect of radio and television these days. The first thing to do, of course, is to study a good book on television fundamentals."

"After you have all of that stored under your curvy red thatch, all you have to do is supplement it by doing a lot of current reading. The radio magazines are doing a wonderful and sometimes unappreciated—job of keeping their readers right up to the second on every new development in TV theory, design, application, and service. Those magazine editors must almost steal some of the new ideas right off the drawing boards of the engineers, for you invariably read about a new development many months before you have a chance to encounter it in actual service work."

"But I read the magazine," Barney said. "Is it if I feel so much like doing television?"

"Mostly because you skip entirely or at least barely skim over any article that is not concerned with something you think you may need tomorrow and sometimes glue only at the latest. For example, if you see an article entitled 'Improvements in A.G.C. Systems,' that looks rather weighty and has some complicated-looking diagrams, you turn past it hastily to read an article on 'How I Use Old Discarded Razor Blades to Solve Intermittents.' You shyer away from any information unless you think you can put it to practical use right away."

"I plead guilty, Your Honor," Barney said with a grin, "but I promise to do better—not because of any of your preaching, mind you, but because of some thinking I was doing on my own while you were talking."

"As I see it, a knowledge of theory is something that is not very much used when I am doing practical work."

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TELEVISION EQUIPMENT
Polared Electronics Corporation of 100 Metropolitan Avenue, Brooklyn 11, New York, has recently issued a comprehensive catalogue covering its line of television equipment for broadcast, manufacturing, and laboratory use.

The new 14-page publication fully describes the company's television cameras, synchronizing generators, monitors, TV amplifiers, and TV power supplies designed for broadcast operation. The equipment described is adaptable to either 525 or 625 line standards.

Of particular interest to management personnel of television stations is the complete line of portable monitoring equipment included.

Copies of the new catalogue may be secured without charge by writing direct to the company.

CONDENSER CATALOGUE
Astron Corporation of 255 Grant Avenue, East Newark, New Jersey, has recently issued a new 12-page catalogue covering its line of condensers for radio, television, and electronic applications.

Designated the Catalogue AC-2, the new publication covers dry electrolytics, molded paper tubulars, oil paper condensers, and the company's new "Metalite" units which are self-healing, subminiature, and fabricated of metallized paper.

In addition to the condenser listings, the new catalogue includes complete descriptive material on standard r.f. filters, as well as units for aircraft and heavy duty applications.

Copies of the new catalogue may be secured without charge by writing direct to the company.

ALLIED'S 1951 CATALOGUE

Designated Catalogue No. 124, the new publication contains a comprehensive listing of radio, television, and electronic parts; test equipment, public address systems, television and radio sets and accessories, TV components, recording equipment and accessories, new 3-speed record players and changers, high-fidelity amplifiers, speakers, tuners and other components for custom installations, as well as complete high-fidelity phon-o-radio systems, antenna systems, kits and supplies, tools and hardware, books, manuals, and diagrams.

The new catalogue will be sent free to those requesting it from the company.

HIGH SPEED RELAYS
A data sheet covering the company's ultra-high speed relays is now available from Stevens-Arnold Inc., 22 Elkins Street, South Boston, Massachusetts.

Catalogue 105b describes the new units in some detail as to contacts, life expectancy, load, contact rating, mounting, operating speed, and coil specifications.

Copies of this catalogue sheet are available without charge from the company.

ERmetic TERMINALS
To assist those persons concerned with the design and specification of hermetic terminals for electrical and electronic products, the T. C. Whitmore Co. has recently published a 12-page catalogue containing much essential engineering data on the subject.

Designed for practical use, this two-color catalogue contains complete data on glass-to-metal, "Alumina" lead-thru, multiple refrigerator types, as well as other units in the company's line. In addition there is a special section devoted to metalized glass seals and electronic insulators. Another section containing helpful engineering information relating to terminal selection and use.

Copies of the catalogue may be secured without charge. Address all requests to the company at Millville, New Jersey.

PORTABLE AUDIO EQUIPMENT
A complete new catalogue covering portable sound equipment for schools, churches, clubs, recreational activities, etc., has just been issued by Newcomb Audio Products Co. of 6824 Lexington Ave., Hollywood 38, California.

The publication lists a wide selection of combination transcription players and public address systems with both two- and three-speed turntables. Two recently-developed portable phonograph units are also described.

All of the models are illustrated and full specifications are given on all of the units. All of the products listed carry the Underwriters' Laboratories approval.

Copies of the new catalogue are available from the company.

ANTENNA GAIN CHART
Technical Appliance Corporation of Sherburne, New York is making its new Engineering Bulletin No. 64 available without charge from Stevens-Arnold Inc., 22 Elkins Street, South Boston, Massachusetts.
January, 1951

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World's Best Indoor TV Antenna
A beautiful antenna which is the ultimate in reception, without gain, nothing to adjust.
List price $9.95 Each $4.78

TV Antennas:
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450 Volts Working
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available to television technicians and others interested in antenna measurements.

This new publication contains actual measurements in db gain over half-wave dipoles for all popular antenna types. The information contained in the bulletin is based on actual laboratory and field tests conducted by the company. The booklet is designed to assist service technicians in selecting the proper antenna for a given television installation.

Any television technician can secure a copy of this bulletin by writing the company direct or by contacting his "Taco" jobber.

REPLACEMENT DATA
Additional data sheets covering TV control and resistor replacements have just been released by Clarostat Mfg. Co., Inc. of Dover, New Hampshire.

Following up on the first release covering RCA chassis types, the latest sheets deal with additional RCA modules and with Du Mont, Stromberg-Carlson, Crosley, and Emerson models. Handy reference charts indicate module and chassis, stock and part numbers, Clarostat catalogue number, list price, function, and description. Any standard TV control or resistor replacement can be quickly identified in these data sheets, and ordered by corresponding catalogue numbers.

These 8½ x 11 sheets with standard binder punchings may be obtained directly from the company or through Clarostat distributors without obligation.

TV FIELD EQUIPMENT
A 6-page illustrated folder which covers the company's latest field television equipment has just been released by the Engineering Products Department of Radio Corporation of America.

Listed are an improved friction head, a new tripod, a new field desk, and a rotatable mount, and remote control for microwave parabola.

Distribution of the brochure (Form 23-8881) entitled "New TV Field Equipment" is limited to broadcasters. Copies may be obtained from any of the RCA district sales offices or by writing to Department No. 522, RCA Engineering Products, Camden 2, N. J.

TV-AM-FM COILS
Stanwayeck Winding Co. of Newburgh, New York has just issued a comprehensive catalogue covering its line of TV-AM-FM coils.

Included in the new 24-page catalogue are adapter plates, antenna coils, broadcast antenna coils, cartwheel i.f. coils, chokes, traps, FM coils, horizontal output transformers, horizontal linearity controls, i.f. transformers, long-wave antenna coils, long-wave oscillator coils, long-wave r.f. coils, loop antennas, marine antenna coils, microphone transformers, oscillator coils, peaking coils, permeability-tuned units, r.f. chokes, r.f. coils, ratio detector coils, regenerative i.f. transformers, sound discriminators, syncro-
lok coils, syncro-guide coils, TV coils, wavetraps, and width controls.

Complete specifications are given on all of these units in addition to five pages of pertinent circuit diagrams.

**SPEAKER BAFFLES**

Acovat-Craft, 48 East San Jose Avenue, Burbank, California is currently offering copies of a six-page folder covering its line of speaker baffles.

The company's line includes 506 styles, colors, and sizes of baffles and range from wall speaker baffle units, bass reflex cabinets, corner speaker units, flush mount grilles, to reducing speaker baffles.

Available colors include walnut, black, ivory enamel, mahogany, and maple in wood cabinets; ivory, brown, red, and grey leatherboard, and a variety of colors in wood and leatherboard combinations.

Full details on all of these units are included in the new folder. Write the company direct for your copy.

**RCA TUBE MANUAL**

A new edition of the "RCA Receiving Tube Manual" has been announced by the Tube Department of Radio Corporation of America, Camden, New Jersey.

This well-known publication, long used by radio and television technicians, electronics engineers, schools, laboratories, hams, and experimenters, incorporates many new features reflecting new developments in electronics.

Designated RC-16, the new manual has been completely revised, expanded, and brought up-to-date. Containing over 300 pages, it is 25 per-cent larger than the previous (RC-15) edition.

The same complete coverage of technical data which characterized previous editions, ranging from elementary theory to descriptions of latest receiving tube applications, has been continued and enlarged in the new RC-16. In addition, the new manual, which now has a new "pie-flat" binding for ease of use, contains many new features. Detailed technical information is provided on more than 460 RCA receiving tubes and kinescopes including many discontinued types. The section on tube and circuit theory has been expanded and includes formulas and examples for calculation of power output, load resistance, and distortion for several classes of amplifier service as well as cathode follower design information. Television coverage includes kinescope installation data and handling information.

The manual is 50 cents and is available from RCA tube and parts distributors.

**SERVICE WALL CHART**

Of interest to radio and television technicians is the new and completely revised edition of the "Tell-U-How" wall chart which has just been issued by Sprague Products Company of North Adams, Massachusetts.
2 latest TECH-MASTER Developments!

NEW "Universal" AC/DC Kit for Tubes Up to 14" Rect.

The first low cost TV Receiver Kit designed for Universal AC-DC operation. Can be assembled in approximately 6 hours with easy-to-folow wiring instructions. Pre-wired aligned 1-F "Synchro-Strip" makes further alignment unnecessary. New unique circuit design features 2-knob control, providing Automatically Synchronized Picture and Sound Tuning, "Beam Power" Audio Output assures excellent tone quality. Small chassis (17"x14"x14") is light in weight (approx. 30 lbs.) and shock-proof, completely "above ground."

NEW! ADVANCED!
Tech-Master 630 Type Kit for All Tubes from 12" Rd. to 20" Rect.

Features Keyed AOC and "Hi-Sweep" Voltage Multiplier system. Indisputably the finest commercial TV circuit in the world. Complete diagram guide each wiring step, making it easy to achieve excellent results. The latest and most advanced TV engineering developments have been added to the time-proven RCA 630 circuits. Two-stage video amplifier, 4 stage picture IF, full 4 mc bandwidth and lowest 12-channel tuning. Tuner gives a sensitivity of less than 20 microvolts. Chassis size 21 1/4" wide by 15 1/2" deep. Approx. Shpg. Wt. 65 lbs.

Write today for facts and prices on this handy Punch.

GREENLEE 

With the GREENLEE No. 731 SQUARE CHASSIS PUNCH

Now, in 1 1/2 minutes or less you can do hole-cutting jobs that might take an hour with old "drilling and filing" methods. Simply insert GREENLEE Punch and turn with an ordinary wrench ... a square or oblong opening is cut immediately. An indispensable, time-saving tool that pays for itself in a hurry.

Write today for facts and prices on this handy Punch.

GREENLEE Tool Co., 1881 Columbia Ave., Rockford, 111.

Lithographed in color, the 22 x 28 inch chart includes valuable service application data on condensers as well as descriptions of common circuit troubles and their remedies, complete color codes for all types of condensers, transformer color codes, resistor color codes, electrical formulas, and other useful and related service information.

The new chart is free of charge if secured from Sprague distributors. Orders by mail addressed to the company in North Adams, Massachusetts carry a ten cent postage and handling charge.

REPLACEMENT MANUAL


Designed specifically for the television technician, the new manual (Form M-461) lists all original equipment parts by their manufacturers' part numbers and shows the recommended replacements which are regularly available from television parts distributors.

STRIP THERMOSTATS

Stevens Manufacturing Company, Inc. of Mansfield, Ohio is currently offering copies of a new bulletin which describes in detail the company's Type S bi-metal strip thermostats. These units have been designed for use in appliances and industrial apparatus and schematic diagrams showing operating principles and dimensions have been included in the bulletin. Also given are photographs of the 13 standard Type S models and typical thermostat response curves.

A copy of this data sheet is available on request.

GEIGER COUNTERS

The New York University College of Engineering is currently offering a four-page booklet to those interested in various phases of Geiger counter circuitry and operation.

Entitled "Counters," the booklet has been prepared by Dr. Serge A. Korff, a well-known authority on Geiger counters. The folder is illustrated with a dozen drawings and the text explains the elements of a Geiger counter as well as the behavior of electrons, positive ions, ion clouds, and impulses.

Another section of the folder deals with penetrating, non-penetrating, and decaying cosmic ray particles.

The author concludes with a discussion of the use of Geiger counters for oil prospecting, thickness gauges, monitoring of x-ray machines, radioactive wastes, and in locating lost items of radium.

The booklets are ten cents each and may be secured from V. W. Palen, Bureau of Public Information, New York University College of Engineering, New York 53, N. Y.
### RADIO EQUIPMENT RC 100 B

**This equipment made by General Electric, was designed for general use as an identification of friendly aircraft**.

<table>
<thead>
<tr>
<th>CABINET CH-118 is of the Standard 19 inch rack type structural steel frame with 100 cycles with the use of the two 125 tubes. Also safety interlocks forms the rear of the cabinet.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TRANSMITTER BC-769 is designed to transmit RF pulsed signals at 470 megacycles per second with resonant grid, plate and filament lines... less tubes.</strong></td>
</tr>
<tr>
<td><strong>KEYING UNIT BC-767 furnishes the pulse of the desired frequency for 470 mc.</strong></td>
</tr>
<tr>
<td><strong>RECEIVER BC-768 was used to detect the 493.5 megacycle reply pulse from the interrogated station and sufficiently amplified these signals for oscilloscope observation... less tubes.</strong></td>
</tr>
<tr>
<td><strong>RECTIFIER RA-52 produces the high voltage. As O-18 kilowatt DC Meter is connected to the box output of the receiver, it furnishes the average current drawn through the box.</strong></td>
</tr>
<tr>
<td><strong>AIR COMPRESSOR M-248 together with 2 head of 1/4 inch soft copper tubing and necessary hardware is used in filling and maintaining transmission lines...3.95ea.</strong></td>
</tr>
<tr>
<td><strong>O.F. Transmitter BC-799 is designed for testing Radar set AN/CPA5, it contains 17 receivers-two transmitters—relay unit—control units—power supply, which requires a 110 to 120 Volt, 50 to 60 cycle source.</strong></td>
</tr>
<tr>
<td><strong>TECHNICAL MANUAL TM1-1113B covering complete unit is available at an amazing low price. WRITE TODAY!</strong></td>
</tr>
</tbody>
</table>

### HEADSET-MIKES

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS-30 Hi Imp. Headset</td>
<td>New $1.50 Used $0.79</td>
</tr>
<tr>
<td>T-34 Hi Imp. Headset</td>
<td>New $1.75 Used $0.98</td>
</tr>
<tr>
<td>T-30 Throat Mike</td>
<td>New $0.80 Used $0.49</td>
</tr>
</tbody>
</table>

### MICROPHONE AND HEADGEAR

This RCA unit consists of Dynamic microphone, push button crystal. CRT gate oscillator, CRT gate gate oscillator, CRT gate plate and filament linesless tubes used to supply many voltages for APS 3 equipment. New $1.24 Used $0.61

### BATTERY CHARGERS AND POWER SUPPLIES

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC-771 Seven Stage Receiver Transmitter</td>
<td>New $1.25 Used $0.61</td>
</tr>
<tr>
<td>BC-788 Seventeen Stage Receiver Transmitter</td>
<td>New $2.95 Used $1.95</td>
</tr>
<tr>
<td>BC-799 Battery operated lightweight interphone</td>
<td>New $1.50 Used $0.98</td>
</tr>
</tbody>
</table>

### COMPLETE UNITS are available at amazing low price... WRITE TODAY!

### SURPRISE PACKAGE

20 lbs. Ass't radio parts. A $25.00 value for only $1.95

### MONOCHROME SPECIAL

MN 26 Y Compass Receiver, twelve stage superhet covering frequencies of 150 to 325 KC. 325 to 625 KC and 340 to 7000 KC in three bands...

### MONETARY SPECIAL

1. **100 MC** Scope unit complete with SCP1 cathode ray tube and shield and all parts except smaller tubes and crystal. Used $2.95 ea.

### CONDENSERS

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mil, 6000 VDC, OIL FILLED</td>
<td>.002550 6.000 VDC, OIL FILLED... $2.95</td>
</tr>
<tr>
<td>1 mil, 6000 VDC, OIL FILLED</td>
<td>.002550 6000 VDC, OIL FILLED... $2.95</td>
</tr>
<tr>
<td>5 mil, 6000 VDC, OIL FILLED</td>
<td>.002550 6000 VDC, OIL FILLED... $2.95</td>
</tr>
</tbody>
</table>

### BCP-604 Transmitter FM

20-28 MC

11 and 15 meters. Can be operated on 10 meters—10 channel push to talk condenser microphone (except huge). With all tubes and masts but does not include a good 110 volt, 60 cycle source. A good buy but loss supplier...

### FLAP FESTOCH

24 VDC, will operate on AC 3300 or 11,000 VPE. Complete set. A good buy but...
THE AD-VISER

DISPLAYING YOUR MERCHANDISE

By IRVING SETTEL

SOME years ago, a radio and television store used a full page advertisement in a local newspaper in an attempt to sell overstocked radios. The advertisement was composed exclusively of copy. No illustration was used. However, the story was readable and offered some very interesting price inducements. The promotion "pulled" but far from anticipated volume. Sorely distressed by the results, the retailer confronted the local newspaper advertising manager. Together, they decided to rerun the advertisement but this time to include a picture of the radios on sale. The results were amazing! The same advertisement with the same headline and copy in the same newspaper "pulled" so well that much of the stock was sold out in a short time.

What was the reason for this great difference in results? Did the picture of the radios make so great a difference? Although there is no way to arrive at a positive answer, it can be assumed that the simple illustrations actually made the difference between success and failure. The radios displayed in the ad attracted the readers' attention to the story of the sale. Once the story had been understood, a potential customer was born.

