OCTOBER
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RADIO & TELEVISION NEWS

ANC

GRID EMISSION TESTS INFLUENCE QUALITY OF VACUUM TUBES

PAGE 39

THE QUALITY OF **RCA** TUBES IS UNQUESTIONED

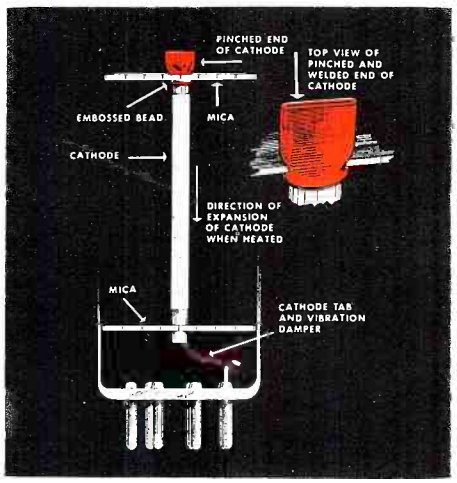
Extra Performance

as a matter of course . . . with RCA tubes

Engineering progress is part and parcel of RCA quality. For instance . . . many of the popular RCA types use *"inverted" pinched cathodes* to minimize microphonics by preventing cathode vibration or displacement.

This improved performance is achieved by clamping the top mica firmly between an embossed bead on the cathode and its pinched top end. This arrangement holds the upper end of the cathode rigidly, but permits the heated cathode to expand freely downward through the bottom mica without producing cathode strain. The lower end of the cathode is prevented from vibrating by means of the damping tab connected between the cathode and stem lead.

This example is another reason why you can count on *extra* performance and long life from RCA tubes—the quality tubes.



Keep informed—stay in touch with your RCA Tube Distributor

RADIO CORPORATION of AMERICA
ELECTRON TUBES
HARRISON, N. J.

NEW

I'LL TRAIN YOU FOR YOUR FCC LICENSE

A Federal Communications Commission Commercial Operator's License puts you in line for a good job in Radio or Television Broadcasting. Police, Marine, Aviation, Two-way, Mobile or Micro-wave Relay Radio. Mail coupon below for 64-page book FREE. It will give you complete facts about my NEW Communications course.

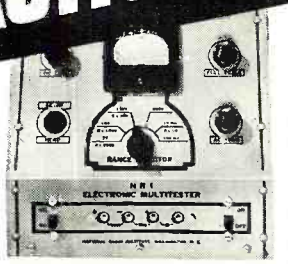
YOU BUILD THIS TRANSMITTER

with parts I send. With this Transmitter you practice how to put a station "on the air." You perform procedures demanded of Broadcast Station Operators, conduct many experiments, make many practical tests.

LEARN COMMUNICATIONS by PRACTICING at Home in Spare Time

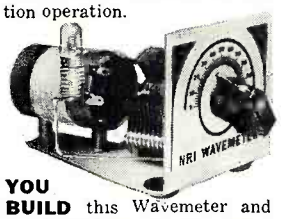
with MANY KITS of RADIO EQUIPMENT I SEND

YOU BUILD this Transmitter Power Supply used in the basic experiments in RF and AF amplifiers, frequency multipliers, buffers, etc.



YOU MEASURE current, voltage (AC, DC and RF), resistance and impedance in circuits with Electronic Multitester you build. Shows how basic transmitter circuits behave; needed to maintain station operation.

YOU PRACTICE setting up code, amplitude and frequency modulation circuits (put voice, music, etc., on "carrier signals" you produce). You learn how to get best performance.



YOU BUILD this Wavemeter and use it to determine frequency of operation, make other tests on transmitter currents.

Ever think HOW FAST Radio-Television Communications is changing, developing, growing? Have you considered what this amazing progress can mean to you?

Look at these facts. In 1946 only 6,000 Television sets were sold. In 1950, over 5,000,000. By 1954, 25,000,000 Television sets will be in use, according to estimates. 100 Television Stations are operating in 35 states. Authorities predict there will be over 1,000 Television Stations. This rapid growth means new jobs, more jobs, good pay for qualified men all over the U. S. and Canada. Then add development of FM, Two-way Radio, Police, Marine, Aviation and Micro-wave Relay Radio! Think what all this means! New jobs, more jobs for beginners! Better jobs, better pay for experienced men!

Are you a beginner who wants steady work in this growing field? My NEW course can help you get an FCC License and prepare for the job you want. Are you a man with some training in Radio or Radar, or a Licensed Operator? My NEW course modernizes, increases the value of your knowledge and experience!

MY COURSE INCLUDES TELEVISION

Course Is New! Different!

Mail coupon now for facts about my NEW, intensely practical course in Radio-Television Communications. Let me send you FREE book. Read outlines of 78 lesson texts written by leaders in Communications and edited for you by my practical staff. See the nine big Kits of Parts I send that "bring to life" theory you learn. Read about the Transmitter you build and operate, about the Electronic Multitester you get. All equipment yours to keep. My NEW course covers Theory thoroughly and you get Practical Experience building units like those shown at the left. It's backed by N. R. I.—the world's oldest and largest home study Radio-Television school.

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Send today! See what my NEW course is like. Find out how I get you ready for a brighter future, better earnings, more security in Radio-Television. Send coupon now in envelope or paste on a postal. NO OBLIGATION. NO SALESMAN WILL CALL! My book, sent to you FREE, tells the full story. J. E. SMITH, President, Dept. 1KE, National Radio Institute, Washington 9, D. C.

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If you prefer a good-pay job in Radio-Television Servicing . . . or your own money-making Radio-Television Sales and Service Shop, I'll train you at home. My famous Servicing Course also includes many Kits of Radio Parts. You use them to get PRACTICAL EXPERIENCE with circuits common to Radio and Television. I also show you how to make $5, $10 a week or more EXTRA MONEY fixing neighbors' Radios while training. Full information in my 64-page book. . . . Mail coupon.

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Knowing Radio, TV, Electronics can help you get extra rank, extra prestige, more interesting duty at pay up to several times a private's base pay. You are also prepared for good Radio-TV jobs upon leaving service. Mail Coupon TODAY.