The importance of illustrations in advertisements has long been recognized by outstanding merchants. Yet there are still a few who make the serious mistake of completely eliminating pictures. The major offenses are committed by retailers who make a poor choice of subject matter and method of presentation. Your advertisement should be considered your "impersonal window or display case." It is advisable to show the same items which are currently being displayed in your windows or store. If possible, avoid using stock photographs and drawings unless they actually represent items within your store. Lay out the merchandise in your advertisement as interestingly as possible. Use short descriptive copy close by. Wherever you can, use prices. They are always appreciated by present day economy-minded readers.

One problem which often presents itself to the advertiser is the selection of the kind of illustration to use. Among the many types available to you both original and from mat services, are the following:

1. Wash Drawings
2. Pen and Ink Drawings
3. Dry Brush Drawings
4. Photographs

The advertiser is often confronted with the choice of one of the above four. The selection should depend upon the effect desired. Each medium serves its own purpose well.

WASH DRAWINGS are used to portray a subtle gradation of tone. It is a drawing made with black or grey water color, applied with a brush. By varying the amount of lampblack and water, gradations from light to dark grey and solid black may be obtained.

Wash drawings are used in illustrations to portray leather, metal, and other reflecting surfaces for items of all sorts. In many cases, wash is more satisfactory than photographs because the artist can glorify the subject by adding or subtracting certain factors. Wash is excellent for all types of radios. However, there is an added expense since it is necessary to make a half tone engraving to capture the tones.

PEN AND INK DRAWINGS are well adapted to illustrations requiring strong contrasts and sharp outlines. No variation in tone is possible with this technique. Pen and ink is used in drawing many types of radios and television sets. It is excellent for fine details and delicate lines. Because there is no gradation of tone in line drawings, half tone engravings are not necessary and savings will result.

DRY BRUSH DRAWINGS are similar in production to pen and ink. No half tones are necessary. Ink, on a partly dried brush, is used to produce a "tonal" effect. Most subjects look good in dry brush and while production is inexpensive, the art work may cost a little more.

PHOTOGRAPHS are best when an impression of realism is required. Faithful portrayal of all merchandise is possible here. Many people believe that photographs are necessarily factual. We know that this may not be true. Modern photographers can perform miracles with their cameras. In addition to realism, a photograph is an excellent medium to use when it is necessary to illustrate a multitude of items. There may be so many that it becomes too expensive and impractical to draw by hand. If, for example, you wanted to show a vast stock of radios
Selenium Rectifiers

Full Wave Bridge Type

<table>
<thead>
<tr>
<th>Input</th>
<th>Type No.</th>
<th>Current</th>
<th>@ 60 Vac DC</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-40v</td>
<td>49105</td>
<td>@ 1 Amp</td>
<td>$2.65</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49106</td>
<td>@ 2 Amp</td>
<td>$3.25</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49107</td>
<td>@ 3 Amp</td>
<td>$3.65</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49108</td>
<td>@ 4 Amp</td>
<td>$4.25</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49109</td>
<td>@ 5 Amp</td>
<td>$4.65</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49110</td>
<td>@ 6 Amp</td>
<td>$5.25</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49111</td>
<td>@ 7 Amp</td>
<td>$5.65</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49112</td>
<td>@ 8 Amp</td>
<td>$6.25</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49113</td>
<td>@ 9 Amp</td>
<td>$6.65</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49114</td>
<td>@ 10 Amp</td>
<td>$7.25</td>
<td></td>
</tr>
</tbody>
</table>

Carter Tapped Rectifiers

Single Phase Full Wave Bridge

<table>
<thead>
<tr>
<th>Input</th>
<th>Type No.</th>
<th>Current</th>
<th>@ 60 Vac DC</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-40v</td>
<td>49151</td>
<td>@ 1 Amp</td>
<td>$2.95</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49152</td>
<td>@ 2 Amp</td>
<td>$3.55</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49153</td>
<td>@ 3 Amp</td>
<td>$3.95</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49154</td>
<td>@ 4 Amp</td>
<td>$4.55</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49155</td>
<td>@ 5 Amp</td>
<td>$5.15</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49156</td>
<td>@ 6 Amp</td>
<td>$5.75</td>
<td></td>
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<tr>
<td>0-40v</td>
<td>49157</td>
<td>@ 7 Amp</td>
<td>$6.35</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49158</td>
<td>@ 8 Amp</td>
<td>$6.95</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49159</td>
<td>@ 9 Amp</td>
<td>$7.55</td>
<td></td>
</tr>
<tr>
<td>0-40v</td>
<td>49160</td>
<td>@ 10 Amp</td>
<td>$8.15</td>
<td></td>
</tr>
</tbody>
</table>

Transformers—115v 60 Cy

High-Temp Insulation

<table>
<thead>
<tr>
<th>Voltage</th>
<th>MA</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2700v</td>
<td>0.3</td>
<td>$4.45</td>
</tr>
<tr>
<td>1800v</td>
<td>0.4</td>
<td>$4.45</td>
</tr>
<tr>
<td>1200v</td>
<td>0.6</td>
<td>$4.45</td>
</tr>
<tr>
<td>900v</td>
<td>0.9</td>
<td>$4.45</td>
</tr>
<tr>
<td>600v</td>
<td>1.2</td>
<td>$4.45</td>
</tr>
<tr>
<td>400v</td>
<td>1.5</td>
<td>$4.45</td>
</tr>
<tr>
<td>250v</td>
<td>1.8</td>
<td>$4.45</td>
</tr>
<tr>
<td>150v</td>
<td>2.2</td>
<td>$4.45</td>
</tr>
</tbody>
</table>

Transformers—220v 60 Cy

<table>
<thead>
<tr>
<th>Voltage</th>
<th>MA</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-115</td>
<td>0.5</td>
<td>$3.25</td>
</tr>
<tr>
<td>150-300</td>
<td>0.75</td>
<td>$3.75</td>
</tr>
<tr>
<td>300-450</td>
<td>1.0</td>
<td>$4.25</td>
</tr>
<tr>
<td>450-600</td>
<td>1.3</td>
<td>$4.75</td>
</tr>
<tr>
<td>600-750</td>
<td>1.6</td>
<td>$5.25</td>
</tr>
<tr>
<td>750-900</td>
<td>1.9</td>
<td>$5.75</td>
</tr>
<tr>
<td>900-1050</td>
<td>2.2</td>
<td>$6.25</td>
</tr>
<tr>
<td>1050-1200</td>
<td>2.5</td>
<td>$6.75</td>
</tr>
</tbody>
</table>

Due to current national emergency and the critical receiving tubes shortage, tubes of the above quantities are not available. We urge all amateurs to be thrifty, and make do with the tubes we have on hand. Any quantity for the above transformers may be had for a small surcharge. Please specify your requirements.

Radio Shack Inc.

189 Greenwich Street, New York, N.Y.

January, 1951

Phone Digby 9-0347

Write for quantity prices.

Note: All prices are subject to change without notice.

F.O.B. NYC, minimum order $20.00. 30% or more, cash returns. All merchandise guaranteed.
HENRY HAS THE NEW
hallicrafters
MODEL SX-71 NOW!

This new type of receiver—the first of its kind on the market—has extra sensitivity, selectivity, and definitely superior image rejection. Continuous AM reception from 538 kc to 35 Mc, and 46 to 56 Mc. One RF, 2 conversion, and 3 IF stages. 103-125 volts AC. 11 tubes plus voltage regulator and rectifier. Only $199.50. (R-46 matching speaker only $19.95)

LOW-COST HALICRAFTERS MODEL S-77
Temperature compensated oscillator; tuned r-f stage, two i-f stages for better selectivity. Covers 540 kc to 43 Mc in four bands. Sensitivity, volume, three-position Tone, BFO Pitch, controls; AVC, BFO, Rec/Standby, and Noise Limiter switches. Built-in PM speaker. Gray steel cabinet, 18 1/2" wide, 9" high, 9 1/2" deep. Piano hinge top. External power, remote control connections. 7 tubes plus rect. This is AC/DC version of popular S-40B. For 115 V. AC/DC $99.95.

I have a complete stock of Hallicrafters receivers and transmitters. I'll make you the best deal on a trade-in for your communications receiver. I give you prompt delivery, and 90-day FREE service. Nobody can beat Bob Henry on a trade-in, and I offer you the world's lowest credit terms. Write, wire, phone, or visit either store today for the best deal. Export orders solicited.

HENRY RADIO STORES
100 Oxnard St. Los Angeles 15, Calif.
"WORLD'S LARGEST DISTRIBUTORS OF SHORT WAVE RECEIVERS"

TWIN LEAD, TELEVISION LIGHTNING ARRESTER
No. AT102

U.S. Patent No. D-4864

UL

completely waterproof

APPROVED for OUTDOOR-INDOOR Use $2.25

Protects Television Sets Against Lightning and Static Charges

JFD SAFE TV GUARD

Simple to install everywhere and anywhere...no stripping, cutting or spreading of wires. More than 300,000 in use today!

SEE YOUR JOBBER OR WRITE TO

JFD MANUFACTURING CO., Inc.
827 16th Avenue, Brooklyn 4, N.Y.
First In Television Antennas & Accessories

and television sets, it would be more practical to use photographs.

Photos usually end up a little more expensive than art work. They almost always require retouching and half-tone screens are necessary for reproduction.

The use of stock photographs or mats are all right when you can match them up with your own merchandise. Do not illustrate items in your advertisements which you cannot supply to the public upon request. Stock illustration books or mat services may or may not carry your items. If they do, you will save the cost of an artist or photographer.

If it is necessary for you to hire an artist, you can keep your costs down to a minimum by employing some of the following suggestions:

1. Remember that artists differ in techniques and abilities as well as in their prices. Always choose a specialist in a particular field. It may cost a little more at the time but will save you money in the long run.

2. Always give an artist complete instructions to avoid mistakes and "redo's." Always demand first to see a rough so that you can see what you are getting.

3. Try to anticipate your art work requirements in advance. In this way, it will be possible to order art work in quantity and thereby afford a saving. Artists will always charge less for quantity work.

4. Always ask the engraver for the original art work. You may have some use for this in the future and you can use the same work over and over again. This holds true for engravings. Do not hesitate to re-use an old photo or drawing if you have the item in stock. If you change layout and copy, it will appear completely new to the average reader.

Remember that the main function of illustrations is to attract attention through interest, novelty, and contrast. Hundreds of years ago, the Chinese discovered that "one picture is worth a thousand words." This proverb is truer than ever today.
**Technical BOOKS**


This little handbook, written by two of the faculty members of the Boston University Division of Radio and Speech, is a practical approach to a problem in professional training that has received very little formal attention from educators and station management.

Since most of the big-name announcers started in a small way with local stations the authors have assumed that those who follow in their footsteps will make their radio debuts in a similar manner. Because of this, the text material covers more than just pure announcing techniques. Most small stations utilize their personnel to the fullest extent by having announcers "double in brass" as disc jockeys, time salesmen, public relations men, etc., so some information on these varied activities is also included.

The book contains a large number of drills and exercises for the tyro announcer, including lists of difficult proper names and unusual words for pronunciation practice.

All-in-all, the prospective announcer as well as those just "trying their wings" should find a lot of down-to-earth advice in this handbook which will be of immediate and practical use.


While this is a specialized text on a highly specialized subject such a book has long been needed to help round out the technical literature available on batteries.

Written by the Chief of the National Bureau of Standards' Division of Electricity, this authoritative work traces the development of primary batteries from Volta's early experiments in 1800 to the present state of the art.

After an outline of the history of primary batteries, the author devotes a chapter to the discussion of the elementary theory of electric cells. He next discusses dry cells, materials and production; the operating characteristics of dry cells; the effect of low temperatures on dry cells and low-temperature types; standard cells and standards of e.m.f.; air-depolarized and other batteries; copper and copper oxide cells; silver oxide and chloro-ride batteries; lead cells having soluble reaction products; mercuric oxide and vanadium dry cells; and, finally, fused-electrolyte cells.

This book has a wealth of valuable information written in an easily-understood style. If the tremendous popularity of the author's previous

---

**In TELEVISION 5 RIDER TV MANUALS**

* 10,544 Models
  * Equivalent of 9 1/2 x 11 ins. size

RIDER P.A. MANUAL

* 2,024 Pages
* 1,285 Models

InAM-FM-Auto Radio-Phono 21 RIDER MANUALS

* 31,382 Pages
* 28,341 Models

These comprise the world's greatest compilation of ACCURATE — AUTHENTIC — RELIABLE Servicing Information ... as furnished by the Service Departments of the Manufacturers themselves. And all of it is yours ... at the astonishingly low cost of LESS THAN 1c PER PAGE!

---

**In TV INSTALLATIONS**

STOP wasting time, patience, and money in trying to "dope out" those difficult TV installations!

TV INSTALLATION TECHNIQUES by Samuel L. Marshall

Order this RIDER book, the ONLY text that gives you complete information on all the mechanical and electrical construction details. Know the absolute facts about such things as ice loading, weight, surface, and shipping regulations — whether for short chimney-attached mast or an 80 ft tower, including foundation. HAVE at your fingertips, accurate data on receiver adjustments in the home — municipal regulations governing the installation of TV antennas and masts in all of the major television areas in the U.S. SURE to help you wherever and whenever an installation becomes a problem! A TIMELY and IMPORTANT book!

326 Pages 327 Illustrations 6 1/2 x 11" Size

And only $6.00 10-DAY FREE TRIAL — Make these books PROVE their value! Unless you agree they are the best investment you ever made—return the books in 10 days and pay nothing!
TWO BRILLIANT NEW CUSTOM CHASSIS —

Now, for the first time, you can enjoy the finest television and FM—plus high fidelity audio—all in one superbly-designed instrument! Now, at last, custom builders and electronics enthusiasts can choose the Craftsmen Television which best suits their needs. See them! Hear them! Above all—compare them!

The RC-101

An outstanding new high fidelity custom video tuner with the same fine big-picture quality and sensitivity as its famous predecessor, the RC-100. Features include keyed AGC and booster switch, plus new, double-shadow tuning eye for precision tuning. 20,000-cycle audio output permits use with high fidelity remote boot-up with high fidelity audio and FM-A/M receivers. Turret-type channel selector.

The RC-200

Here, at last, is a TV-FM-high fidelity audio receiver which, in one chassis, combines true high fidelity television and FM reception! Has all features of RC-101, plus 3-watt, push-pull high fidelity audio system and coverage of FM band. Continuous-type tuner and tuning eye permit 1-knob control of TV, FM or phonograph. Both chassis finished in polished chrome.

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SWITCHETTES

STOCK NUMBER MANUFACTURER'S TYPE NUMBER CONTACTS TERMINAL LOCATION UNIT PRICE
303-20 CR1070C103-A3 N.C. Side $0.47
301-29 CR1070C103-B3 N.O. End $0.47
303-34 CR1070C103-C3 1-N.O. 1-N.C. End $0.47
303-19 CR1070C103-E3 N.O. End $0.47
303-43 CR1070C123-B3 1-N.O. 1-N.C. Side $0.47
303-41 CR1070C123-C3 1-N.O. 1-N.C. Side $0.47
305-22 CR1070C123-J4 SPST Side $0.47
303-17 CR1070C124-M4 SPST Side $0.47
303-16 CR1070C128-C3 1-N.O. 1-N.C. Side $0.47

LEAF SPRING SWITCHES

STOCK NUMBER CONTACT ARRANGEMENT SPEC. BACK OF PANEL DIM. PRICE
303-96 HPDT One Side. $1.65
311-58 1A Momentary & 1A. 31/32x13/16 1.25
309-242 2C One Side. 31/32x13/16 1.25
305-183 3A Momentary & 3A Momentary. 31/32x13/16 1.50
319-43 DPDT Center Off. 31/4x21/16 0.85
319-44 HPDT Center Off. Mosman. 31/4x21/16 0.85
319-199 3B. Mosman. 31/4x21/16 0.85
309-128 20. Mosman. 31/4x21/16 0.85
309-165 3A. Mosman. 31/4x21/16 0.85
311-96 4PDT. Baseline Actuator. 31/4x21/16 0.85
319-14A 3A. 31/4x21/16 0.85
319-43A HPDT Center Off. Mosman. 31/4x21/16 0.85
305-165 3A & 3A. Switchboard Type. 4x13/16x16 0.95

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January, 1951

117
ARC-S or 274-N TRANSMISSIONS COMPLETE 5-10 mce. Used, excel. cond. $12.95 3-4 mce. Used, excel. cond. 10.95 4-5 mce. Used, excel. cond. 10.95 5-7 mce. Used, excel. cond. 10.95

ARC-S or 274-N RECEIVERS 1-3 mce. For ship use, Excel cond. $14.50 3-5 mce. Excel cond. 13.95 6-8 mce. Good cond. 10.95 10-15 mce. Excel cond. 21.95 Command Receiver, flex cable 6'. $5 Command Receiver, permanent magnet 22.50 Command Knobs for Receiver, Ea. 0.5 MIF/ARC-5 Plate Modulator 7.55 Triple Receiver Control Box 16.50

274N ANTENNA RELAY BOX Contains 95 ohm, 24 volt, 500 watts. 2.25 SIGNAL LAMP Plastic grip, 13 V. 6.0 amp. Use it on your car or in your home. Fits 400 & 600 volt circuits. Only 29c

METERS! THE BEST BUYS IN THE BOOK! 0-10,000 volt, round, Simpson. $2.45 0-1000 volt, flat, Weston. 3.95 0-1000 volt, round, Weston. 4.95 0-150 volt, round, Simpson. 2.75 0-200 mfd, round, Memmert. 6.95

TUBES! THE BEST BUYS! TUBES! 6L6 1.25 6BL6 1.75 6BPL6 1.75 6BL7 1.75 6BPS7 1.75 6BPS7 1.75 6BV30 1.75 6B189 1.75 6D6 1.75 6D7 1.75 6D8 1.75 6D9 1.75 6D10 1.75 6W6 1.75 6W7 1.75 6W8 1.75 6W9 1.75 6C5 1.75 6C6 1.75 6C7 1.75 6C8 1.75 6C9 1.75 6C10 1.75 6C11 1.75 6C12 1.75

COLUMBIA ELECTRONIC SALES
522 South San Pedro Street
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What's New in Radio
(Continued from page 89)

mounting holes to fit most tone arms. It is furnished with an adapter plate to permit mounting in RCA and similar 45 r.p.m. record changers. Output is listed at approximately 6/10 volt at 1000 cycles on a Columbia No. 103 test record and 1 volt on the RCA 12-5-31-V test record.

OUTLET BOX
Equipment and Service Company of 6015 Oriole Drive, Dallas, Texas is currently marketing a new lightweight outlet box which provides five all-weather outlets from a single inlet. Known as the "Greenbie" Type 6005, the new box is especially designed for AM and FM remote applications, TV remote, and for use in service shops and ham shacks. When used with the company's accessory connector Types 106 and 115 the unit becomes a waterproof, weatherproof, and disconnect-proof power connector. The Type 106 inlet connector is rated for 8000 watts and the outlet connector Type 115 is rated for 1500 watts. An illustrated bulletin covering the new outlet box is available from the company.

SERVICE TOOL
Rosenberg Brothers of 625 West 55th Street, New York, N. Y., has recently introduced a handy service tool which technicians will undoubtedly find of help in their servicing work. The tool is a Rosco "Flash-Driver," a combination screwdriver and flashlight which features an unbreakable plastic handle, complete flashlight assembly including a light directing tube and clear plastic lens, and a magnetized blade to hold screws. A large knurled switch knob on the handle operates the flashlight. The "Flash-Driver" is available in two models, one with a 1/2 x 4" blade and the other with a 3/16 x 4" blade. Information on either unit may be obtained from the manufacturer.

PANEL INSTRUMENTS
The Simpson Electric Company of 5200 W. Kinzie Street, Chicago, Illinois is currently in production on a line of modernistic panel instruments which are available in three different sizes. The new models come in 4 x 3", 3 x 2", and 2 x 1" sizes. The design is identical

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PORTABLE ELECTRIC PLANTS FOR MOBILE RADIO USES
Supply A.C. power for broadcasting or at scene of events. Can be carried by hand or in trunk of car. Weight as little as 40 pounds. A.C. models 350 to 35,000 watts.

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on all three sizes. Model numbers are 1029, 1027, and 1127 respectively.

The large, easy-to-read scale provides good readability under all light conditions. Etched faces extend across the entire fronts of the meters and are protected with unbreakable plastic. Vertical chrome-plated strips are recessed into the plastic fluted cover. The open scale layouts provide space for the use of the customer's name, trademark, or distinctive color combinations.

Full details are available from the company on request.

NEWCOMB PORTABLE
Newcomb Audio Products Company of 6824 Lexington Avenue, Los Angeles 38, California has added an AM receiver to its line of audio equipment.

The Model B-100 is a rugged unit which can be used for schools and other locations where the receiver is subject to abuse. It features a jack for connection of additional amplification to cover larger areas. The jack may also be used for headphones.

A built-in loop makes an external antenna unnecessary in most areas and the 3-gang design eliminates annoying heterodyne squeals and assures adequate selectivity, according to the company.

The set is of all-a.c. construction, has a 6" Alnico V PM speaker, and an amplifier design which utilizes an inverse feedback circuit and beam powered output. The tuning knob avoids the use of strings and may be turned beyond the range of the dial without damage.

The set is housed in a plywood cabinet covered with washable two-tone fabricoid material. A heavy metal grille protects the speaker. The entire unit measures 7½" x 15¼" x 8" and weighs 13½ pounds.

BASE AND SOCKETS
Alden Products Company of 117 North Main St., Brockton 64, Mass. has recently added the Alden "20" non-

**ORTHOGONAL SERIES 32, 33 and 34**

This TORQUE DRIVE vertical-type crystal cartridge is being used more and more in original equipment and for replacement. The 32 series greatly improves 78 rpm reproduction—saves record wear. The 34 series for 33½ and 45 rpm beautifully plays the new wide-range, high fidelity recordings—tracks perfectly at 5 grams pressure. The 33 series handles all three speeds, with remarkable efficiency. All specially moisture protected for extra long life. Has ½" and ¾" hole spacing. Color coded. Simple to install. Replaceable osmium-tip or sapphire-tip needles.

**SERIES 12 and 14**

The Series 12 TORQUE DRIVE crystal cartridge replaces over 150 types in general use for 78 rpm. Saves time and work—speeds servicing. Gives better reproduction and longer record life. Series 14 for 33½ and 45 rpm is performing brilliantly in thousands of record changers. Tracks perfectly at 5 grams pressure. Color coded. Replaceable osmium-tip or sapphire-tip needle.

**SERIES 16 TWILT FOR ALL 3 SPEEDS**

Superbly plays 33½, 45 and 78 rpm records with a single twin-tip replaceable needle without weight change, with tracking pressure of only 6 grams, and does it with TORQUE DRIVE efficiency. You merely tilt the Twilt and select the 1-mil or 3-mil needle tip for fast or slow speed records. Setdown is accurate. Mounts easily in most any standard pickup arm, with nothing more required than reducing needle pressure. Also available without tilting mechanism.

**SERIES 60 REPLACES OVER 20**

New Econo-Cartridge for economical replacement of over 20 conventional Bimorph crystal types. Frequency response to 6000 cps. Output is 3.5 volts with compliant needle, and 4.5-5 volts with straight shank needle. Has exclusive E-V needle stop which prevents chuck from rotating excessively and damaging crystal.

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interchangeable base and sockets to its line of plug-in components.
The new “20” pin base with matching sockets was designed specifically for plug-in unit construction. There is no molded center boss to break and the pins are strong and sturdy. By selecting variations of pin layout of less than 20 pins, critical voltages and frequencies can be isolated and the base can be made non-interchangeable so that it will mate only with the correct socket.

These new units have been suggested for applications in open units, shielded units, relays, filters, or for terminal cards for wiring complete assemblies.

Two types of sockets are currently available, the 400-20 for chassis mounting, and the 400L-20 designed for rack mounting. The first unit takes a minimum of space and can be eyeleted or riveted to the chassis. The rack units mount on “U” channels side-by-side or in series with overlapping ears.

Data sheets giving all pertinent data on these new base and sockets are available. Address your requests to Norman Curtis in care of the company.

International Short-Wave
(Continued from page 67)

Brazil—ZYK3, 9.565. Recife, noted 1630 on Sunday with “Brazil Calling” (English); ZYYH, 11.765. Sao Paulo, heard 1945, easily separated from CKRA. (Bromley, Ontario) Radio Record. Sao Paulo, is still using 9.505; noted evenings (EST). (Lane, South Dakota.)


Radio Nacional, Rio de Janeiro, uses a 250 w. transmitter on 6.147 in parallel with CKNC, 11.72; CKLO, 15.32; CKCS, 15.19; CKZ, 11.76; CKLO 9.63; CKOB, 6.09, and CKRZ, 6.06.

CHNX, 6.130. Halifax, Nova Scotia, still closes 2310. (Grove, Ill.) Noted from 0500 weekdays, from 0800 Sundays. (Dary, Kansas) VSEA, 9.54, EDT, Dunmore, noted with news 1500. (Richards, Sask., Canada) VED, 8.265, also Edmonton, heard with music 2240, fair level in Delaware. (Cox.)

Cape Verde Islands—Praia’s CR4-A, approximately 5.900, is good level to 1700 sign-off. (Cox, Delaware, and others.)

Ceylon—Radio Ceylon’s new “commercial service” noted signing on 0245 on 15.12. (Leary, Indiana.) Carries BBC news relay 2100. (Fargo, Ga.) At the time this was compiled, the schedule for the “commercial service” was 1530-2350 and 2330-0130 on 21.620, 2045-0220 on 15.120 and 9.520, and 0630-11.75. BBC programs are relayed by Radio Ceylon at 0325-0900 on 17.730; 0325-1205 on 21.620, and 0910-1205 on 15.120.

Chile—CE1714, 11.74. Santiago, noted 1800-2200. Spanish; occasional after 2110 with music. (Russell, Calif.) CE776, 7.660, Santiago, heard 1817 through QRN. (Bromley, Ontario.)

China—A Chinese-speaking station on 9.73 noted 0541-0600 sign-off; beled Nanking. (Wineh, Calif.)

Radio Peking appears to use 17.6851 and 15.054V for English news 0835; some days the 10.26 outlet carries that program and other days has separate session in Chinese. Cox, Delaware, hears the 10.26 outlet evenings from 1900 or earlier; sign-off varies 1920-1930; all-Chinese.

Colombia—HJCH, 4.895, signs off 2305; HJAG, 4.897, signs off 2303; the 4.797 outlet is HFYY (or 1), “La Voz de Commercio,” RCN, one of the Radio Cadena Nacional stations, location is Armenia, noted signing off 2220. (Stark, Texas.) HJDP, 4.885, Medellin, heard 1905. (Cox, Delaware.)

“Emisoras Unidas.” Barranquilla, is heard in English on 4.797 in Panama on 4.785 at 0600-2300. (World Radio Handbook Bulletin) HKJD, 6.00, heard with native music 23335; HJFA, 4.86, Pereira, heard signing off 2301 after marchanthem. HJCC, 11.68, Bogota, heard
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A. Mahogany table model cabinet. For changer radio combination or straight changer. Beautifully finished, highest quality, heavy gauge wood. Size—17" long by 16 1/2" wide by 10 1/2" deep overall. Inside dimensions—15 3/4" long by 15" wide by 10" deep. Includes motor board.

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C. Heavily built—utility case. For phono or transcription player. Built of 3-ply wood. Attractively covered in brown leatherette. Corners reinforced with leather. Heavy hardware used throughout. Can also be used as tool case. Dimensions: 19" by 16 1/2" by 7 1/2".

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Now TV reception without the outdoor antenna. Effective range 20 to 25 miles from station. Excellent reception. Easily installed—takes 5 seconds. Easily orientated. Heavy base—will not tilt. Attractive. Friction clutch-type action on the rods. Complete with lead in... $2.49
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Model RPA—
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150W SOLDERING IRON

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CATHODE RESONATOR
Every ham and experimentor will want one of these great UHF bugs. This Navy test oscillator with its gold-plated cathode resonator contains a 955 oscillator and a 955 modulator. Ranges from 534 to 2350 Mc—covers entire 235-240 Mc band. Heavy aluminum shield provides space-allowing space for batteries. 1/16" aluminum case with handle makes excellent test or test instrument case.

ALL CHANNEL TV ANTENNA
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This Lafayette 10-watt High Fidelity Amplifier has a range of 40 to 12,000 cps and is ideal for use with AM-FM tuners, record players, and recorders. Built-in preamp, separate bass and treble controls; mike, phonograph, or recorder input jack; 6 tubes; 270° dial. 1/2" x 56 Mc; 50 cycles. 4.50

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We will ship any equipment, condition, and lowest price. We will buy new or clean used ARC-1, ARC-3, ARC-5, BC-312, BC-342, Test Instrument Case, 115 volt, 60 cycle, DC. 4.95

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6.190, 2330-1800; Munich, 6.160, 2330-1900; Stuttgart, 6.030, 2300-1900. (Cushen, N. Z.) Hamburg, 7.290, heard 0056 with music, fair to good level. (Cox, Delaware.)

Greece—Radio Athens, 7.300, noted with news 1045-1100, then French. Greek Armed Forces Radio Station, 6.340, Athens, noted with daily broadcast in English 1615-1630; recordings; asks for reports to 3 Zalucosta Street, Athens, Greece. Unknown Greek reported to 1500 near 5.975 or 5.980 may be Radio Epiros, Jannina; another Greek station, believed Radio Macedonia, is heard afternoons to 1600 sign-off on low-frequency side of Alicante (around 7.950). (Pearce, England.) Laissi, 6.754, heard 0025; weak signal in Delaware. (Cox.)

Guatemala—TNGA, Guatemala City, is now using 9.660 in addition to 6.040; English period has been extended to 2200-2230 daily. (Grove, Ill.) Reports are requested to Box 601, Guatemala City, Guatemala; noted signing off with “O, Come All Ye Faithful.” (Lane, South Dakota.) Sent two miniature Guatemalan dolls in native costume in reply to report. (Russell, Calif.)

Haiti—The Magloire Broadcasting Circuit, Port-au-Prince, has programs in French, with English and Spanish announcements, over 4VCM, 6.165, 0600-1000, 1200-1500, 1700-2000. (World Radio Handbook Bulletin.) Has been heard 0430 in English by Balbi, Calif. Measured at 0600 by Oskay, N. J., on 6.187; fine musical program then.

The “wanderer,” 4VRW, more recently on 9.84 again, closes 2200 on Mon.-Sat.: at 1700 Sun. (Grove, Ill.) 4V2S, 5.95, tuned 2130; signed off 2137. (Russell, Calif.)

Honduras—HRN, 5.87, Tegucigalpa, noted with talk in Spanish 2215. (Russell, Calif.)

Hong Kong—ZBW3, 9.525V, noted signing off 0930 with “God Save the King”; relays “Radio Newsreel” from BBC, London, 0900; then has local weather report. (Neeley, Calif.) Noted with news 0515, poor signal, QRM’d. (Balbi, Calif.)

Hungary—Budapest appears to be using 6.248, 9.833, 11.910 to Europe-British Isles as early as 1145 (tune-in) to 1830 closedown; news 1600 and 1810 (a late, unconfirmed, report from abroad says news has been changed from 1600 to 1700—KRB); and 7.2221, 9.833, 11.910 to North America at 1930-2030, 2300-2400, news 1900 and 2300. The 7.2221 outlet is “sandwiched” between Malta, 7.220, and BBC, 7.230. (Grove, Ill., Oskay, N. J., others.)

India—Radio Sweden says Delhi is now radiating to the West Indies 1830-1930 on 9.620, 11.760, 15.160.

VUMX, 4.920, Madras, noted 1030-1045 with news relay from Delhi. (Pearce, England.)

January, 1951
Indo China — Radio France Asie ("The Voice of France in the Far East"), Saigon, noted on 11.78 in French, signing off 0730, fair to good signal. (Neeley, Calif.) 0930.

Large equipment in your own cabinet. Available also with Giant assembled ready-to-use Television receiver and 12' Speaker for $194.50.

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Radio & Television News
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**MINIMUM ORDER $2.00**

**January, 1951**
1100-1700 on 6.020 with 11.895 parallel at 1100-1200, and 7.220 parallel at 1200-1700. However, 6.015 has been widely reported in parallel with 7.220 in the 2300 period, heard in USA.

The 15.125 channel noted 0830-0900 with QRM from Rome's 15.120 outlet; relays "Radio Newsreel" from BBC, London, 0900. (Cox, Delaware.)

Mauritania-Noted 15.000-15.060 on Sunday with all-French program around 1050. (Pearce, England.)

Monaco—Monte Carlo, 9.785 and 6.035, noted 0300 with news in French. (Cox, Delaware.)


The Portuguese program was noted recently 0000 on 9.177. (Santo, Texas.) Lourenco Marques has returned to 15.196V from approximately 15.370, noted 1200 to 1500 sign-off, all-Portuguese; good level. (Grove, Ill.) Noted in Brazil; asks for complete reports on all stations. (Sercens.) Call is CRTC5G. (Peddle, Newfoundland.) Heard in Britain as early as 1215. (Pearce.)

New Caledonia—FK88A, Noumea, measured 6.0346 recently; previous measurement was 6.0384. (Oskay, N. J.)

New Zealand—Radio New Zealand now has a DX program on the first Tuesday of each month; it is called "This Radio Age" and is carried on ZL3, 11.78, and ZL4, 15.28; time of broadcast has not been learned but is presumed to be during the 0200-0530 period.

ZL4, 15.28, is now used parallel ZL3, 11.78, from 0200, replacing ZLS, 9.62; also noted from 2100 onwards. (Balbi, Calif.)

Cushen, N. Z., lists schedule to YNOW, 7.6385, 7.6385, 9.645, 11.785, from 0200, replacing ZL8, 9.62; presumed to be during the 0200-0530 period.

While shopping at a surplus radio supply store recently, I noted a 304TL and exclaimed: "Now isn't that a novel lamp?" She wasn't referring to its characteristic curves, either. Aside from its filament rating of 60 watts, I agreed that, for the price, it was plenty cute. So, with utter disregard for our financial condition, I laid out the best part of 25 cents, and brought home a 304TL.

Considering the filament current requirements, it was quickly decided that the best way to use it was to use a 60 watt bulb. A little more inspiration of this kind led to the design of this unique lamp. After reading Guy Dexter's article, "Putting the 304TL to Work," the 304TL was carefully stored for future use and a 304TH which had previously died from "kilo-wattitis," was withdrawn from the scrap pile.

A 2 x 2 x 4 metal utility box serves as the "chassis." The top cover plate was drilled to take the base pins. The tube is held in place by soldering the pins to the cover plate. To mount the socket, a heat-dissipating plate connector was modified by sawing most of it away, leaving only the small shoulder with the set-screw. This forms a bushing to mount the socket onto the plate connection. The connecting wire was run into the socket by drilling a hole through the side of the cap. The wire was passed through the hole, and along side the tube through a hole in the base cover plate, close to the tube. The line cord enters the base through a hole in the rear. A s. p. s. t. rotary switch, fitted with a National HRS-1 knob, eliminated the need for a switch-type socket. (Using a switch-type socket might put undue strain on the glass during "on-off" operation.) A 60 watt bulb and a shade with a bulb-clamp completed the construction.

Although it is advisable to handle the lamp carefully during construction, it is fairly rugged and will withstand the usual handling with no danger of "letting the vacuum out."

--JL--

Over-all view of the novel "ham shock" lamp built from surplus xmitter tube.