I TRAINED THESE MEN

"N.R.I. has been my stepping stone from a few hundred to over $4,000 a year as a Radio Engineer."—ALTON B. MICHAELS, Trenton, Georgia.

"I am employed by WKBO as transmitter operator. Have more than doubled salary since starting in Radio full time!"—A. HERR, New Cumberland, Penna.

"Am Broadcast Engineer at WLPM. Your NEW Communications course shows the kind of equipment we use."—J. BANGLEY, JR., Suffolk, Virginia.

"4 years ago, I was a bookkeeper with hand-to-mouth salary. Am now Radio Engineer with ABC network."—N. H. WARD, Ridgefield Park, N. J.

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National Radio Institute, Washington 9, D. C.

Mail me your 64-page Book about Radio and Television Communications opportunities and training. (No salesman will call. Please write plainly.)

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Address.....

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

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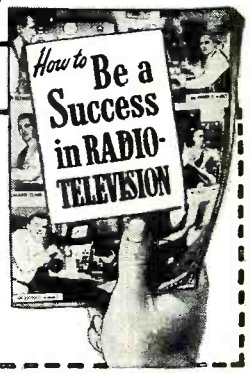

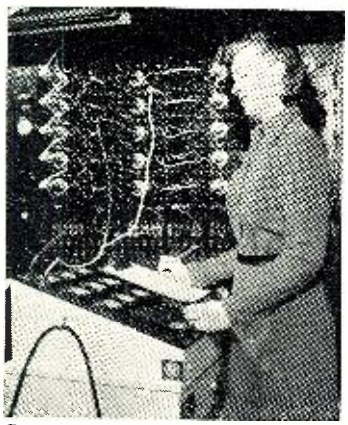

COVER PHOTO: Part of the quality control test equipment at Tung-Sol. Samples of every production run are tested to insure service even under widely fluctuating supply voltages. (Kodachrome by Donald E. Hults)

First in radio-television-electronics
Average Paid Circulation over 200,000

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DEPARTMENTS

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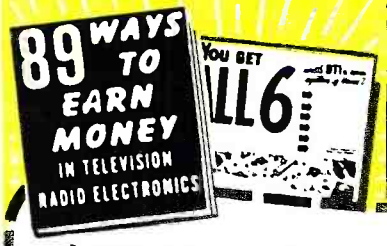
Here's the REAL THING!

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 right

Get BOTH of these information packed publications FREE!



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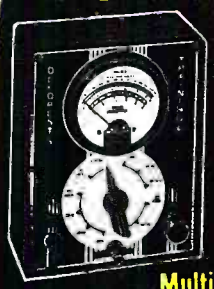
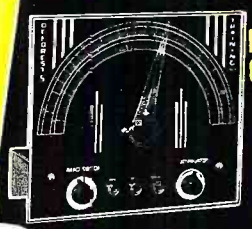
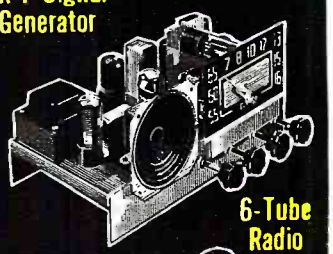


Multimeter

Oscilloscope



R-F Signal Generator



6-Tube Radio

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Address.....Apt.....

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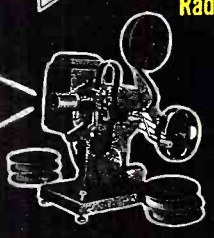
HOME MOVIES



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A DeVRY INSTITUTION

Your voice in Davy Jones' locker

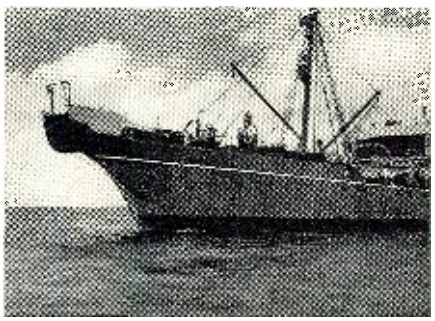
To strengthen voices in the newest submarine cables between Key West and Havana amplifiers had to be built right into the cables themselves. With the cables, these amplifiers had to be laid in heaving seas; and they must work for years under the immense pressure of 5000 feet of water.

For this job, Bell Laboratories engineers developed a new kind of amplifier — cable-shaped and flexible, with a new kind of water-tight seal.

To serve far beyond reach of repair, they developed electron tubes and other parts, then assembled them in dust-free rooms.

The two cables — each has but two conductors — simultaneously carry 24 conversations as well as current to run the electron tubes.

With these deep-sea amplifiers, submarine cables carry more messages . . . another example of how research in Bell Telephone Laboratories helps improve telephone service each year while costs stay low.



Cutaway view of deep-sea amplifier. Tubes and other elements are housed in plastic cases then enclosed in interleaved steel rings within a copper tube. Layers of glass tape, armor wire and impregnated fiber complete the sheath. Cable ship, shown right, payed out cable over large sheave at bow.

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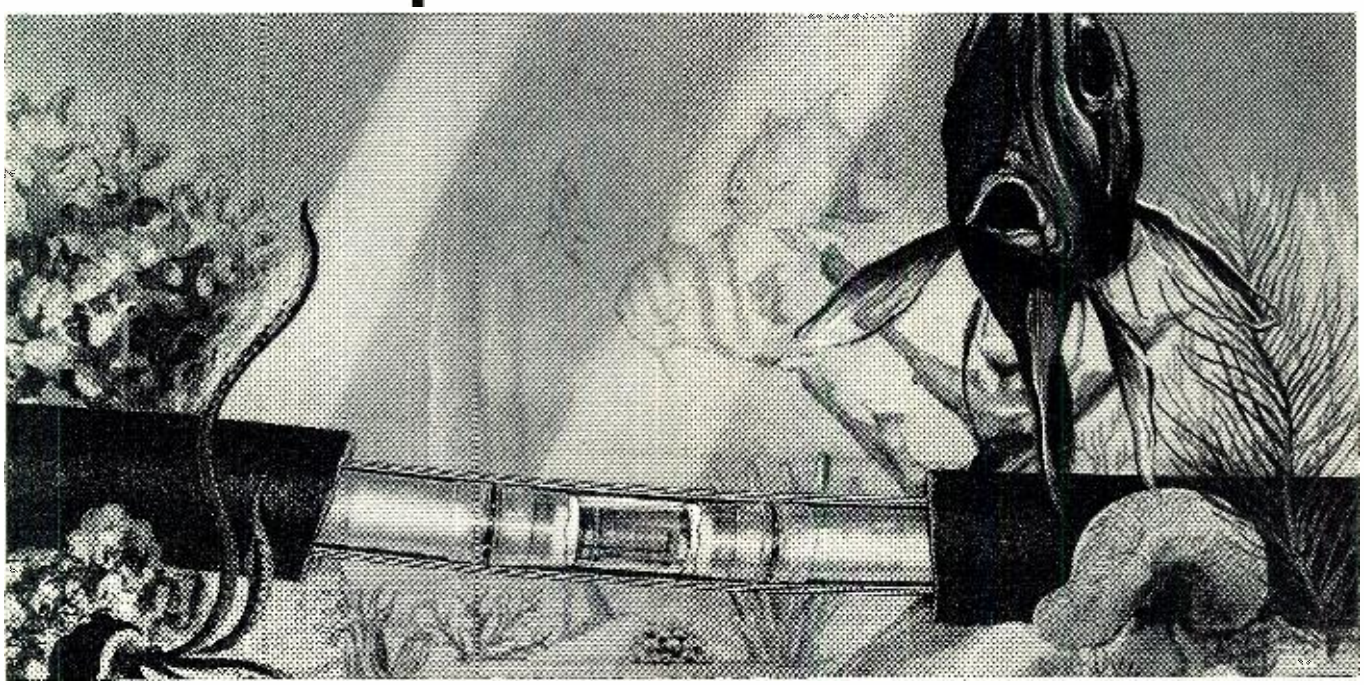
• *Exploring and inventing, devising and perfecting, for continued improvements and economies in telephone service.*



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who can create customer confidence with his Bonded, cash-protected method of doing business . . . who can instantly identify himself to his customers with the Raytheon Creed Display, the Bonded Decal and the Raytheon Bonded Identification Card

. . . is the Service Dealer whose business is booming.

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For the RECORD

BY THE EDITOR

JOINT INDUSTRY BOARD FOR TV SERVICE?

IT IS most gratifying to see a real and continued effort on the part of the television industry to "clean house" and its leaders demanding a code of ethics for its servicing media. Well-established organizations are showing real progress in obtaining new group and individual memberships. Several plans have been proposed and are under study. Another, just received from NATESA and mailed to its members, makes the following proposal:

It recommends that a JOINT INDUSTRY BOARD, comprising such national groups at RTMA, NARTB, Set Distributors, EP & EM, EPMA, NEDA, NARDA, NATESA, Better Business Bureaus, and other interested national groups be immediately established. "This Board should promptly set up standards and codes of ethics for both service companies and servicemen. It should then arrange sub-committees in various metropolitan areas. The *JOINT INDUSTRY BOARD* would set up qualifying technical examinations, both theoretical and practical for servicemen and set up a qualifying system for service companies. The requirements for a grade of 'Acceptable Company' should be the furnishing of acceptable copies of certified financial statements, sworn statements showing an itemized list of test equipment, certificates of insurance, and a listing of manpower showing categories. The service company, upon issuance of an 'Acceptable Certificate,' could then advertise the fact. The working of the plan would be voluntary.

"The service technician upon receipt of 'Acceptance Certificate' would then be acceptable to any 'Accepted Contractor.' 'Accepted Contractors' must hire 'Accepted Technicians' in a ratio of 3 'Accepted Technicians' to each unaccepted. An apprentice rate could be set up. A small fee necessary to cover cost of the examinations would be chargeable to both technicians and contractors. We suggest $25.00 for contractors for the initial examination and $10.00 per year thereafter as a renewal fee. The Board will reserve the right to ask for subsequent statements at any time it feels it necessary to assure continued ethical operations. Insurance companies should be required to furnish the Board with notice of cancellation of insurance policies. Technicians should pay a fee of about $5.00 initially and a renewal fee of about $2.50 annually thereafter.

"We believe that the manufacturers and telecasters should then be expected to publicize this plan and its 'Accepted Contractors' nationally. Fulfillment of this plan would assure honest, ethical, and intelligent service. It would assist immeasurably in eliminating bankruptcies and frauds. The loss both financial and prestige-wise to the TV industry would be stopped. The cost to the industry would be only a fraction of its worth. It would eliminate the regular threats of political control and need of licensing. The public would be assured of better service, at better prices. The Better Business Bureau would be freed of a tremendous load."

We believe this plan is worth careful study by the Industry In fact—any intelligent plan is certainly worth considering if it will help pave the road to successful and ethical television servicing. What do YOU, as a TV technician think of this plan? Do you have a better one? We'd like to hear from you.

The Audio Fair

NEXT month (Nov. 1, 2, and 3, to be exact) ushers in the Annual Convention of The Audio Engineering Society and The Audio Fair at the Hotel New Yorker in New York City. Your editors will be on hand to welcome those attending this important occasion and to try to help make your visit pleasant and informative. It is expected that last year's attendance record will be broken.

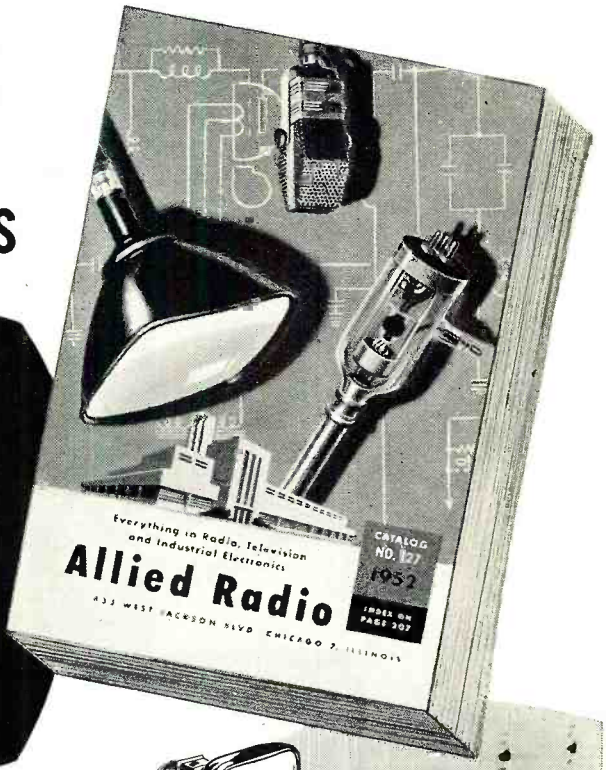
Audio Feature Issue

OUR readers' reactions to previous Annual Audio Issues show a steadily increasing interest in all phases of the subject. Accordingly—many special audio feature articles are scheduled for next month, in addition to other regular contents. We know you'll like the November issue, even better than in previous years.