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Motor: 115 Volts D.C. @ 2.3 Ampers, 1/4 HP, 3430 RPM

Generator: 110 Volts A.C., 400 Cycles @ 1 Ampers

Complete with hash-filters, etc.

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These are standard NATIONALLY ADVERTISED BRANDS priced ridiculously low. All are brand new, non-inductive, non-aging wire-wound types, insensitive to wide temperature variations. Sizes not listed below can readily be made up by series, and/or parallel arrangements at a fraction of the cost of precision resistors available elsewhere.

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<thead>
<tr>
<th>Size Range</th>
<th>Ohm Range</th>
<th>Price</th>
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<tbody>
<tr>
<td>100-150 Ohm</td>
<td>1% WW3</td>
<td>$0.15</td>
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<tr>
<td>150-250 Ohm</td>
<td>1% WW4</td>
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<tr>
<td>250-500 Ohm</td>
<td>1% WW5</td>
<td>$0.55</td>
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**Eddyline Electronics Inc.**

154 Greenwich St. New York 6, New York

**Radio & Television News**
1015; on 15.27 at 0110 with news for E. Bengal. (Pearce, England.)

Peru—OAX4Z, 5.898, Lima, noted 2050 with classical music; previous measurement was 5.894. (Oskay, N. J.)

Philippines—DZHE, 6.030, and DZHR, 15.300, Manila, "The Call of the Orient," closedown 1015; frequently asks for reports. (Neeley, Calif.) DZHE is heard in Calif. signing on 1800 to 2000; announces DZHE, 6.03, in parallel; signal fair; mostly religious programs. (Balbi.)

Radio Philippines, 9.500, Manila, noted in England 1040-1100 when has news and signs off 1107 after program preview for next day. (Pearce.)

Poland—Warsaw is reported on a new channel of 7.205 to 1600 closedown. (Radio Australia.) The 9.525 outlet recently was audible around 1920 in Texas. (Stark.)

Portugal—Lisbon, 6.374, is excellent nightly to 2100 closedown. (Leary, Indiana.)

Portuguese Guinea—A World Radio Handbook Bulletin says CQM7, Bissau, is operating over 6.993 daily 1630-1800; power 1 kw. However, Bellington, N. Y., and Oskay, N. J., have heard Bissau recently on approximately 5.839 to 1800 when closes with "A Portuguesa." Was measured by Oskay as 5.8392.

Portuguese India—Radio Goa operates on 9.610 daily except Sunday 2030-1230; Sunday schedule is 2130-1230; English on weekdays is 2030-0430, 0730-0930, and Sundays 2300 (Sat. EST) - 0330, 0530-0730. Reported heard in England on 9.608 to 1215. (Radio Australia.) A new 10 kw. transmitter soon will be put into service. (Radio Sweden.)

Roumania—Bucharest, 9.252, noted afternoons; news 1500; leaves the air 1600. (Maurice, N. Y.) Has improved signal lately. (Cox, Delaware.)

Saudi—Arabia—Jeddah, 11.950, is heard at good strength at 1300, closing time varies 1340-1400. (Radio Sweden.) Still noted in Arabic nightly around 2300-2330 on 11.95, 11.75 (best). (Bellington, N. Y., Stark, Texas.) Heard in Britain on 5.975 in Arabic 1230. (Pearce.)


This list may not be complete as on Sundays most transmissions start 0115 rather than 2345; Saturday closings usually are 1645 rather than 1605.

Southern Rhodesia—Salisbury is now scheduled 0400-0615, 7.280; 1000-1500, 3.320, 6.018, 9.490. (Radio Australia.) (Continued on page 151)
CHAPTER NEWS

Augusta-Camp Gordon

Ralph S. Grist, General Coordinator of Military Services for the Southern Bell Telephone and Telegraph Company, was guest speaker at the chapter's October 19th meeting. He described the many problems incurred in meeting the large scale communication demands made on his company by the armed forces during World War II. The quest to solve these problems led to the establishment of a "Coordinator's" office. Mr. Grist also cited several interesting incidents whereby the services of his office were employed in furnishing communication demands.


The chapter's November meeting was devoted to the subject of photography and its industrial and military applications. Capt. Roger L. Leonard and Lt. William F. Rockar, photographic experts from Camp Gordon, discussed combat photography.

Baltimore

A tour of the Aberdeen Proving Ground featured the Baltimore Chapter's October 25th meeting. Following luncheon in the post cafeteria, Colonel T. K. Vincent, Deputy Commander of the Post, welcomed the group and outlined the routine for the afternoon. Highlights of the tour were visits to the Ordnance Museum, the Ballistic Research Laboratories, and the Supersonic Wind Tunnel.

Boston

Maj. General Francis L. Ankenbrandt, USAF, Director of Communications, United States Air Force, was the principal speaker at the chapter's October 19th meeting at the Boston Naval Shipyards, Charlestown. Special guests of the chapter were members of the Volunteer Air Reserve Service Training Squadron, USAFR, and the Volunteer Electronics Company, 1-3, USNR.

After dinner, the meeting was opened by Chapter President T. F. Halloran, who introduced the two guest units. A round robin of self-introductions was held to introduce members of AFCA. Announcement was made of the appointment of Edward A. Johnson, vice-president of the Barry Corporation, as the new Chairman of the Membership Committee.

Capt. A. R. Taylor, USN, Chairman of the Communications Committee, reported the formation of a subcommittee on Civil Defense Communications with Myron D. Chase, of the New England Tel. & Tel. Co., as chairman. A prospectus outlining preliminary plans for Civil Defense communications with a preamble listing data on trained personnel and facilities available, and offering the talents of AFCA members in the New England area, has been submitted to the Director of Civil Defense, Massachusetts.

Program Chairman Raymond B. Meader, New England Tel. & Tel. Co., introduced General Ankenbrandt who addressed the meeting on "Air Force Communications-Electronics Problems in Korea."

Decatur

The Decatur Chapter met on October 12th at the Decatur Signal Depot. The Board of Directors presented the revised constitution of the chapter to the membership, which was adopted unanimously.

The speaker of the evening was Lt. Colonel Jack N. Nahas, Deputy Commanding Officer of the Decatur Signal Depot. His talk, illustrated with motion pictures, covered the geographical, political, and economical aspects of the Kingdom of Yemen. Colonel Nahas had represented the Army as a member of an eleven man diplomatic mission to this small country of the Arabian League.

New York

A very interesting and colorful demonstration lecture by C. N. Hoyler of RCA Laboratories Division, Princeton, N. J., was the feature attraction of the chapter's October meeting. In his talk on "A Glimpse into a
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containing
The BASIC KNOWLEDGE, TECHNIQUES & DATA of RADIO
TELEVISION
ELECTRONICS
LEARN ... PLAN ... DO ...
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Covers the fundamentals, theory, complete technique and on
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Entire set was written with instruction and reference for all
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ings, and diagrams. You will quickly under-
stand the makeup of the television signal, how the
receiver accepts and passes the signal through, how
the picture is developed, how to operate a television station, how to produce
a show, camera and control room techniques, color
problems, etc. Complete coverage of antenna selec-
tion and installation techniques. How to eliminate
ghosts, interference, and noise. How to build up the
signal in low strength or poor locations, etc. A com-
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alignment instruction, with charts and pictures. Pat-
tern pictures for adjustment, positioning, width and
height controls, focusing problems and many com-
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January, 1951
Research Laboratory." Mr. Hoyler first reviewed the various steps in the development of modern electronic computers. He demonstrated some of their applications by means of laboratory models. Next was shown an improved electronic computer utilizing a crystal controlled oscillator. With this device, it is possible to ascertain electronically the speeds of very fast moving objects such as shells fired from a gun or guided missiles. As a demonstration of this effectiveness, Mr. Hoyler let a small metallic ball roll down an inclined plane between two coils of wire separated about a foot apart. The electronic computer showed on lamps the exact intervals in thousandths of a second required for the ball to travel the distance between the two coils.

The basic elements of color television were shown in another laboratory model by Mr. Hoyler. The fieldsequential method of producing television was first demonstrated by means of a mechanical laboratory model followed by the RCA method. It is believed that all those present learned a great deal about the advantages and disadvantages of color television.

Pittsburgh

Plans for the year, designed to attract additional individual and group members, were made at the Pittsburgh Chapter's October 10th meeting in the Bell Telephone Company auditorium. The program schedule, submitted by Sylvester C. Stoehr, chairman of the arrangement committee, includes the following:
- tour of the Copperweld Steel Company plant at Glassport; address by Colonel Arthur Pulsifer, Chief Signal Officer, Second Army; demonstration-lecture by Dr. J. O. Perrine, assistant vice-president, AT&T Co.;
- discussion of military procurement by a representative of the Department of Defense, Washington; tour of the new RCA plant at Canonsburg.

Donald Phillips of Western Union Telegraph Co. gave a most interesting resume of plans being made by the communications division of the Civilian Defense Organization.

Washington

The first of a series of meetings scheduled by the Washington Chapter took place on October 18th with Major General Spencer B. Akin, Chief Signal Officer of the Army, as the guest speaker. Rear Admiral Stanford C. Hooper, "father" of Navy radio, addressed the chapter at a luncheon meeting on November 16th. The January meeting will feature a discussion of controls, allocations and priorities by H. B. McCoy, Assistant Administrator of the National Production Authority for Industry Operations.

In his address on "Communications in Korea," based on his recent survey at the front and in the area of Signal Corps operations, General Akin emphasized that the imperative need of the Army Signal Corps in combat military communications is to have enough trained specialists who are familiar...
FIVE VITAL QUESTIONS

- What does color television mean to me?
- Am I missing out on any of the newest developments in AM-FM-TV?
- Can I honestly say I am ready to cope with that new amplifier — oscillator — receiver — calibrator — converter — ?
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- What one source may I turn to for authoritative answers to all my electronics questions?

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with the capabilities and limitations of the electronic, radio, and wire communications equipment supplied to the war theater.

With enough trained communication specialists available, the Chief Signal Officer told the group of approximately 250, his observations in Korea showed communications for the Army operations both in the front lines and in the divisional and rear echelons had operated successfully, both in the use of short-range handie-talkies and walkietalkies and the higher-powered SCR-300, 195, and 399 stations, and in the installation of radio relay systems which overcame the transmission obstacles of the mountainous terrain.

"No major changes are indicated in our present long-range Signal Corps research and development program," General Akin stated, bringing out that the Signal Corps equipment had met all tests of combat in Korea. "The new equipments that are now coming out of this program or already rolling off the production lines (to join the new military field wire WD-1 which proved so successful in the Korean fighting) will insure that our troops will continue to have the most modern and effective type of military signal communications that can possibly be devised," he said. Providing enough highly skilled personnel, which had been greatly limited during the previous peacetime "economy" period, "is our big problem," the Chief Signal Officer reiterated, and the training of technical specialists for the Army in the Signal Corps schools is imperative.

The Signal Corps plunged into action immediately upon the outbreak of hostilities in Korea, General Akin related, and shipments over the tremendous 10,000-mile supply route began at once, after he had asked the Far East Command for its supply needs. There was "complete coordination of all communication facilities available to the Army, Navy, and Air Force, the Chief Signal Officer emphasized.

At the luncheon the national directors of the AFCA, who held a special meeting during the day to make plans for the next national convention in Chicago at the Drake Hotel April 19-20, were the guests of honor. Theodore S. Gary, vice-president of Automatic Electric and national AFCA president, was at the head table at the luncheon.

Other head table guests were: Maj. Gen. K. B. Lawton, Deputy Chief Signal Officer; Rear Admiral S. C. Hooper, USN, Ret.; Brig. Gen. Wallace B. Smith, who commands the AACS; Capt. W. D. Ammon, Deputy Chief of Naval Communications; Vice-President and General Manager J. R. C. Crigler of the Chesapeake & Potomac Telephone Co.; Col. W. W. Watts, RCA Engineering Division executive vice-president and AFCA national vice-president; and Col. George Dixon, AFCA executive secretary. Francis Engel, RCA Victor Washington manager and president of the AFCA Washington Chapter, presided at the luncheon.

Other national AFCA directors at the affair included Russell Cunningham, United Air Lines communications superintendent; Rear Admiral Earl E. Stone, of the Joint Chiefs of Staff; William H. Mansfield, secretary of the Southern Bell Telephone & Telegraph Co.; former FCC Commissioner E. K. Jett; David Hull of Raytheon Manufacturing Co.; and General Counsel Frank Wozencraft.

Pretty Shirley Stolper poses with a DuMont television receiver which was the largest set displayed at the 3rd annual Television and Electrical Living Show held recently in Chicago. The screen is 30 inches and the set stands 7 feet high and is 5 feet wide.

RADIO & TELEVISION NEWS
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LINE FILTERS

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Type "A"—Each unit contains two 4 N66, one 84, 80 and 60 oz. aluminum alloy
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non-magnetic steel column, and under
some 50 Amp. choke in fully assembled
condition. Base, metal, column, pole, etc.,
and all parts are firmly secured in place
with tubing and nuts. Complete for $2.00
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Brand new, General Electric BC-375 or
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custom set of spares included as well as 100
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Supreme Instrument Corp. Model 592 Speedester, Not
just 20,000 ohms per volt, but
24,000 ohms per volt
The world's most sensitive voltmeter. The fastest multiplier motor made always
Top in quality, accuracy, compactness,
and speed of operation. Divides
readings at your disposal. Each
item includes two other units.
Two 100 ohm multipliers, a
200 ohm tester, an
$15.00 extra. Double Stack Antenna as shown—
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SCR 274N Command Set
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THE GREATEST RADIO EQUIPMENT
VALUE IN HISTORY

Supreme Instrument Corp. Model 592 SPEEDESTER. Not just 20,000 ohms per volt, but 24,000 ohms per volt
A mountain of valuable equipment that includes:
- Signal Generator, RT-1711 Brand New 12 Tube. 110 Volt Receiver-Generator, Oscilloscope complete with all tubes and power supply (Gvt. APA-1 Radar Set). Scope tube is equipped with a detachable calibrated screen.$39 30
- SENSATIONAL ALL-PURPOSE SENSORS. Brand new Selsyns made by G. E. Company. Two more or less identical units work perfectly on AC or DC voltages. Can be connected directly to any motor and used for indicating direction of weather vanes, rotating directions, turning signals, etc. $10.00
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A fully enclosedfinished metal cabinet. The
speaker and c a s e match communication receivers
and in addition make perfect intercom and sta-
tion. Our price $4.95. With output transformers, our
price $6.95.

"P.M. SPEAKERS" Latest type T.V. Speaker
a fully enclosed finished metal cabinet. The
speaker and case match communication receivers
and in addition make perfect intercom and sta-
tion. Our price $4.95. With output transformers, our
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placed (largest dimension 6 inches). Per-
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For

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For

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(Continued from page 49)

at one end only. Patch cords should be checked as many come from certain manufacturers with "both ends grounded."

Another system, used by CBS and by certain recording studios, is a "single jack" system. Its only difference lies in the mechanical construction of the jacks and plugs, and will not be discussed in this article.

To further illustrate the action of the jacks, we refer you to Fig. 9A. Here the secondary of the transformer is shown in its "normalized" position to the line amplifier. When connected in this fashion, the signal will flow as indicated by the arrows. Fig. 9B is the simplified version of the same circuit, with only one side of the line indicated. This same technique is used throughout the diagram of Fig. 5 to show the jacks and their use in the entire system.

When the double plug is inserted

Fig. 8. Detailed wiring of two pairs of double jacks (in "normalized" position).

from the patch cord the action illustrated in Fig. 9C will take place. Here the switches are lifted from contact with the normal springs and the circuit is broken, as far as the normal springs are concerned. By inserting a double plug the program would continue if one end of the patch cord were inserted into the output jack of the preamp and the other end into the line amplifier input jacks. There are many cases where it is desirable to break the circuit at this point, either for measurements or to introduce the signals from an audio oscillator, etc. Another use is found in the inclusion

Fig. 6. Frequency response curves for the AE-2 equalizer. Dotted curves are obtained when using channels 3 and 4, and the solid curves when using channels 1, 2, and 5.

Fig. 7. The line amplifier. Quality transformers are required for optimum results.

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THAT GOOD LOOKING OLD CONSOLE—
REPLACE THE OBSOLETE RADIO
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ESPEY AM/FM CHASSIS
and your favorite console is “right-up-to-date”

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NEW FEATURES—Improved Frequency modulation circuit, drift compensated • 12 tubes plus rectifier, electronic tuning eye and pre-amplifier pick-up tubes • 4 dual purpose tubes • High quality AM-FM reception • Push-pull beam power audio output 10 watts • Switch for easy changing to crystal or variable reluctance pick-ups • Multi-tap audio output transformer supplying 4—8—500 ohms.

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Write for literature RN for complete specifications on Model 511-B and others.

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No fear of costly “call backs” that eat up a dealer or installer’s profit. In any climate, anywhere... the new WALSCO Signal King antenna provides sharper, clearer response over entire TV spectrum. Rugged aluminum alloy construction for elements, cross-arm and mast. Corrosion resistant. All steel parts are cadmium plated to AN specifications.

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- High gain on all channels—no weak spots. Excellent for fringe areas.
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- Assemble in a jiffy (less than 2 minutes).

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CHALK UP another First for SELETRON! Here is “mite-size” 8J1, keyed to the requirements of modern electronic circuits... A new and smaller 65 mil rectifier with particularly low reverse leakage, built to the following specifications: Input 130 V rms; Max. Peak Inverse Voltage 380 V; Max. D.C. Output Current 65 MA; Plate Size 11/16” square; Stack Thickness 9/16”.

And don’t forget the 20 Mil “Mite”—No. 8Y1, designed especially for power and bias supply in Radio and Television!

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SELETRON DIVISION
RADIO RECEPTOR COMPANY, INC.
January, 1951

V2 Walter L. Schott Co. Beverly Hills, Calif. • Chicago • New York...
INVERTERS
Specially Designed for operating A. C. Radios, Television Sets, Amplifiers, Address Systems, and Radio
For Inverting D. C. to A. C.