Radio & Television News Staff Moves East

OUR sister publications, including FLYING, POPULAR PHOTOGRAPHY, and other national magazines, are now headquartered in New York City. With continued expansion of the company, it is desirable that RADIO & TELEVISION NEWS also join forces with the remainder of the company, at its new headquarters. We believe that with expanded facilities we will now be able not only to maintain the present leadership of RADIO & TELEVISION NEWS but will be able to bring to our readers many new ideas, techniques and new departments. . . . . O.R.

the only complete catalog for everything in Radio, TV & Industrial Electronics



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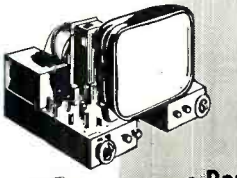

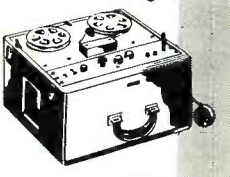

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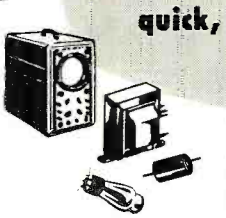

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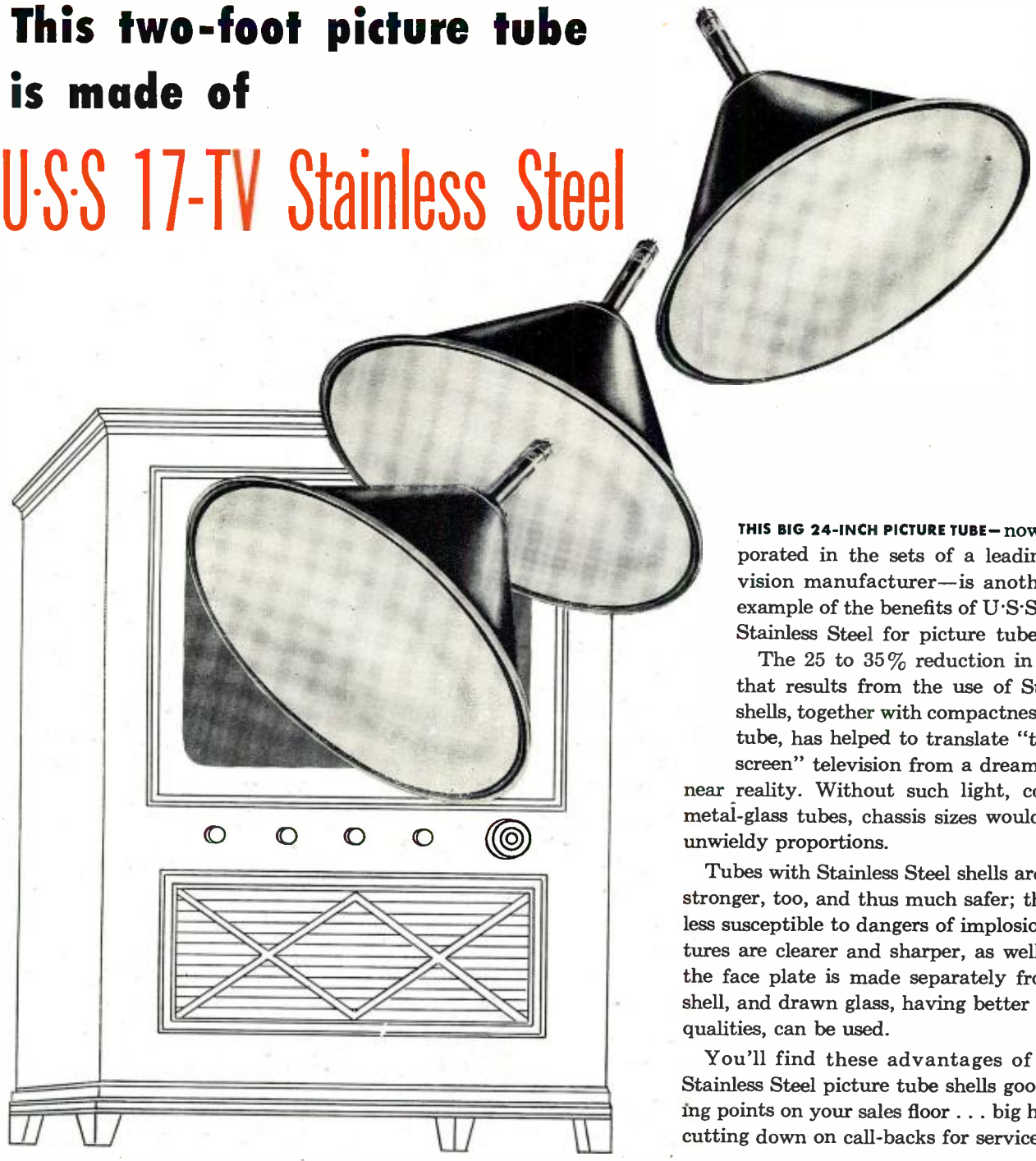
U·S·S 17-TV Stainless Steel



THIS BIG 24-INCH PICTURE TUBE—now incorporated in the sets of a leading television manufacturer—is another fine example of the benefits of U·S·S 17-TV Stainless Steel for picture tube shells.

The 25 to 35% reduction in weight that results from the use of Stainless shells, together with compactness of the tube, has helped to translate "theater-screen" television from a dream into a near reality. Without such light, compact metal-glass tubes, chassis sizes would reach unwieldy proportions.