Fig. 3. Functional diagrams of the double jack system referred to in the text.

of a loss pad which affords isolation between the preamp and the line amp.
Such a loss pad may be purchased or
home-constructed to provide any fixed loss. It may be connected permanent-
ly in circuit with the normal springs as
shown in Fig. 9D or it may be made up
into a separate unit and patched into
the line at the point shown.

Note that grounds are not shown ex-
cept on the individual pieces of equip-
ment on the diagrams. Each unit is
grounded to the ground bus at only one
point in order to prevent ground loops.
Actually, the grounding system com-
prises a pair of #8 copper wires, se-
curely connected to a cold-water sys-
tem and terminating in a special
terminal block within the racks of the
audio bay. Circuits are usually
grounded in order of their level. For
example, the most direct connection
to the grounding bus to the cold-
water system is from the phono input,
microphone inputs, preamp, line amp,
etc., in that order.

It is of extreme importance in audio
work that a good return-to-ground be
made on all equipment to reduce the
normal residual hum and noise of the
system. Waterpipes which are buried
underground are probably the most ef-
fective for average use.

The physical layout of the jack field
must receive due consideration. Pro-
gram circuits of low level should be
widely separated from those of power
circuits, especially when they carry
signal levels that differ by approxi-
mately 20 db. In the layout shown,
nearly all of the low-level inputs are
located at the left hand side of the Jack
panels, as shown in Fig. 4. All power
level circuits are situated at the ex-
treme right of the jack panels.

Shielded 2-wire cable of low loss is
used to connect the various units in
the entire system. Those of low level
circuits are grouped together and
brought in at the left side of the rack
while those of high level are brought in
from the right side of the rack.
They are all 2-wire, cotton-covered
shielded cable and after having been
dressed in place, they are covered with
spaghetti tubing. This eliminates
shorts in the cabling and permits
grounding of each cable at one point
only, usually at the jack of the circuit.
Identification strips are removable.
Several were made since the photo of
Fig. 4 was taken and therefore do not
agree entirely with the diagrams.

Fig. 10. Construction of standard jacks
of the types widely used in sound studios.

It is advisable, when laying out the
jack fields, to locate them so that they
will be conveniently located for inser-
tion of the patch cords and so that the
identification of each jack may be eas-
illy seen. It will be obvious to the
reader that great flexibility is afforded
by use of the jack field. With it we

Fig. 11. Construction of double plug.
Notches show polarity. When plug is
inserted notches are held toward the left.

can make insertions or connections
either into or from various circuits and
components for purposes of tests or for
monitoring. Furthermore, by providing
multiple jacks on commonly used cir-
cuits, such as the bridging bus, to be
described in later chapters, we are able
to substitute or to bypass certain units
when desirable. The multiple jacks
are nothing more than parallel connec-
tions which do not employ a normal
spring. They are simply a convenient
means for reaching a circuit by means
of a patch cord.

When the jacks are properly nor-
malized and when the impedance of
the bridging bus is held to 600 ohms
(±10%) the entire system is opera-
tive without any patch cords inserted.
Changes in circuitry may then be made
without materially changing the loads.

(To be continued)
Within the Industry
(Continued from page 26)

which to build a plant to handle the expanding military demand for the products of the company's electronics and x-ray divisions ... GENERAL ELECTRIC COMPANY has announced the reopening of its radio tube plant in Utica, New York. The factory will be converted for the manufacture of emergency radio receivers. Communications equipment ... SIMPSON ELECTRONIC COMPANY of Chicago has opened its fifth factory at 932 Benton Street, Aurora, Illinois ... C.G.S. LABORATORIES, INC., has moved to 391 Ludlow Street, Stamford, Conn. ... AMERICAN ELECTRONEERING CORPORATION has recently taken over new and larger quarters at 5025-29 West Jefferson Boulevard in Los Angeles ... CORNISH WIRE COMPANY, INC., has moved its general executive offices to a new address of electrical engineering at York ... RADIO CRAFTSMEN, INC., Chicago manufacturer of custom-built television and radio chassis and electronic equipment, has acquired 12,000 feet of space at 4401 N. Ravenswood, Chicago, which will be used in the production of television chassis ... RAYTHEON MANUFACTURING COMPANY has recently set up a new plant at Quincy, Massachusetts, for the manufacture of electronic tubes of the subminiature and miniature type for military requirements ... STEINER PLASTICS MFG. CO., INC., has taken over a new plant at Pratt Oval, Glen Cove, New York. The company forms and fabricates thermoplastic sheets, rods, and tubes used in the electronics industry.

INSTITUTE OF RADIO ENGINEERS has just announced the winners of four of its annual awards for 1951.

Robert B. Dome, electrical consultant of the General Electric Company, has been named recipient of the Institute's Morris Liebmann Memorial Prize which is awarded annually.

Mr. Dome's award was made for his contributions to the intercarrier sound system of television receivers, miniature and miniature construction, and various simplifying innovations in FM receiver circuits.

The Browder J. Thompson Prize was awarded to Alan B. MacNee, assistant professor of electrical engineering at the University of Michigan, for his paper "An Electronic Differential Analyzer." The award is given annually to the author under thirty years of age for the paper recently published by the Institute which constitutes the best combination of technical contribution to the field of radio and electronics and presentation of the subject.

The Harry Diamond Memorial award, given annually to a person in governmental service, was awarded to Marcel J. E. Golay of the Signal Corps Engineering Laboratories, Fort Mon-

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"$5" METER ... An outstanding buy!

Here is a beautiful instrument exactly suited for use as an "$5" meter. Illuminated face. Operated by a 9BM (supplied with lamp bracket and 9BM). Diameter across face is 2½", black bakelite case, reverse-set pointer. New, surplus ... limited quantity only. 9BM is 65c ea. 836 Hi-vacuum rectifiers, 2 for ... $1.50.

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Fl. transformer, 850V, 150 ma. 2.5V. New, unused. Frame type. ... $1.95 ea.

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Alcan-sort, push-to-talk micro. Button on top. New, unused. Was $2.50, now reduced to $1.50.

RCA Hand Mike, hi-grade, single button. Button colored with cord and plug. New. Were $1.98 now reduced to $1.50.

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This is a sturdy, dependable tool for service shops, schools, laboratories. Also used in hobby shops. Vertical and horizontal supports, steels. $24.50...

Now with Larger Hole $44.50

A small lathe for hobby shop, small service labs, hobbyists, hobbycrafts, model makers, machine shops, schools, etc. Automatic chucking and 5 spindle speeds. Can be mounted on face plate or bolted to table. Will handle diameters up to 1½". 271/4" swing over bed. 1½" between centers. Swing over bed 2 1/2". Comes with the table, 5 brass centers, and 5 extra keys. 24" x 24" table size. New, ... $55.95.

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COMPLETE KITS FOR 1/2 WAVE TVI FILTERS

Assure yourself of success with the highly effective 1/2 Wave TVI Filters from the Offenbach & Reimus Co. Company. TH19S NEWS, KIT consists of drawn aluminum case, 11" long, for 8 volts and 2½" wide. For 2½" wide, (Supers.) Also three 150 henry variable iron-core transformers with 150 henry iron core transformers. 11" long, for 8 volts and 2½" wide. For 2½" wide, (Supers.) Also three 150 henry variable iron-core transformers with 150 henry iron core transformers. 11" long, for 8 volts and 2½" wide. For 2½" wide, (Supers.) Also three 150 henry variable iron-core transformers with 150 henry iron core transformers. 11" long, for 8 volts and 2½" wide. For 2½" wide, (Supers.) Also three 150 henry variable iron-core transformers with 150 henry iron core transformers. 11" long, for 8 volts and 2½" wide. For 2½" wide, (Supers.) Also three 150 henry variable iron-core transformers with 150 henry iron core transformers. 11" long, for 8 volts and 2½... $24.60

January, 1951

137
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provide BETTER TV PICTURES through more efficient installation!

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Combination 3 position switch and socket provides neat, efficient connection of TV set to any one of three antennas with easy, instant change-over. Flush-mounted in standard outlet box. Fits double receptacle plate. Acrylic plastic with non-ferrous metal parts. List, $3.5

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mouth, N. J., for his contributions in the over-all Signal Corps research and development program and particularly for his accomplishments leading toward a reduction in the infrared-radio gap.

Willis W. Harman, associate professor at the University of Florida, received the Editor's Award, established to stimulate the use of good English in technical writing, for his paper "Special Relativity and the Electron" which appeared in the November 1949 issue of the "Proceedings of the I.R.E."

DR. HARRY STOCKMAN has been named director of research of the Tobe Deutschmann Corporation of Norwood, Massachusetts.

Prior to accepting his new post, Dr. Stockman served as consulting engineer and scientist to several industrial firms in the greater Boston area. During 1945-48 he was associated with the USAF research program in Cambridge and taught the 1941-45 pre-radar and other courses at Harvard University.

Active in electronics research and development for more than twenty years, Dr. Stockman served on the Communications Panel of the RDB during 1947-48. He is the author of numerous scientific and experimental papers, reports, patent communications, and textbooks. He is a senior member of the IRE.

GEORGE F. WUNDERLICH and HAROLD E. SORG have recently been named vice-president and general manager, and vice-president in charge of research, respectively, for Eitel-McCullough, Inc., manufacturer of transmitting tubes and TV picture tubes.

BILLY ROLLINS has been promoted to the post of vice-president in charge of production and purchasing for Crescent Industries, Inc. He has been with the firm since 1939.

THOMAS G. BANKS has assumed the post of director of research and development at Gates Radio Company of Quincy, Illinois. The position is a newly-created one.

The Radio and Television Division of Sylvania Electric Products Inc., has named HOWARD RIORDON as general manufacturing manager for that division.

WALTER A. BUCK, vice-president and general manager of the RCA Victor Division, has been elected to the Board of Directors of Radio Corporation of America. He succeeds EDWARD J. NALLY, who retired because of age.

BEN MILLER has resigned his post as sales manager of United Transformer Company to "go fishing."

HANK RUSSELL has taken over the duties of the retiring official.

SIDNEY A. JOFFE has been elected president of Pathé Radio and Television Corporation, succeeding A. H. STOBIE in the position.

WILLIAM D. LOUGHLIN, prominent radio engineer and chairman of the board of directors.
of Boonton Radio Corporation, passed away recently at the age of 57 after an illness of several months. GEORGE R. SIEGRIST, executive vice-president, treasurer, and director of the Akerson Colloids Corporation, retired recently because of ill health. He was associated with the company for thirty years. At a recent stockholders meeting of Herman Hosmer Scott, Inc., VICTOR H. POMPER, sales manager of the firm, was elected a director of the corporation. JOHN F. BYRNE has been named associate director of research for the Division of Communications & Electronics of Motorola. SHANNON C. POWERS is the new general sales manager of the Russell Electric Company, a Raytheon subsidiary located in Chicago. DR. IRVING LANGMUIR, the recently retired associate director of the General Electric Research Laboratory, was awarded the John J. Carty Gold Medal of the National Academy of Sciences. The medal, together with an accompanying certificate and honorarium, was presented at a recent meeting of the Academy.

Spot Radio News

(Continued from page 18)

instance sufficient protection may be obtained if the service areas do not overlap. As an added factor, it was pointed out, it was believed that channels to be received in any given area should be grouped as far as possible so that the frequency range, for which receiver antennas will have to be provided, could be minimized and receiver tuning simplified.

The plan, offered by John Preston, chief allocations engineer of the American Broadcasting Company, on behalf of the association, was soundly criticized by FCC Counsel Harry Plotkin who said that the proposal was purely a theoretical one without substantial support. His fire was directed particularly on the association's assumption that the intermediate frequencies would be adopted whereas no official word had been received that such a move had been approved, industry-wide. The thought that radiation would have to be tolerated also irked the Commission's attorney who declared that such interference might have a serious effect on other services, some of which might involve public safety. This blast recalled to many the seething letter Major Armstrong had sent to the Commission on radio's Lion. In the Major's opinion, the radiating receiver problem in FM and TV was "a disgrace to the engineering profession." He believed that the present conditions were the result... of the disregard of rules of engineering that were known twenty years ago... In both TV and FM these rules have been and are now being flagrantly violated by a large part of industry, perhaps to their immediate profit, but certainly to the ultimate detriment of the public."

By applying the proven "end-fire" principle to TV antennas the WORKSHOP DUBL-VEE set the pace for 1950. Its quick acceptance — over 80,000 installed in three short months — is a testimonial to WORKSHOP'S acknowledged leadership in antenna design and engineering.

The DUBL-VEE is typical of WORKSHOP antennas in other fields — commercial, amateur and aircraft. In every instance, advanced engineering and outstanding performance have established ready acceptance. You know when you specify the DUBL-VEE, or any other WORKSHOP antenna, that you are getting the best.

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THE "Fringe Area TV" Reference Book.
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TV signal propagation, evaluation of TV antennas, making a TV signal survey, types of feeds and towers and recommended installation practices. Full data on rhombics, how to use open-wire feed line, how to stimulate grid bias, line commoning, TVI, etc.

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The most practical, comprehensive book on antennas. 200 pages of down-to-earth help on antennas, feed line, radiation and propagation for all frequencies up to 1000 Mc, including FM and TV, Plain language; no need to brush up on math. A necessity for everyone interested in transmission or reception.

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The hearings were also sparked by a blistering exchange between consulting engineer Paul A. DeMars and Plotkin, as well as Commissioner Webster, when DeMars questioned the qualifications of K. A. Norton, the Bureau of Standards' propagation specialist, whose advice had been sought by the Commission on several occasions. DeMars said that Norton had not only erred in many instances, but reversed his opinions. Norton's statement of 1944 was cited as one illustration. At that time, according to DeMars, Norton said that the very-high stations at high power operating on 80 megacycles, in such places as South America and Australia, during times of high sun-spot activity would interfere with the TV and FM stations in this country. When queried in '47 during another proceeding by Major Armstrong, whether the frequency of 80 megacycles was correct, Norton was said to have admitted that he was wrong and that 40 megacycles should have been specified. Several other instances during which Norton changed his mind were cited by DeMars who declared that "...here is a man who has contradicted himself." In his opinion this was a serious affair which tends to "cast serious doubts" about his abilities. Quizzed on this serious charge by Commissioner Webster and asked specifically whether Norton should be disbarred from appearing before the Commission, DeMars replied that the answer could be yes, insofar as the subject of propagations is concerned. Plotkin, in his opinion, said that admission of an error could disqualify one as an expert, and the consulting engineer replied it all depended on the number of times such mistakes might be made. When the word battle ended, Plotkin said that "...Nothing has been shown in any way which impairs the qualifications of . . . K. A. Norton."

As the barrage of testimony continued to accumulate, it looked as if the record set during the color marathons of '47 would see many phases of the TV and FM stations in this country.

WHILE WASHINGTON BRISTLED with problems of TV and Federal jurists deliberated on the finality of the Commission's decision on color, the FCC became a target of hostile criticism, with the members being hounded for answers to an endless parade of questions from everyone on the buying or selling front.

An eloquent answer to the mountainous task which faces the ether guardians was provided by Commissioner E. M. Webster, in an address before the Kansas City section of the IEEE. Explaining the important phases of the policy-making processes involved during a hearing, and particularly during the recent color session, Webster said: "As an engineer, I was expected to have an opinion as to the technical competence of the various color television systems that were presented to the Commission. My role in the final decision, however, went beyond evaluating the equipment itself. The ultimate decision had to be made with consideration to all aspects of radio communications. The problems were complex and I was challenged to make a responsible decision."

Discussing the problems of personal issues involving integrity of engineers which were so prevalent during the hearings and continuing into present channel sessions, Webster said that ..."when personal biases or prejudices of one sort or another are thrown into a situation only havoc, resulting in the gravest consequences can result. This fact was forcefully brought to my mind while I was listening to engineering testimony during the recent color television hearing. An attorney for one of the major broadcasting interests attacked the integrity of an engineer with both slashing and belittling. This radio engineer is a fellow of the IRE and a highly respected member of our profession. While the attack did not appear to me to have succeeded, I was somewhat shaken by the fact that the attorney had made the effort. I realized then, as at no other time, that engineers who are called upon to represent private interests must be doubly careful to maintain their integrity, so that they do not appear to be selling out on their profession. The Commission, which is so dependent upon the advice of private radio engineers, must have complete confidence that the information it is receiving from them is thoroughly reliable, otherwise we will fail in our duty to render decisions in the public interest."

THE SINCERE INTEREST which the Commissioners have in rendering decisions was also aptly described by Madame Commissioner Frieda Hennock before the New York Women's Advertising Club. Pointing out that of the possible 2000 new stations that might be assigned in the new upstairs band, she was urging that twenty-five per cent should be reserved for the use of educators for non-commercial and non-profit broadcasting. In Miss Hennock's opinion educators ... "cannot overlook or ignore television ... for they here to stay just as surely as the electric light, automobile, or airplane."
She felt that the potentialities of visual education by way of TV offer new and almost unlimited horizons to teachers. Television channels assigned to educators will be an investment in the future of America, culturally as well as commercially, she emphasized.

In a prior talk before the National Association of Women Lawyers in Washington, Miss Hennox also hammered away at the obligations which she felt she had to meet as a member of the Commission. Disclosing that, in fulfilling the statutory mandate under the Communications Act to study "...new uses for radio, provide for experimental uses of frequencies, and generally encourage the larger and more effective use of radio in the public interest..." the Commission has a duty to look into the future. "Accordingly," she said, "we...cannot be content with what is here today, but we must look to see what may be tomorrow, what new developments radio may bring which may make us more secure, more happy, and more comfortable."

Explaining that the Commission's role is not merely a technical one, Miss Hennox said that Congress has been quite explicit in defining the function of the body, to see to it "...that the use of the valuable domain of the airwaves, the property of the people of the United States, shall be in the public interest, which means nothing more or less than that it shall be for the benefit of the people of the United States."