Tubes with Stainless Steel shells are much stronger, too, and thus much safer; they are less susceptible to dangers of implosion. Pictures are clearer and sharper, as well, since the face plate is made separately from the shell, and drawn glass, having better optical qualities, can be used.

You'll find these advantages of U·S·S Stainless Steel picture tube shells good talking points on your sales floor . . . big helps in cutting down on call-backs for service.

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NATIONAL TUBE COMPANY, PITTSBURGH · TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM · UNITED STATES STEEL COMPANY, PITTSBURGH
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UNITED STATES STEEL

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Signal Generator — Audio Oscillator — T. R. F. Receiver

MASTER ALL PHASES!

Get Master Shop-Method Home Training from an Established Practical Resident School with its own Training Shops, Laboratories, and Studios—and almost 50 Years of Successful Experience in Training Ambitious Men.

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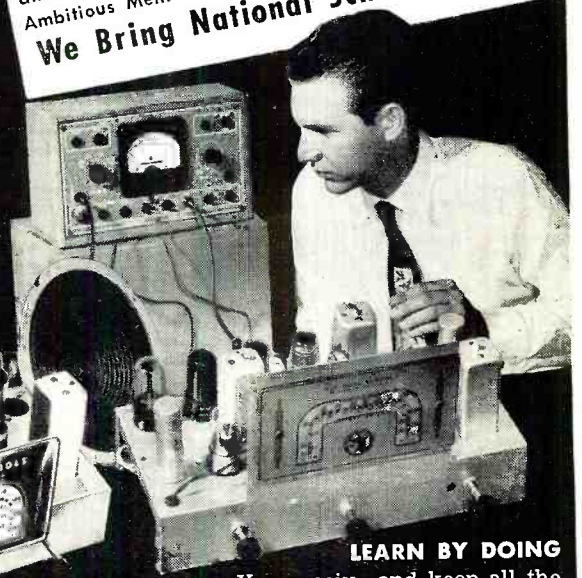

Superheterodyne Receiver

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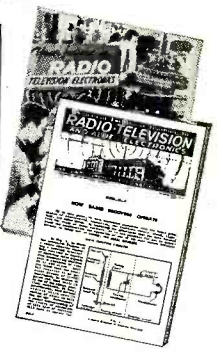

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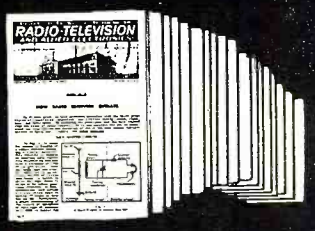

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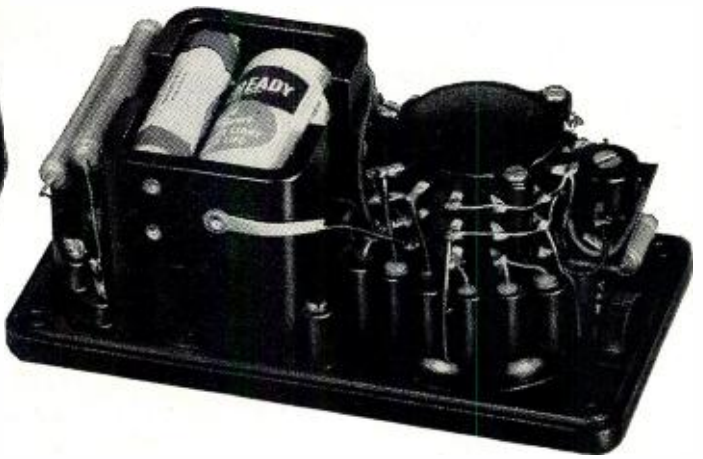
Model 666-R

NOTE the wide ranges of this compact pocket-size instrument. Note controls—flush with panel. Then study the inside view. Nowhere will you find, in design and manufacturing quality, the equal of 666-R.



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1. Resistance Ranges from 0-3000 Ohms (.5 Ohm low reading) to 3 Megohms, self-contained. Also A.C.-D.C. Volts to 5000, 10 ranges; and 3 Direct Current ranges.

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3. Unit Construction—Resistors, shunts, rectifier, batteries, are housed in a molded base integral with the switch. Direct connections without cabling. No chance for shorts.

4. Resistors are precision film or wire-wound types, each in its own compartment.

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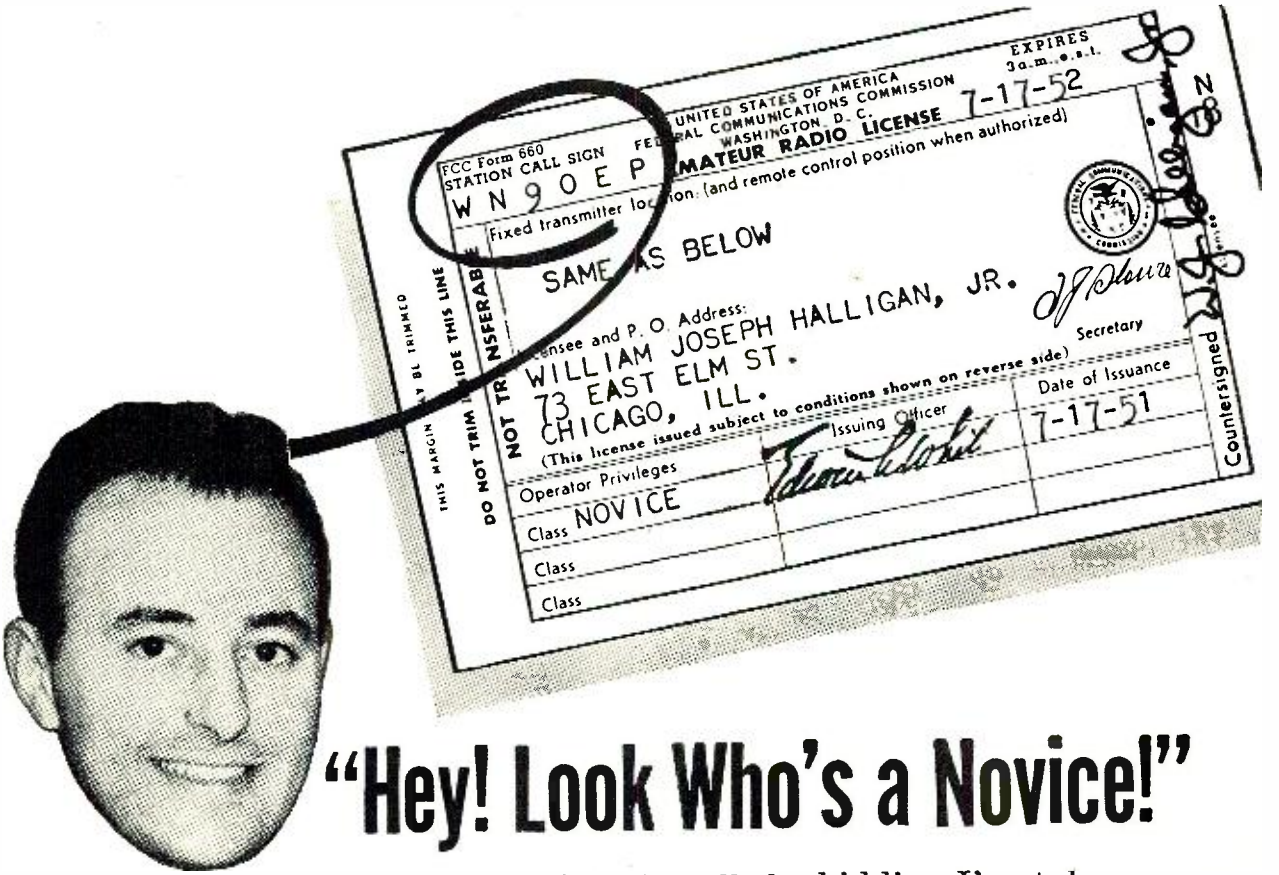