Citing that the burden for the "...improvement of the quality of America's broadcasting lies squarely on the shoulders of the public and the broadcasters," Miss Hennox declared that "every citizen must take broadcasting seriously. She felt that none of us can ignore broadcasting...for it will...in any event have a great effect on our lives and futures of us all."

Her comments at these two meetings were particularly interesting in view of her opinions on the color decision which called for a delay in final action until June 30 of '51, when she felt that all proponents would have had an opportunity to display what they might have to offer to meet the criteria established by the Commission. Fastening the ruling and demanding that a decision must be made now, did not, in her opinion, provide for a fulfillment of the obligation to encourage the larger and more effective use of radio in the public interest, as cited in the Act.

**TEXAS** has received the first grant for a reactivated State Guard Radio Service providing for the use of twenty base stations and seventy-two mobile units, operating on 2726 kilocycles. The State Guard, distinct from the National Guard, has established communications headquarters at San Antonio and will begin an active training public-safety program. Congratulations to the alert radionics of the Lone Star State...L.W.

**January, 1951**
1951 BARGAINS

THE "MARKA-SWEEP"

Kay Electric Company of Pine Brook, New Jersey has recently introduced a new all-electronic i.f. sweep and marker generator designed especially for the production alignment of TV receiver i.f. systems.

Designated the "Marka-Sweep," Model IF, a three-position switch in the unit selects the 20-30, 30-40, or 40-50 mc. range with overlap. The sweep width is approximately 15 mc. All carriers are oscillator fundamentals. The instrument produces a true zero amplitude reference baseline on the oscilloscope display. The output level may be varied between approximately 50 microvolts and 250 millivolts across the 70 ohm unbalanced output. A panel switch narrows the sweep and recenters it to make it suitable for sound channel measurements.

Provisions are made for simultaneous injection of picture carrier, resulting in a 4.5 mc. swept signal at the second detector which is suitable for aligning intercarrier receiver sound channels. Up to nine extremely narrow crystal-positioned, pi-type markers are available at i.f. frequencies specified by the customer. There is an individual "on-off" control for each of the nine marks.

TV MICROPHONE

The RCA Engineering Products Department has developed and is currently marketing a new ribbon-pressure microphone which has been designed especially for the television industry.

The "Starmaker" is a slender and unobtrusive microphone which will not hide the faces of singers, speakers, or others using it. The 15 ounce mike is inconspicuous not only because of its size and shape but because of its special "TV gray" finish which makes it appear to fade into studio backgrounds or blend with the clothing of entertainers.

The Type BK-4A is suited for sound reinforcement and radio broadcast pickup, and has an output comparable to larger conventional studio microphones. It has an output of 110 μv. per dyne/sq. cm. for an output impedance, in accordance with RTMA standards, of 30, 150, and 250 ohms. The microphone is non-directional and provides uniform frequency response between 50 and 15,000 cycles. Its effective output level at 1000 cycles is −50 dbm. Special transformer design results in a low hum pickup level of −125 dbm.

G-E SERVICE PARTS

General Electric Company of Syracuse, New York has announced a complete line of television receiver parts, applicable to G-E and many other receiver makes.

The new line includes 70 degree deflection yokes for magnetic deflection circuits, horizontal sweep output and high voltage transformers, and other components such as EM-PM focus coils, width and linearity controls, ion trap magnets, etc.

A new catalogue which gives a complete description of the various components may be obtained from the Parts Section of the company's Receiver Division.

BRACH ANTENNA

The Brach Manufacturing Corporation of 200 Central Avenue, Newark, New Jersey has developed a new television antenna known as the "Bow-Tie V Antenna."

The new Model No. 452 antenna does not require directors or reflectors.
tors. It is a closed circuit "V" antenna in which three antenna rods of the same electrical length emanate from each side of a non-hygrosopic insulator and joined at the ends by means of shorting bars. The shorting bars provide more surface area and raise the gain of the antenna, proportionately higher than would the adaptation of directors or reflectors, especially on the upper channels, according to the company.

As there are no free vibrating elements and the antenna uses seamless tubing and a high impact insulator the new antenna is said to be able to withstand virtually all wind velocities and ice loading conditions.

**LIGHTNING ARRESTER**

LaPointe-Plascomold Corporation of Unionville, Conn. is now constructing its "Vee-D-X" four-wire lightning arrester of a high dielectric, double phenolic material. The new RW-204 arrester is designed for installation in accordance with the National Electric Code and is also approved by Underwriters' Laboratories. The unit will accommodate four-wire rotator line as well as the regular 300 ohm transmission line.

**ANTENNA HOIST**

The Haugen Mfg. Co., 412 S. Front Street, Mankato, Minnesota, has developed a unique television mast and tower hoist which will erect and lower towers up to fifty feet in height. The new "Jiffy-up" unit permits one man to make the antenna installation on any type of rooftop. The base, which is permanently installed on the roof, is especially designed so that the mast hoist can be easily attached for raising or lowering the mast or tower. The base is extra heavy in construction, will work on any type of roof, and will accommodate large masts. The installer needs one hoist for all of his installation work and a base unit for each installation.

Descriptive literature on the new hoist is available from the company.

**7-INCH SCOPE**

A new 7" cathode-ray oscilloscope, especially designed for general use in radio and television receiver testing and in laboratory and production applications, has been announced by the Radio Tube Division of Sylvania Electric Products Inc. of 1740 Broadway, New York 19, New York.

The new instrument incorporates a multivibrator sweep circuit for linear internal sweep from 10 to 30,000 cycles which may be synchronized to 60 cycles, an external signal, or signal ap-
plied to its vertical input terminal. Balanced, non-astigmatic sweep is assured by push-pull deflection. Terminals are provided for direct connection to horizontal and vertical deflection plates and to the control grid of the cathode-ray tube for intensity modulation.

The vertical deflection amplifier provides a sensitivity of 1 volt r.m.s. for one inch peak-to-peak deflection, sine wave frequency response at full gain flat within 3 db. of 1000 cycles value from 7 to 70,000 cycles free of peaking and usable to much higher frequencies, and an input impedance of $1/2$ megohm and 34 $\mu$fd.

Designated the Type 132Z oscilloscope, the new unit measures 17\% high, 11\% wide, and 17\% deep and weighs 39 pounds. The sale of this new scope is being handled by the company’s authorized distributors.

### REPLACEMENT BALLASTS

**JFD Manufacturing Co., Inc.** of 6101 Sixteenth Avenue, Brooklyn 4, New York is currently offering its line of air-cooled TV ballast tubes as replacement items.

Employed as original components by several TV set manufacturers, the ballast tubes are available in seventeen different models. Heavy resistance elements and large insulating surfaces are designed to provide efficient operation. The black enameled shell is perforated for greater heat dissipation.

Further information and literature is available direct from the manufacturer, its representatives, and distributors.

### TV SCREEN POLISH

The Walter L. Schott Company of 9306 Santa Monica Blvd., Beverly Hills, Calif., has just announced the availability of a new television antenna, the **Walco “Signal King.”**

According to the company, the new unit is a universal antenna capable of receiving all channels. A special signal “director” has been added to improve gain on high band channels and eliminate ghosts. Ease of stacking makes the new antenna suitable for fringe area applications, in the opinion of the manufacturer.

Catalogue information on the new antenna is available from the company.

### WALSCO “SIGNAL KING”

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### TV SCREEN POLISH

The Jim Robbins Company of 1555 E. Eight Mile Road, Hazel Park, Michigan has begun the national distribution of a new polish designed specifically for cleaning the outer screens of television receivers.

Known as “TV Care,” the new polish leaves the plastic tube protector clean, scratch-free, and conditioned against many of the future scratching hazards. Investigation has shown that almost 90% of the scratching of such screens is due to the tiny dust particles, which are attracted to the plastics, being ground into the surface under the pressure of normal cleaning or wiping. These particles are negatively charged and cling to a positive static charged screen.

The new polish uses a grounding agent to completely eliminate the static charge while another ingredient cleans the plastic surface. Thus, the plastic is left clean, scratch-free, and virtually dust-resistant by being conditioned against future recharging.

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Catalogue information on the new antenna is available from the company.
This new and improved continuous tuner is available to both jobbers and set manufacturers. It employs a Mallory-Ware three-section spiral Inductuner plus antenna tuning. The company claims that this combination provides good sensitivity and selectivity. The space required is identical with that of most leading switch-type tuners. Stacking and mounting holes further facilitate interchangeability. Electrically, the new Inputuner is designed to work into the i.f. system of TV receivers using a separate sound i.f. It is available with variations in the mixer plate network, making it adaptable, without alteration, to various types of separate sound i.f. receivers.

TWIN-DRIVEN ANTENNA
A new all-driven-element antenna has been announced by Technical Appliance Corporation of Sherburne, New York.

This new "Taco" antenna has been designated as the 1700 series and is known as the "Twin-Driven Corner Antenna." With all of the elements driven, the directivity of reception has been narrowed, thus minimizing ghosts caused by reflected signals. The front-to-back ratio is high. Both high and low band lobes coincide due to the phase relationship controlled through feeding.

Mechanically, the new unit offers low wind resistance and is rigid when assembled. Assembly is accomplished by means of the company's "Jiffy-Rig" type of construction. The antenna elements are merely swung into place and wing nuts tightened to prepare the antenna for installation.

These new units are available in single or stacked models depending on the requirements of the installation.

SWEEP GENERATOR
The Triplett Electrical Instrument Co. of Bluffton, Ohio has recently introduced a low-cost TV-FM sweep signal generator in response to the demand for accurate test equipment priced within the range of the average technician.

According to the company, any good AM signal generator can be used with the new unit as a marker thus making it possible for the service technician to reduce his investment in sweep signal generator equipment.

The Model 3435 provides continuous range coverage to 240 mc. for all TV carrier and i.f. frequencies. There is no gap in frequency and continuous tuning is provided over all of the TV and FM bands. The main frequency dial is marked with channels as well as frequencies.

The instrument features continuously variable sweep width, effective from 50 kc. to 12 mc. with "Off" position; phase controlled sweep voltage for scope horizontal input; and a standby switch for the temporary silencing of the generator during other work on equipment under test.

January, 1951
The unit is copper-plated steel construction throughout. All critical circuits are included and the power transformer is static shielded.

Y.T.V.M. KIT
Approved Electronic Instrument Corp. of 142 Liberty Street, New York.

New York is currently offering a new Y.T.V.M. kit, the Model A-220K.

Suitable for television servicing applications, the new instrument has 5 a.c. ranges and 5 d.c. ranges. 5 resistance ranges cover from 0-100, and 0-1000 ohms and 0-1, 0-10, and 0-1000 megohms.

The unit incorporates a balanced bridge circuit a zero-center readout for FM-TV discriminator alignment and has a d.c. input impedance of 25 megohms. The instrument uses three tubes, a 6186, a 6SN7 and a 6X6. The meter used is a 4½" 0-200 microamperes unit with an open-face, non-glare calibrated meter scale. The meter circuit is "burn-out proof."

The power supply is 110-120 volts, 60 cycles and the power consumption is 15 watts. The power transformer is electrostatically shielded.

The kit comes complete with a heavy gauge steel cabinet in a battleship gray crackle finish, three standard brand tubes, all parts including the power supply, operating instructions, pictorial and circuit diagrams, and a guarantee.

Complete details are available from the company.

TV BOOSTER
Television Equipment Corporation of 238 William St., New York 7, has developed a new television booster which is said to be particularly effective in fringe areas.

AN INEXPENSIVE DIODE PROBE
By SAMUEL T. WALTON

SEARCHING for non-standard hardware to construct test equipment is, in general, a time-consuming process. The main part needed in the construction of this diode probe was a suitable metal tube with a dielectric end in order to house the condensers, resistor, and diode crystal as well as hold the metal probe. A pencil flashlight with a plastic end, such as those sold in the five-and-ten cent store for thirty to forty cents, met my requirements satisfactorily.

The condensers, resistor, diode crystal, test prod pin, coaxial lead, and the jack may be obtained from an electronic accessories store.

In building this unit, first remove Parts A and B as shown in Fig. 1B. Parts A and B may be removed by means of a long screwdriver after Part C has been unscrewed. This is best accomplished by standing the penlight on end and pressing down Part A, then giving the screwdriver a sharp rap with the palm of your hand. Part D is the penlight bulb. This may be retained and used in your absorption wavemeter as it is a low-current lamp.

Next, assemble the condensers, resistor, and diode crystal as shown in Fig. 1C, using varnished cambric tubing (spaghetti) where insulation is needed. This assembly is completed while the components are out of the penlight tube. This assembly is then wrapped with low-loss insulating tape. This wrapping should be done carefully in order to provide sufficient insulation and hold the assembly in place.

The next step is to dress the coaxial or auto radio lead in the cable to the correct length and attach to the components. Attach and solder a bare wire, 8 to 10 inches in length, to the shield at Point 1 in Fig. 1C. This wire is laid back along the cable and fed through the opening in the end of the penlight tube. It is used for making the ground after the components are installed in the penlight tube. Pull and slide the components into the tube and solder the ground wire to the case. Be sure the lead of the .01 microfarad condenser is long enough to attach easily to the test pin prod.

Finally, install the test pin prod in the plastic cap and feed the wire of the .01 microfarad condenser through the hole of the test pin prod and screw the plastic cap in place. Pull the wire of the condenser tight and secure it with the nut of the test pin prod, taking care not to overtighten lest the plastic cap be damaged.

There are several circuits for diode probes, published recently in radio magazines, which may be used in place of the one shown in Fig. 1A. The one shown worked well with a v.t.v.m., however. A clip and lead can be attached to the probe case for a shorter ground connection, a condition which is often desirable when testing some circuits.
Known as the S-505, the new unit includes a gain control for reducing the gain of the booster on strong signals, and two untuned broadband amplifiers for both low and high bands. This latter feature is said to be especially applicable to intercarrier type television receivers inasmuch as it gives equal amplification to video and audio signals.

**AUDIO AMPLIFIER**

A new audio amplifier, designed by N.J.R. Electronics Company for TV applications, is now being distributed nationally by Milo Sound of 200 Greenwich Street, New York 7, New York. The new Model 10MP can be used either with the receiver's existing speaker or with a higher quality reproducer. With the set's own speaker, a 75% aural improvement is obtained, according to the distributor. With a quality speaker, the amplifier delivers its full range of 100 to 13,000 c.p.s.

The amplifier plugs into most of the existing single-ended amplifiers. It uses two 6K6's or 6V6's in push-pull and a 6J5 driver. The harmonic distortion is less than 3% and power output is 6 to 8 watts.

Because the unit measures only 3" x 5", it can be fitted directly onto most television chassis. It comes complete with tubes and a 2-foot extension. Details are available from Milo Sound.

**UNIDIRECTIONAL ANTENNA**

Tricraft Products Company, 1335 North Ashland Avenue, Chicago 22, Illinois is currently in production on a unidirectional antenna for FM and television applications. The new P-38 is a single bay incorporating seven elements. The design of the antenna is such that in the high television band three colinear elements are fed with in-phase equal currents, which single element group gives a gain over a half-wave dipole of approximately 6 db.

Behind the three elements are placed two colinear reflectors cut for the high television band and a third longer reflector that is active in increasing the forward gain in both the high and low television bands. The resultant high band antenna gain is nearly 10 db, over the entire high TV band, according to the company.

When operated in the low TV band, the three fed element group of the high band becomes a single half-wave dipole with the approximate sinu-
NEW!

RECTANGULAR
BLACK TUBE

16in.TELEKIT

PRICES
BEGIN AT
49.95
LESS TUBES

JOBBERS: WRITE FOR CONFIDENTIAL
PRICE INFORMATION

16 BR Telekit
$79.95

Console Cabinet shown
$19.95

You can build this fine 16 in. rectangular black tube
TV set. All you need is internal service kit, and
bulbs. You save weight, and don’t need to
hook up to a wall outlet. $19.95. In stock.

12-B Telekit
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8-B Telekit
$49.95

Both Less Tubes

Exciting new line
Introducing
Exciting new line

12 Channel Tuner
$12.95

Pre-built, factory aligned. Range of H.F.
amplification. Tuning on 12-channel tuner
equip any TV set with video 1.f of 25 to 32 in.
and sound 1 f of 21 to 22 Ml. Not a kit. Complete
with tubes. Only 6 wires to connect.

Teledkit Booster
$12.95


TELEKIT

ELECTRO-TECHNICAL INDUSTRIES

1432 N BROAD ST. DEP'T 2 PHILADELPHIA 21 PA

olida current distribution of any thin
half-wave dipole. Behind this dipole
is placed the reflector, cut to give
maximum forward gain on Channel 2
and in front of this dipole is placed
a director cut to give maximum for-
ward gain on Channel 6. As a result,
the antenna gain is nearly constant
over the entire low TV band at ap-
proximately 6 db. over a half-wave
dipole.

The company will forward a data
sheet giving complete details and re-
ception patterns to those requesting
one.

NEW SERVICE GROUP

A MEETING of independent service
technicians has been called for
January 28th in Washington, D. C.,
for the purpose of organizing a new na-
tional service group to be known as the
National Association of Electronic
Technicians.

At a recent meeting held in New
York City, delegates from 29 different
companies' organizations passed a
resolution calling for a national asso-
ciation. Any service group interested in
being represented at the Washington
meeting are asked to contact Norman
Challin, 545 Fifth Avenue, c/o ARSY,
New York 17, N. Y.

"GREAT EAGLE"

WHEN the Simpson Electric Com-
pny held its annual sales confer-
ence late in September at Lac du Flam-
beau, Wisconsin, Ray Simpson, the
past president and present chairman
of the board, acted as host to the group.

The Indian headdress Mr. Simpson
is wearing in the picture is no gag. It
signifies his new status as honorary
chieftain of the Chippewa Tribe. His
official name is "Me-gese" or "Great
Eagle." The Indians at Lac du Flam-
beau accepted him into the tribe at a
ceremony, complete with war dances,
which was held during the sales con-
ference. The honor was conferred on
Mr. Simpson in recognition of his re-
habilitation work among the Indians,
made possible by his employment of
members of the tribe at the Simpson
factory opened there four years ago.

Ray Simpson, chairman of the board of
the Simpson Electric Company, shown wearing
his ceremonial headdress to which his en-
titling him to the right of his recent acceptance as
an honorary chief of the Chippewa Tribe.

NOW!

SPEED UP ALL SOLDERING WITH
UNGAR

Feather-Light Soldering Pencils with
HI-HEAT TIPS

INCREASED WATTAGE

Stop wrestling with big irons. New HI-HEAT
TIPS in your Ungar Electric Soldering Pen
produce a really versatile tool that’ll
perform on a par with the big, bulky 100-
150 watt irons. If you can’t get immediate
delivery, please be patient, for production
hasn’t yet caught up with demand. Ask your
supplier for No. 1236 Pyramide or No. 1239
Chisel. List price: $1.25 each.

UNGAR
ELECTRIC TOOL CO., Inc.

LOS ANGELES 54, CALIFORNIA

THE FASTEST SELLING
Ground Rods

For TV

AND OTHER
INSTALLATIONS

With a new quick-
acting, time-saving
clamp that insures
positive contact on
#4 to #14 gauge
conductor. 5/8-inch
solid steel rods, copper
plated and point-
ed for easy driving.
Available in 4 and
6-foot lengths. Also
½-inch rods in 3, 6
and 8-foot lengths.

At Your Jobber

PREMAX PRODUCTS

DIVISION CHISHOLM-RYDER CO., Inc.
5108 Highland Ave., Niagara Falls, New York

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RADIO & TELEVISION NEWS
 Corner Speaker  (Continued from page 55)

45 degree conic section will result. Small finishing nails can be driven into the edges for securing the aluminum.

To avoid possible flexing of the aluminum when reflecting sound, the cone can be filled with plaster of paris or fine sand. A top section should now be fitted to conform to the outlines of the cone and screwed into position.

The writer was content to paint the rear of the arrangement black and leave it open. It is suggested, however, that if this offends other eyes, the top piece can readily be extended in dimensions so that grille cloth can be fixed to the entire top portion, enclosing reflector and all. A vertical piece in front of the speaker would allow a square corner for mounting the grille cloth. Bass response is as good as the speaker itself can provide. The fact has previously been established by competent authorities that the reflex type box gives pronounced bass boost. If such boost is desired, a suitable port may be added to this box. Since the band opened there have been no strings or catches to this offer. "Proof" consists of a list of the contacts already made. The hams worked since the band opened include the September 1950 issue, Helen Cloutier, W8GJX happened to mention that she was awarded a box of oranges for working fifteen Orlando stations.

GOOD NEWS FOR HAMS

In his article, "21 Years a Ham," in the September 1950 issue, Mr. Leach introduced his fifteen Orlando stations.

According to a letter received from Jess R. Leach, W4CML, this offer was discontinued as of May 1, 1950, leaving a considerable number of disappointed hams throughout the country who had twelve, thirteen, fourteen of the Orlando stations logged. According to Mr. Leach, the offer has again been renewed as of November 10, 1950 on the same basis as previously. In other words, all postwar Orlando contacts will now be considered. That the hams who have worked a number of the Orlando group do not have to start over may add to the list until the number of stations reaches the 600.

The offer, as it stands now, is this: The Orlando Amateur Radio Club will ship prepaid a box of select tree-ripened Central Florida citrus fruit upon receipt of proof that the ham has worked fifteen different ham stations in Orange County. Mr. Leach stresses that there are no strings or catches to this offer. "Proof" consists of a list of the stations worked since the band opened after the war, with the date of the QSO, time, and the operator's name, if possible.

Mr. Leach explains that the reinstatement of the offer was made after the club members decided that the cost of the project was incidental compared to the pleasure the group derive from its contact with hams throughout the United States. Hams who already have several QSO's recorded will be happy to hear of the reinstatement of the offer and the hams who haven't entered the "orange sweepstakes" will want to try their hands at winning their morning orange juice.

January, 1951
Wide Range Reproduction For the Home

The Triad HF-10 Amplifier, from a circuit designed in cooperation with J. N. A. Hawkins, prominent sound engineer, has been produced especially for those who like to build their own sound reproducing systems. When used with the high quality speakers, tuners, turntables, and pick-ups now available, a system can be built that will meet the requirements of even the most critical music lover. The Triad HF-10 kit supplies the basic engineering and solves the most difficult mechanical layout problems. With 18 db. of feedback, affording a reflected impedance of less than 2 ohms to the 16 ohm speaker tap, within 1 db. linear frequency response from 20 to 20,000 cycles, and with a minimum of distortion over this same range, the HF-10 is worthy of use in the very finest home music installations.

Features...

- Wide Frequency Response: Within one db.
- Low Distortion: Less than 2% from 50-18,000 cycles at full 10 watts output. Less than 1% from 20-20,000 cycles at 5 watts.
- Heavy Speaker Banging: Reflects less than 2 ohms to speaker from 16 ohm tap.
- Equalization: Continuously variable to +12 db. or -30 db. at 50 or 8000 cycles.
- High Gain: 74 db. from crystal microphone or radio receiver, 96 db. (equalized for magnetic pickup) through preamplifier.
- Low Noise: Hum and other noise 60 db. below maximum output. A-741 equalizing coil has 70 db. shielding.
- Beautiful Appearance: Gray hammertone chassis with ivory silk-screened lettering, matching gray Triad transformers.

Prices

- HF-10 Kit—Includes S-31A, R-144A, A-741, and C-10X Triad transformers, chassis, prints and assembly instructions. List Price $39.85
- HF-10A Kit—Same as above except for substitution of HS-81 output transformer for S-31A. List Price $37.75

See your dealer or write for Bulletin HF-10, and Catalog TR-49A which describes the complete Triad line.

MARS OPENES RANKS TO CIVILIAN HAMS

The Department of the Army has announced that it will accept civilian members in its MARS program. Civilians interested in joining the system are invited to contact the Signal Officer of their nearest Army installation. Authorization for civilian membership in MARS Army inspires the continued use of the net as a back-up communication system if activities and reserves of the Army are mobilized. MARS membership does not affect draft status, the Army emphasized. Civilian members must be 21 years of age or older and must hold a valid FCC amateur radio station license. They must also agree to operate their stations in accordance with rules and regulations prescribed for the MARS by the Army. Only amateurs who own stations, in operation at time of application for MARS membership, can be considered. No radio equipment can be furnished civilian amateurs under existing law.

A3AA-CS3AA at Lages Field, Terceira Island, in the Azores Archipelago, has been named "MARS Station of the Month" by Major Rawleigh H. Ralls, Chief, MARS, U. S. Air Force. The station has proven a big morale factor to Air Force personnel stationed on the "rock" by permitting them to talk to the folks back home via 10 and 20 meter phone. Daily contacts with AIR at the Pentagon and with AR2AA at McAndrews Field, permits informal handling of a lot of squadron affairs.

Lt. Col. Sidney Nutt, "Sid," is the licensee, MARS Director, station custodian, and Commanding Officer of the 1986th AACS Squadron. Sid does just about everything as can be seen from his titles and he does spend some time at the mike. Master Sergeant Nick Pozarich, W6ZGB-6FZGB-CS22 (boy, what a c.w. call) is chief radar mechanic for the squadron. Nick keeps all the radar gear in tip-top shape so that maintenance does not interfere too heavily with his skeds. Myron Kisselburg, W6ZNA, a civilian employee of the Gilfillan Corporation, also does his bit of brass pounding.

The prefix Charley Sugar coming from the Azores rather than the accustomed Charley Tare has thrown many DX men and SWL's for a loss but it has helped the gang at CS3AA to work all continents in record time and get well along the road toward WAZ and DX Century Club certificates. The station was granted an experimental license by the Portuguese government and is permitted to operate in the amateur bands and on MARS frequencies. It is the experimental aspect of the license that accounts for the "Sugar." For those looking for an exclusive QSL, CS3AA routes around 14,550 kc. most of the time.

The station layout consists of a TDO transmitter. This is a 10-channel remote control job manufactured by Collins Radio. It produces 350 watts of r.f. from a pair of 813's and is modulated by 805's. The receiver is a "Super-Pro," BC 779. The antenna is a long, long wire aimed at St. Louis.
Missouri and loads up nicely on all frequencies.

Chief MARS played Santa Claus to the Gang and sent them a new MARS package station consisting of a Collins 32V2 transmitter, Collins 75A2 receiver, a Gordon dual 10-20 beam and a V.H.F. 152 converter. The West Lages Antenna Erection Society spent the Christmas holidays building a tower and erecting the beam which accounts for a boost in the signals.

Nick and Myron are currently building the 11.705 outlet and if the results are encouraging they threaten to go in for two meters. It does offer potentialities for some v.h.f. DX records. European v.h.f. men please copy.

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**International Short-Wave (Continued from page 127)**

Spain—EDV10, Madrid, noted on approximately 7.167 signing off 1903 with "Arriba Espana" and two pieces of music after program summary in Spanish. (Stark, Texas.) Oskay, N. J., recently measured this one as 7.190 at 15:00; previous measurements included 7.1655 and 7.1802.

Surinam—Paramaribo, 15.405, noted signing off 2035. (Stark, Texas.) Noted in California with musical program 2000 with announcements in both Dutch and English. (Russell.) P2H5, 5.758, parallel with 15.405, now announces as "Radio Surinam, Avro's" (in Dutch); closes 2100; the 15.045 outlet usually joins 5.758 at 16:45 (generally without announcement); 5.758 fades in around 1730; "Bringing Christ to the Nations" (transcribed in English) is a Sunday feature 1730-1800, followed by "The Lutheran Hour" (also transcribed in English). (Grove, Ill.)

Sweden—"Sweden Today" (English) has been heard well lately 0815-0830 over both 11.705 and 15.155. A Danish DX broadcasts says Radio Sweden now is using 6.065 and 10.780 for the 1900-2100 on 15.155. (Stark, Texas.)

Tahiti—Radio Tahiti, Papeete, sent mimeographed verification via airmail two months after report was sent; asked for further reports and suggestions. (Richards, Sask., Canada.)

Taiwan—Winter schedule of "The Voice of Free China" is 2300-0100 on 15.235 and 11.735, first hour is English; 0500-1130 on 6.040, 7.135, and 11.735, news 0630-0640; best time to listen on 6.040 is after KCBR leaves this channel 1000. (Neeley, Calif.) Balbi, Calif., and N. Y. O. on 0430 and not 0500, Oskay, N. J., measures the 41-m. outlet as 7.1338.

Taipeh on approximately 7.334 has fair signal mornings (EST); call appears BCSF or BCFS. (Neeley, Calif.) Heard in N. Y. on onward transmissions from 15.235 with good strength. (Cushen.) Dlig, Calif., says this one is directed to Occupied China; believes call may be BCSS; frequency varied considerably last spring around 7.450 but seems now set on approximately 7.334. He believes call of the Chinese Air Force Station on approxi-
That's what we call the 16" 17" and 20" rectangular neutral-density filter tubes that Reeves Soundcraft Corp. is manufacturing as successors to Remington Rand's TV Picture Tube Division.

IT IS GOOD BUSINESS to INCORPORATE Reeves Soundcraft "TRULUMES" as the BUSINESS end of TV sets you manufacture, service, convert, or for which you stock tubes.

In the coming months more and more of these fine rectangulars will become available. An inquiry NOW will enable us to tell you how YOU may sooner become one of our happy kinescopic beneficiaries. Dictate an inquiry today.
Last Minute Tips

Here are some late tips on Mexican radio stations. "Radio Universidad Nacional," operated by the autonomous Mexican National University, has programs in Spanish daily 1100-1800 over XEYU, 9600; works on a cultural, non-commercial basis. (World Radio Handbook Bulletin.) Grove, Ill., others, report strong signal from XEXB, 5.896 channel. Adds that a station "battling" with Bombay, Mexico, is YVKB, 4.880, Caracas, still has news daily 1845-1900. (Cox, Delaware.)

**

ARR-1 RECEIVERS

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ARR-1 RECEIVERS

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THERMADOR SPECIAL TRANSFORMERS

**

Thordarson Swinging Choke 11-400, 400, 600 to 500 ma. 115 or 230 volts. $8.95.

THERMADOR SPECIAL TRANSFORMERS

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Thordarson Swinging Choke 11-400, 400, 600 to 500 ma. 115 or 230 volts. $8.95.

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THERMADOR SPECIAL TRANSFORMERS

**

Thordarson Swinging Choke 11-400, 400, 600 to 500 ma. 115 or 230 volts. $8.95.
**A New Corner Speaker System**

A new conception of speaker design by Sun's audio experts. Performs equally well in large or small rooms. Consists of 12" woofer and 6" tweeter in modern or classic cabinet design. Speakers are installed back to back with tweeter facing wall. Treble notes are distributed throughout room with crisp, clear definition. Bass notes quickly interchangeable; (4) Automatic equalization; (5) Frequency response +2 db at 50-12,500 cycles at 15" per second; (2) Uses RMA 7" and NAB amplifier chassis.

---

Concertone Broadcast Quality Tape Recorder -- only $345

A magnetic tape recorder chassis that rivals the most expensive professional equipment, yet sells at only a fraction of the price! For the unskilled user. Connects to any home music system equipped with a separate amplifier chassis. Compare these features: (1) Dual Speed: 7.5" and 15" per second; (2) Uses RMA 7" and NAB 10 1/2" reels; (3) Single or Dual Track Heads quickly interchangeable; (4) Automatic equalization for speed; (5) Frequency response ±2 db from 50-12,500 cycles at 15"/sec.; (6) Simultaneous monitoring from tape; (7) Separate heats for high frequency erase, record, playback. Write for free folder.

---

**Use Kester Flux-Core Solder**

FOR TV AND RADIO WORK—Kester Plastic Rosin Core Solder and Kester “Resin-Five” Core Solder. Kester Solders are made only from newly-milled grade A tin and virgin lead.

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**Press Time Flashes**

Bangkok, 6.24, 11.91, 15.91, noted 0515 with news; YDQ3, 11.060, Makassar, Celebes, USI, noted 0600 with program for Dutch Forces; Radio Makronissos, 7.965, Greece, heard 1445 with Western music, then news in Greek; CRT7U, 4.932, Mozambique, noted 1115 with good signal in request program; ZPA5, 11.945, Encarnacion, Paraguay, noted 0615 with news in Spanish.

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**Two Blocks North of Chambers Street**

Established 1922 • Open Daily 9-4, Sat. 9-4:30

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**Application for Employment**

Please send sets of MULTI DRAWERS © $3.50 per set. Mail coupon now!
December 1; will return to Standard Time around March; Rio de Janeiro Time now is three hours ahead of EST; Manaus Time is two hours ahead of EST. (Serrano, Brazil)

The Florence-Repallo High Frequency Conference ended without reaching agreement on an assignment plan. The Hague Conference, which was to have set the implementation date for the Atlantic City Allocations, has been postponed indefinitely, so there may be a long time before these allocations—which include expanded high-frequency broadcast bands and the new 21-megacycle amateur band—come into effect. (Legge, N. Y., via URDXC)

Radio Athens, 9.607, noted testing dailies 1430-1445 in English. (Boice, Conn., Ferguson, N. C.) Also noted testing 2000-2058, in English 2000-2015; asks for reports. (Stark, Texas)

Vancouver's CBX, 6.160, heard signing off after news and weather report. (Alcock, Ky.)

Grové, III., says LRA, 9.69, Buenos Aires, has news daily 1905, 2015, 2100, 2250, 2300, 2345; Mailbag is Sundays 2245; gives detailed schedule 1900, 2100, 2300, 2305. (Grove, Ill.)

CE1180, 11.99, Santiago, Chile, noted 1100, with news in Spanish. (Russell, Calif.)

HRXW, Comayaguila, Honduras, verified but did not send schedule; gave frequency as 8.990. (Ferguson, N. C.)

BFEBS, Singapore, noted on 11.88 at 0745 when announced 15.300, 11.880, 9.690, and a 49-m. outlet. The new Mexican outlet on 11.90 which relays m.w. XEX, Mexico City, 9.690, and a 49-m. outlet.

In verifying, Prague, Czechoslovakia, listed schedule to North America as 1900 on 15.230; 2100 and 2230 on 11.84, 15.23. (Maurice, N. Y.) Prague, 6.010, noted with English 1715-1730. (Bellington, N. Y.) English programs for Europe now are listed for 0645-0730 on 11.840; 1415-1450 and 1530-1545 on 9.504 (may mean 9.55 ?) ; 1715-1730 on 6.010, 9.504, and 1800-1845 on 6.020. (Radio Sweden)

YNAS, 6.300, Managua, Nicaragua, noted to 2100 or later. (Stark, Texas)

The station heard around 1730-1800 on approximately 9.430 in Radio France Asie, Saigon, Indo-China; has English 1730, then French and usually signs 1800 with "La Marseillaise." (Stark, Texas) Claims is on 9.524.

ZAA, 7.845, Tiraná, Albania, noted 1515 with news; signs off around 1615. (Bellington, N. Y.)

Radio Tito, Sarajevo, is on the air 1500-1600 on 11.094, and at that time on Thur. and Sun. on 7.015; at 1700-1900 daily on 4.845. (Arnold, Bermuda)

Budapest, Hungary, definitely now has news 1700 instead of former 1600

January, 1951
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AMATEUR TV STATION IN CANADA

ON September 1st, a complete TV transmitter, using equipment designed by J. R. Popkin-Clurman, W2LNP and described in the May, June, and July 1950 issues of RADIO & TELEVISION NEWS, was set up at the home of John D. Woodlock, VE2HE in Iberville, Quebec, approximately 28 miles north of the United States border and 32 miles from the city of Montreal.