"Hey! Look Who's a Novice!"

"You can't imagine all the kidding I've taken from all the Hams here at Hallicrafters. How come, they said, that 'The Biggest Ham Shack in the World' contains a guy who doesn't own one of those coveted "FCC cards"?

"Now, I Tell 'em: Just call me W N 9 O E P!"

Bill Halligan, Jr.
Sales Manager
Communications Division
The Hallicrafters Company.

P.S. "We are so excited about the development of Novice Class operators that we're going to give ten new Hallicrafters S-76 receivers FREE to the first ten novices to work all states after September 8, 1951, and to obtain their General or Conditional Class licenses. In addition, every other novice who completes the above before a specified date (to be announced next month) will receive a prize. You must start as a novice but all your QSOs count, so get going!"

NEWS FLASH!—Three new Hallicrafters are now in production. You'll be seeing soon the . . .

S-81 Civic Patrol—Keeps you "in the know" on emergency radio messages! Covers VHF 152-174 Mc. (S-82 covers H/F 30-50 Mc). Either set: **$49.50**

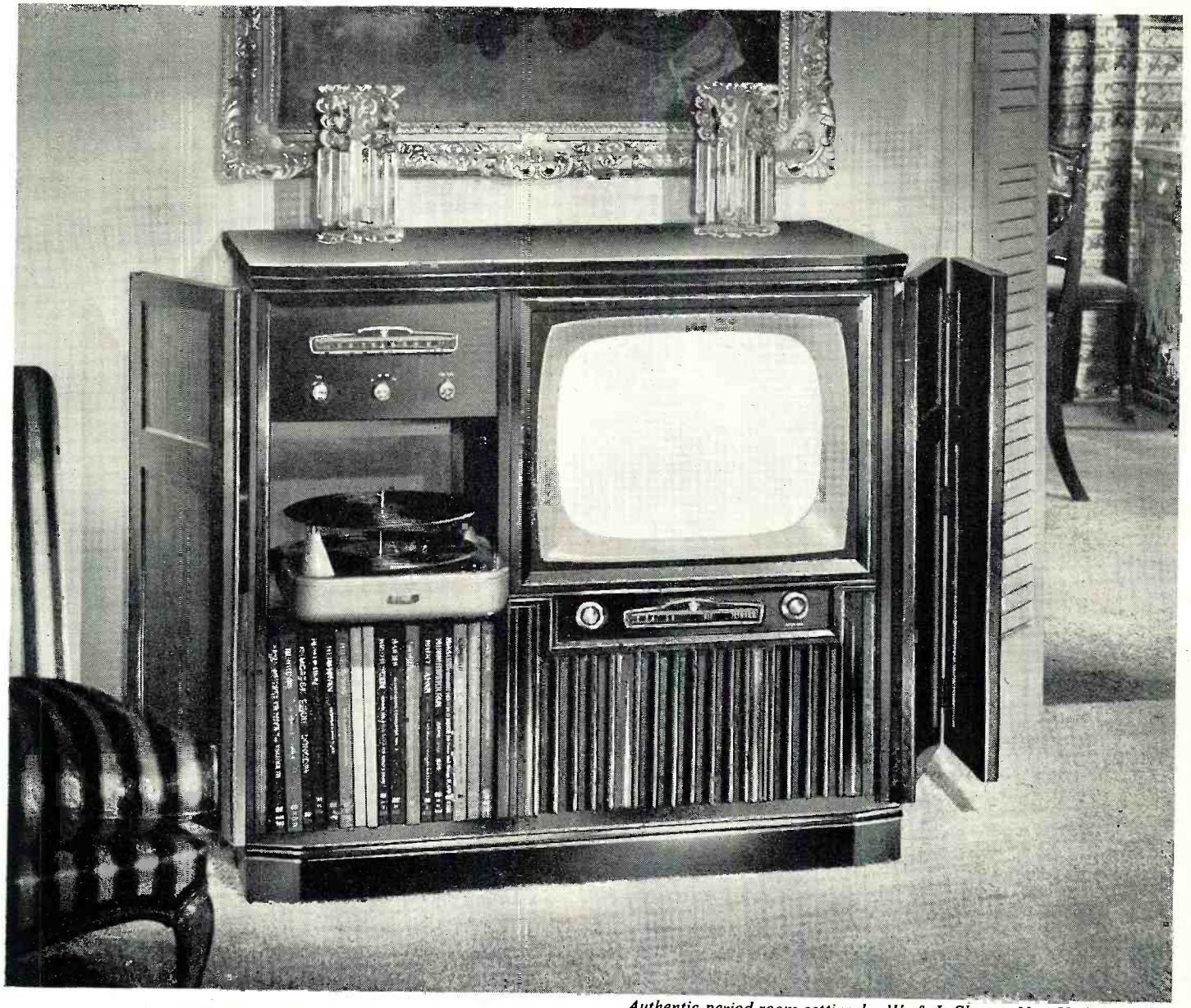
S-80 Defender—Super-sensitive, long-life battery radio for remote areas and emergency civil defense. Standard broadcast plus short-wave from 6-18 Mc (aircraft, amateur, international broadcasts). **$44.50** (Less batt.)