The equipment was on the air continuously from September 1st to 5th putting out a test pattern and pictures. Propagation tests were made using this equipment. The carrier frequency was 53.51 mc. (6 meter amateur band) and standard television receivers, slightly modified by shifting the local oscillators down from Channel 2, were used for field tests. The transmitter radiated 25 watts peak and was fed into a "Vec-D-X" Type RD-13-A array which was rotatable. Effective radiated power was estimated at 250 watts.

Strong signals were received at La-colle, Quebec by VE2AMO, 21 airplane miles away and at several places in the city of Montreal, about 32 miles away. The blanking bars were received at La-valtrie, Quebec at the station of VE2SV, approximately 51 miles distant, with a faint picture being seen.

A receiver was set up at the home of VE2JN in St. Johns, Quebec, and a program transmitted for his benefit. Others participating in this series of television tests were VE2WF, VE2AEZ, VE2SG, VE2RC, VE2AG, VE2LQ, and C. M. Berry of Montreal and O. Fontaine.

Since September 8th, the transmitter has been on the air with test patterns and has been received in many of the suburbs of Montreal with good picture detail.

John D. Woodlock (right foreground) checking operation of his ham TV setup. Since this original item was written, word has been received that Mr. Woodlock died suddenly in his sleep on October 31, 1950 at his home in Iberville, Quebec, Canada.

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with the top output terminal positive as shown in 6D. As the applied voltage is lowered from the value required for null, the output voltage will reverse polarity and increase to a maximum in the opposite direction.

This circuit has two useful applications; one as a polarity-reversing control, the other as a voltage regulator. Operation as a control circuit results from the action just described. The output voltage of reversing polarity, produced by changes in value of the input voltage, may be applied to polarized relays or to thyatron grids. Voltage regulator action is obtained when the applied voltage is somewhat more positive or more negative than the value required for bridge null. Under these conditions, output voltage changes will be a small percentage of supply voltage changes. The closeness of voltage regulation will depend upon the Thyrite exponent (See Equation 1).

Fig. 6E shows a potentiometer (voltage divider) in which the load taps are taken between series-connected Thyrite resistors. When the load currents are small with respect to the current flowing through the Thyrite string, the load voltages will be fairly constant. A portion of load voltage resulting from variations in load current, while not entirely eliminated, are much lower with the Thyrite potentiometer than with a conventional unit using linear resistance sections.

A simple voltage regulator is shown in Fig. 6F. The ratio of linear resistance (R) to Thyrite resistance (T) is chosen such that the Thyrite resistor operates within the steepest portion of its volt-amphere characteristic. Large changes in Thyrite current, resulting from corresponding changes in applied voltage, accordingly will produce small changes in voltage drop across the Thyrite resistor. Since output voltage is taken across the latter, output variations will be a fraction of supply voltage changes. The effectiveness of this regulator is enhanced when the output load current is small compared to current flowing through the Thyrite resistor. Since output voltage is taken across the latter, output variations will be a fraction of supply voltage changes. The effectiveness of this regulator may be increased by cascading several sections, as shown in Fig. 6G. Variations in the output of each section are a small percentage of variations in the voltage applied to that section. As the number of sections is increased, the output voltage variation accordingly approaches zero. However, regulator action will be attenuated by the initial applied voltage, as well as the voltage variation. The practical limit to the number of cascaded sections which can be used in a particular case is determined by the

**January, 1951**
amount of voltage reduction which can be tolerated.

The circuits of both 6F and 6G may be employed as signal limiters ahead of, or between the stages of a tube amplifier. Such limiters offer far from clipper circuits in that they keep the signal amplitude reasonably constant without squaring the wave. However, the odd-harmonic distortion introduced by the Thyrite must not be neglected.

The circuit of 6H may be considered the inverse of the voltage regulator (Fig. 6F). Here, the non-linearity of the Thyrite resistor is used to multiply variations in the applied voltage. It should be noted that it is only by this variation ratio which is multiplied by this circuit, and not the voltage itself. Actually, the input voltage is attenuated, although the ratio of change is increased in the output. The ratio may be increased still further by additional sections in cascade, as shown in Fig. 6I. The practical limit to the number of sections which may be added is set by the permissible amount of voltage reduction. For best results, circuits 6H and 6I both should operate into high-impedance loads. Also, the linear resistances (R) must be small in comparison with the Thyrite resistances.

Operating Data

(1) Electrical Stability. (a) No change with time. (b) With proper application, Thyrite can be operated indefinitely without change in characteristic. (c) Unaffected by pressure or vibration. (d) Has same characteristics for impulses of microseconds duration as it has for d.c. or a.c. instantaneous values of current and voltage. (e) Free from polarization effects.

(2) Power Ratings. (a) Continuous. Depends upon permissible temperature rise of Thyrite and provision made for dissipation of heat. A continuous rating of 0.05 watt per square inch of Thyrite surface is usually allowable for separated discs, with the plane surfaces vertical, in still air. This conservative rating can be increased, where necessary, by the use of special provisions for cooling, such as radiating fins, forced-air draft, or immersion under oil, or Pyranol. (b) Short-time. Short-time rating depends on volume of disc. Assuming no time for radiation, a temperature rise of 80 C. results from energy input of 2000 watt-seconds per cubic inch of Thyrite.

(3) Effect of Temperature. An increase in Thyrite temperature tends to increase the current, the increase in current also being dependent upon the voltage applied. The change in resistance at constant voltage is from 0.4 per-cent to −0.73 per-cent per degree C. over the temperature range 0 to 100 C. To avoid undue oxidation of
the metallized surface and to preclude depreciation of impregnating compound, the operating temperature of Thyrite should not exceed 110 C. continuously, nor exceed 150 C. for short times. However, proximity of Thyrite to other materials may dictate lower operating temperatures.

(4) Effect of Humidity. Effect on Thyrite volt-ampere characteristics is minimized by use of impregnating compound. At currents below one milliamper, and for high-humidity conditions, further precautions may be necessary.

BIBLIOGRAPHY
The author has consulted the following references and recommends them to readers desiring a more extensive treatment of Thyrite characteristics and applications.


BYPASS REPLACEMENT
By L. Fleming

A COMMON failure in transformer-operated TV receivers, such as the Philco Model 48-1000, is the shorting out of the 0.1 mfd. paper bypass condenser connected between ground and the screen of the horizontal deflection output tube. When this condenser shorts, it places the full 300 to 400 volt supply voltage across the screen deflection resistor, which is usually a carbon unit of around 2000 ohms. The result may be smoke, smell, and burned-out 5U4 rectifiers.

An overheated carbon resistor tends to go down in resistance, rather than up, and thus the loaded down resistor becomes practically a dead short across the plate supply. The failure is just the opposite of a "safe" failure. The usual fuse protection against exessive plate current in the 6H6G tube is of no help, because the short is external to the tube.

This type of failure can be made "safe" by using one of the new metalized paper condensers for the screen bypass. The self-healing characteristic of metalized paper is just the thing for this application. According to the manufacturers, if one of these condensers breaks down, the resulting are discharged through the paper dielectric removes the weak spot in the paper and at the same time vaporizes the metal film around the spot, clearing the fault.

January, 1951
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Technical Qualifications:
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3. Army veterans TECH SGT or higher.

Personal Qualifications:
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2. Ability to assume responsibility.
3. Must stand thorough character investigation.
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For constant impedance at either source or load, ideal for individual volume controls in multiple speaker sets-ups without affecting source impedance.

UHA-001 5 ohms $ .95 UHA-002 25 ohms $ 1.50
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RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

THE crystallization of a plan that was launched in Chicago in September by a group of Chicago television service contractors occurred at a conference held in Washington in late October. At this meeting, which was attended by service representatives from many sections of the country, the National Alliance of Television and Electronic Service Associations (NATESA) was formed. The general plan for the operation of the national federation was agreed upon and a slate of officers selected.

Frank J. Moch, the dynamic president of the Television Installation Service Association of Chicago, was chosen president of the new organization. Albert M. Hains, president of the Television Contractors Association of Philadelphia, was named vice-president, while Jim Hustad of the Omaha Television Installation Service Association, Omaha, Nebraska, was named secretary. The duties of treasurer will be handled by Bertram L. Lewis of the American Radio Technicians Guild of Rochester (N. Y.).

The philosophy and purpose of the National Alliance of Television and Electronic Service Associations is outlined in a letter from Mr. Moch to the editor of your "NEWS" department:

"NATESA was formulated to give the service profession an equal footing with the rest of the industry. We are certain that this new national group, when it is given its rightful place at the council tables of the industry, can do a great service for the entire industry.

"As President of both TISA and NATESA I am pledged, as I have always been in the past, to achieve full stature for the service profession. I am certain that such a goal can be reached very soon. Many conferences have already been held with other elements of the industry; many others are scheduled for the near future. One of the cardinal principles of NATESA is that it will not be a 'racket.' It will be...

What's the best fringe area antenna—Yagi, conical, circle, or fan? Norman L. Chaffin answers questions for a group of Akron technicians at a recent service lecture session.

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operated by service people. It will work unselfishly to the end that service will be recognized not as a necessary evil but as a very essential, integral element of the industry.

"NATESA will adopt a code of ethics and an emblem which will be the symbol of competence to the public. It will vigorously prosecute any service racket from without or within the profession. Among its goals will be:

1. Recognition of service as an honorable element of the industry.
2. The establishment of standards.
3. The establishment of "post graduate" training.
4. The establishment of adequate compensation for personnel and management.
5. A place on industry's councils."

Organizations that want to contact NATESA should address their letters to: Frank J. Moch, President NATESA, 5908 South Troy Street, Chicago 29, II.

Manpower Situation

Government agencies, the Armed Services, and the television and electronics manufacturers are taking experienced field service technicians at a quickening rate. While the most serious inroads on the ranks of experienced service personnel have occurred in the metropolitan areas its effects are being felt by the service industry throughout the country.

The seriousness of the situation is clearly reflected in a frank "open" letter recently released to the leaders of the television industry by Albert M. Haas, president of TCA in Philadelphia.

"In Philadelphia the picture is clear: The loss of service technicians in television to the Armed Services and to the manufacturers of television and electronic equipment has become appreciable.

Service calls are now being handled in five days instead of 24 hours because there just aren't enough technicians to handle them! Reports from members of this association indicate that the spread of competence to the public. It will take years to train a technician to full flood of technicians to handle them!

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in five days instead of 24 hours because there just aren't enough tech-
A group of Akron technicians take a breath between lectures presented by the Lecture Bureau in a recent Radio-Television Service Industry Day program in that city. From left to right are: W. C. Parsons, East Akron Radio Service; Bill McPherson, Medina Radio & TV; John Ablett, Mac's Radio Service; and Mike M. Srivaya, Medina Radio & TV.

The statistics given in Mr. Haas' "open letter" are helpful in getting a clear picture of the problem: "We understand that there are about 60,000 qualified electronics experts engaged in television service. This means that we have one man to handle 167 sets of the ten million now said to be in operation.

"Without losing any of these men the service job involved in keeping ten million sets functioning, aggravated by the parts and tube shortages, is staggering. For each man to handle the service on an average of 167 sets, under today's conditions, is impossible. The line has to break somewhere under the pressure."

But despite the known and widely recognized seriousness of the situation no industry plans of any kind have been advanced toward solving the problem. In few cities like Philadelphia and Chicago, where strong, active service organizations are operating, steps are being taken to put into operation planned programs to utilize the available personnel most efficiently. But these local programs cannot solve the pressing problem of manpower depletion. The problem cannot be solved by the service industry alone.

The real solution lies in some aggressive, soundly-conceived industry-wide program that will take into account the technical manpower needs of all segments of the industry and operating under a plan that will capture the interest of more men and women in this great new opportunity that is Television.

Parts Problem Serious

The service industry seems to have acquired "Trouble" as its stepmother in these arduous days. Another facet of the problem of providing satisfactory service is the difficulty in getting replacement tubes and parts. Many manufacturers continue to sell the "tied-in" 12-month parts warranty contracts which, in the face of their enormous agencies that are drawing heavily on the service industry for technicians for top priority work.

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ability to meet replacement commitments of previous contracts in the past several months, will have some very unfavorable repercussions unless distributor "pipelines" are soon filled with the necessary replacement supplies.

At the beginning of this period of shortages practically all service operators accepted distributor "due bills" for tubes and parts replaced under warranties and used parts and tubes from their own stocks. However when it became evident that their own stocks soon would be depleted leaving them holding the bag on the parts' investment and without supplies to take care of their growing COD business needs, service contractors found it necessary to take drastic protective action.

TISA of Chicago advised its members: "In the case of inability to get a replacement part on "in warranty" sets, advise the customer that the parts replacement is the sole responsibility of the manufacturer and his distributors. In your factory collected the parts fee. If you have the parts available in your stock, use it in the set if the customer so requests, however, charge the customer full list price for the part and return the defective part to the distributor otherwise a long delay will result."

And TCA of Philadelphia stated its position in a letter to the manufacturers of television receivers and their distributors in the Philadelphia area: "...this bus has gone on record (10-19-50) as advocating that all contractors charge the customer for the replacement of parts in warranty and to advise the customer that he should take up with the manufacturer the replaceability of the affected parts and reimbursement for any parts provided by the contractor.

"We are impelled by the urgency of the present parts situation to take this step, much as we regret it. Our hope is that the manufacturers will take whatever steps are necessary to reduce the urgency and permit us to function in our accustomed role. When that happens we will be most happy to cooperate with the manufacturer in maintaining the customers' enjoyment and appreciation in his television receiver."

Before the present serious international situation developed the manufacturers of tubes and components were busy in meeting the growing needs of the industry. They were allocating definite percentages of their production for distribution through regular replacement parts channels. Although the independent parts distributing pipelines were adequately stocked on most replacement items they were not overstocked.

The war scare buying that boomed television and radio sales during the normally light summer months may have disrupted supply to the providers of replacement parts field to buy additional supplies of the components they needed to increase their set pro-

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January, 1951
duction. Several receiver manufacturers shipped tubeless television receivers to their distributors with instructions to pick up the necessary tubes from an independent parts distributor.

In the light of these developments it appears that receiver manufacturers have concentrated on the production of complete receivers without regard to their obligations to supply adequate stocks or replacement parts to maintain these receivers in service. Perhaps their thinking is based on a gamble that the normal post-Christmas buying letdown will slow sales and permit the replenishment of distributors' stocks of tubes and parts at a bargain all right. It is a gamble against a rising crescendo of customer complaints that will bring the great "White Fathers" in Washington with more ropes to hamstring our greatest potential industry.

This problem harbors lots of trouble for service operators. They are powerless to do anything about it except to keep pounding away at other industry organizations urging them to take fast, concrete action toward a correction of the situation before it results in complete service chaos.

What Size TV Service Companies?

Amidst all of the confusion created by the impending defense demands of the industry, scare buying, and critical shortages of replacement parts and tubes, economic patterns for the efficient and profitable operation of independent service companies are becoming apparent. The editors of your "NEWS" department have been conducting an exhaustive survey of successful service business operations in all sections of the country. Our report to you will be carried in a feature article in the February issue of Radio & Television News. Watch for it. You will find it interesting.

TV Set Conversions

The best barometer of the great differences in the activities of independent service business operators in various sections of the country is reflected in what they are doing in the business of converting television receivers. This business was a lifesaver to many of the smaller service contractors in metropolitan areas last Spring when the battle for installation and service business got rough. And it was a boon to the larger contractors in keeping their organizations busy during slack periods.

Yet in many cities independent service operators have been indifferent to the stable business possibilities of the television conversion business. Some said they had converted one set and found they could not handle the business at competitive prices. Others had paid no attention to it.

The conversion of television receivers is a long-range business activity. Where we are now converting from 7", 10", and 12" picture tubes to all the currently desirable larger sizes, we are also establishing a user acceptance
The secret of profitable television receiver conversion business for the small operator is in specializing in one make of receiver and size of picture tube at a time. Once you have solved the problem of converting a particular type of receiver in your shop and have determined the cabinet changes that must be made, you can set up a simple "conversion line" and handle this type of receiver profitably.

If you are not a good "customer relations" type of man, you will have to get someone to solicit the business for you. Conversions are not hard to sell.

The question we are asked most often about customer relations is this: "How do you handle a customer and get him to pay for trouble he caused by tinkering with his TV receiver without making him mad?"

For many years one of the basic faults of radio service operators in dealing with customers was the tendency to assume an almost apologetic attitude, the quoting prices for a service job or in filling a customer frankly all of the parts that should be replaced to put his receiver in first-class playing condition. Maybe it was because we were selling our service time in competition with $3.50 a c.-d.c. sets; or perhaps it was caused by our own feeling of inadequacy to turn the stuff out faster. Regardless of its cause, it was an almost universal trait among service operators. They thought so little of their own abilities as business men that they applied speakers who told them how lousy they were!

The men who have become successful television service operators have built their businesses on the sound thesis that customers are justly entitled to receive the service they pay for, but only the service they pay for.

Good customer relations are an essential element in any successful television service business. One of the most useful booklets for establishing good customer relations with TV set owners that we have examined is the booklet published by the Better Business Bureau of New York called "Things you should know about the purchase and servicing of television Sets." It is written for the TV receiver purchaser and owner and it sets out clearly what the user has a right to expect and what he is not entitled to receive.

If you do not have a satisfactory television receiver catalog available for distribution in your town you should get a couple of copies of this booklet and carry one of them with you whenever you call on your service customers. You can get these booklets at a cost of ten cents each from the Better Business Bureau. Here is the address: The Better Business Bureau of New York, Inc., 280 Broadway, New York 7, N.Y.

January, 1951
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Several errors occurred in the article, "Noise Reduction for High Quality Reproducing Systems." (Matthews, "By Wire," appearing on page 70 of the September 1950 issue of this magazine. In Fig. 3 (page 72) the arm of the potentiometer R should be connected to the lower end of R, not to "+" as it appears. The value of R, which is listed as 5000 ohms, should be a 1,000 ohm unit. Some readers have reported erratic behavior at the suppressor. This has been traced to the fact that an input of less than 1 volt average signal level, should appear at this point.
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