S-78A—Improved FM/AM chassis; radiation-proof; automatic frequency control; standard broadcast plus FM 88-108 Mc.; 8-watt push-pull output. **$89.50**

hallicrafters

"The Biggest Ham Shack in the World!"

WORLD'S LEADING MANUFACTURER OF *PRECISION* RADIO & TELEVISION • CHICAGO 24



Authentic period room setting by W. & J. Sloane, New York

CROSLEY Sets the Pace for 1952 with DUO-FREQUENCY TELEVISION!

For Today **the clearest, steadiest picture . . . plus the enduring beauty of authentically styled cabinets.**

For Tomorrow **quickly, inexpensively adaptable to all forthcoming UHF channels . . . and equipped with color connections for FCC authorized color.**

Here is television engineered for the finest and clearest performance *today* . . . adaptable quickly and inexpensively to all forthcoming UHF channels and FCC authorized color *tomorrow!* Authentically styled for every home décor from traditional to modern—in lastingly beautiful cabinets of mahogany or maple veneer, or blond wood finish . . . with **Ultra-Proved Chassis** that provides 100% increase in reserve sensitivity—adds new brilliance and range to performance . . . **Permaclear Pictures** on wide-angle screens, pictures that stay sharper and brighter longer . . . **Unituner** that makes Crosley Television as simple to tune as a radio—a single control tunes both picture and sound automatically . . . **Glare-Deflecting Removable Picture Window** that keeps glaring reflections from viewer's eyes, and is easily and safely removable by the owner for cleaning the picture tube face. These and many other advancements make the new Crosley Duo-Frequency Television line for 1952 THE television of today and tomorrow!

Keep your eye on CROSLEY!

You remember the fall of 1949 when Crosley made its history-making move in refrigeration. A move that resulted in sales gains that brought Crosley right up among the top leaders in the refrigerator field—gains that brought increased sales and profits to Crosley Dealers everywhere—gains that made the Crosley name one of the standouts in the business!

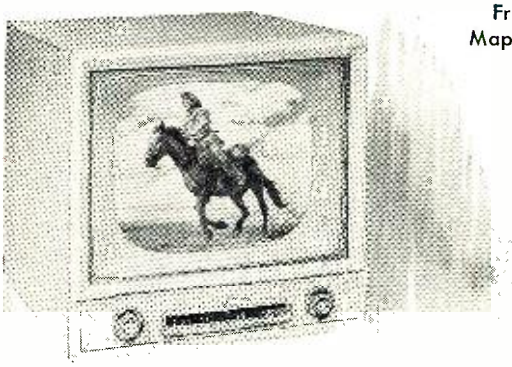
Now, in television, Crosley is repeating the strategy that changed the picture in refrigerators—giving the public a television line it really wants, backing that line with unusual, unconventional, hard-selling-at-the-retail-level advertising and promotional support.

The emphasis in 1952 Crosley Television is strongly on the magnificent and authentic styling of our cabinetry. More than ever before, American housewives are keenly conscious and selective about the furnishings in their homes. A "good picture" alone is no longer enough—they want fine *furniture*, too . . . furniture that expresses their personal tastes and fits in with their present home furnishings.

The twenty-one new Crosley TV Models for 1952 offer your customers a complete selection of traditional or modern cabinets in the finest mahogany or maple veneer, or blond wood finish furniture that will harmonize with the interior of any home—modern, French Provincial, Early American, 18th Century, any style of furnishing.

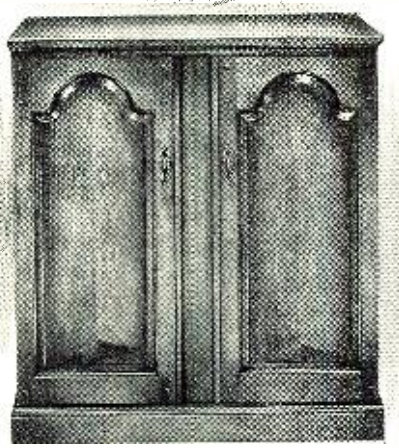
With powerful and well-timed advertising, promotional and point-of-sale support behind Crosley's superlative styling and performance, this may well be the greatest television sales opportunity you have ever seen. Keep your eye on Crosley!

The ENRICO CARUSO—Model DU-20 PDM.
Georgian Combination. 20-inch picture tube.
Hand-rubbed mahogany veneer.

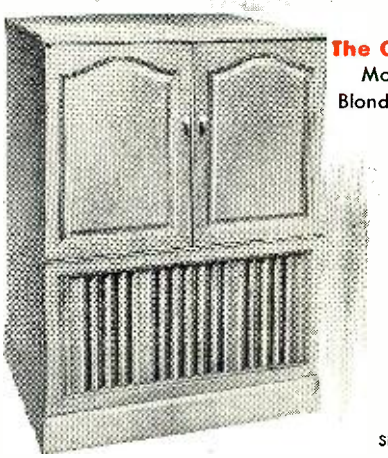


The SARAH BERNHARDT—Model DU-17 PHN.
French Provincial Combination. 17-inch picture tube.
Maple veneer. (With TV only—DU-17 CHN)

The JOHN PHILIP SOUSA—Model DU-17 TOB.
Modern Table Model. 17-inch picture tube.
Blond finish. (Mahogany veneer—DU-17 TOM)



The OTIS SKINNER—Model DU-17 PDB.
Early American Combination. 17-inch picture tube. Maple. (Mahogany veneer—DU-17 PDM)



The GEORGE ARLISS—Model DU-17 PHB.
Modern Combination. 17-inch picture tube.
Blond finish. (With TV only—DU-17 CHB)

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Television • Radios • Shelvador® Refrigerators
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Spot Radio News

★ ***Presenting latest information on the Radio Industry.***

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

TV's sprawling ice blockade, which finally began to rumble and reveal fissures here and there as the Commission initiated a long-overdue dynamiting session, opening up the power throttles of dozens of teletransmitters throughout the country, prompted brimming joy among hundreds of thousands as they saw brighter, sharper pictures on their sets. Many others beamed, too, as they learned that their remote locations had been drawn into the inner circle of reception, a situation which it had been felt would not prevail for years, many years.

Telegrams to New York City's five viewcasters, disclosed that increases in effective radiated powers were being allowed to not only provide double and triple outputs, but a step up in gain of over seven times, as in the instance of WPIX, whose 3.6-kw. signal had been permitted to jump to 21.7 kilowatts. The increases were as dramatic in other cities, too. Miami's lone station, operating on 1.45 raced up to 16.5. Residents in nearly fifty areas, at this writing, were finding reception much better because of power boosts: Louisville, Syracuse, Dallas, Omaha, Chicago, Nashville, Cleveland, Utica, Rochester, Columbus, Erie, Wilmington, Lancaster, Johnstown, Kalamazoo, Oklahoma City, Huntington, San Diego, Atlanta, Louisville, Cleveland, Los Angeles, Binghamton, Rock Island, Detroit, Indianapolis, Cincinnati, Philadelphia, Ames, etc.

According to the FCC records, one station is currently operating at the permitted peak or 50 kilowatts; WHAS-TV, operated by the *Louisville Courier-Journal*. Originally they had an *erp* of less than 10 kilowatts.

All grants have been issued on a six-months' trial basis to permit field studies of coverage and any interference problems. In most instances, the experts say, the powers will be allowed to stay at the high point on the dial, with even further increases being granted in some instances. However, it is expected that there will be trouble spots. As a matter of fact, one telecaster has already entered a complaint; WNHC-TV, New Haven, Conn. In a petition they declared that should they become a Channel-8 station, as the Commission has noted in their allocation plan, their present power of less than 2 kilowatts will not be sufficient to serve their community. In addition, they said it was feared that WABD's higher power in New York City, would cause serious adjacent channel interference. Accurate control of transmission and placement of antennas, could prevent such interference, it has been said. The next few months will provide an intriguing set of records which will indicate not only whether the New Haven broadcasters are correct in their assumption, but whether there will be any alterations necessary in other power and channel permits.

ALERT PLANS, particularly for broadcasters and amateurs, which had been in the hush-hush discussion stage for many months, became a matter of public record a short time ago, as the Office of Civil Defense released a regulation for New York City stations, prescribing procedures to be followed by AM, TV, and FM stations and hams.

Described as a means of depriving the enemy of assistance of high-powered transmitters on which to home, spreading an alarm when a attack is imminent, and, in addition, permitting command and information channels in the event of attack, the regulation notes than all stations will be required to follow the rules religiously. In the case of AM transmitters, it will be necessary for them, upon receipt of a *red* alert, which would indicate an attack is imminent, to announce that such an alert has been sounded and broadcast a siren warning over its facilities for three minutes. Stations will also be obliged to broadcast a . . . "sustaining recorded musical program or recorded civil defense instructions . . . for the duration of such alert. At five-minute intervals after its first announcement of the sounding of the *red* alert, and during the period of such alert, it shall announce that a *red* alert has been sounded. No other announcements shall be made during the period of such alert. The call letters and location of the station shall *not* be given."

The TV and FM station procedure was noted as being quite different from the AM plan. Both will be required to announce immediately that a *red* warning has been received, broadcast the siren warning for a minute, and go off the air without further comment.

All ham stations will be required to sign-off immediately as the *red* signal is transmitted.

A comprehensive monitoring facility

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THAT'S the way to become an expert radio service man. Study the theory and principles first. These are vitally important. Then roll up your sleeves and actually work with radios – assembling, experimenting, trouble-shooting, repairing. That way you learn radio *from the inside out.*

Which explains why I.C.S., in its new Radio Course, concentrates on *equipment.* You get the best. Matched parts for an excellent 5-tube superheterodyne receiver. Your own professional-quality multitester. A complete signal generator kit. High-grade servicemen's tools. "Rider's Perpetual Trouble-Shooter's Manual." Plus lesson material and instruction service second to none. Also included is Principles of Television, which is a steppingstone to TV installation and service.

Learn by doing! That's the world-famous I.C.S. method. Thoroughly practical. Completely modern. *Success proved.* The coupon below brings you full details–on radio servicing or on any of the more than 400 I.C.S. Courses. Mark and mail it *today!*

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Without cost or obligation, please send me full particulars about the course *before* which I have marked X:

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net has also been provided in the alert program. According to the regulation . . . "Within 12 hours after the termination of the program of the New York State civil defense radio network, following the *white* alert (all-clear alert), each AM and FM station, each television station and each amateur station designated to monitor the interim state control station and to link itself into the state-wide network of amateur operators, shall complete and mail to . . . the . . . commission . . . a full report concerning its activities from the time of its receipt of the *yellow* alert (a confidential signal signifying that an enemy attack is likely, which may also be used in CD tests) . . . or the *red* alert . . . to the termination of the program of the . . . network following the *white* alert."

A CD ORGANIZATIONAL pattern for the communications section of municipal control centers has also been released. Reviewing the role of the center up to the moment an attack warning is received, CD notes that the radar net of an area aircraft warning service serves to analyze the movement of enemy aircraft on a radar plot. Meanwhile, ground observers are required to send their information, via specially-handled existing wire communications, to a filter center, which transmits the data to radar stations, who plot this information with their own information, and send final results to the area air-defense control center. This center, in turn, plots and collates the information from the radar stations and other air-defense control centers. The commander in charge of the air-defense control center is then required to analyze the findings and decide when and what kind of a warning should be sent out.

In addition to telephone and teletype communications, control centers will be required to make full use of radio communications. Two reasons are cited as the purpose for the requirement: To insure continuity of communication if the wire services should break down, and to provide communication with mobile and other civil defense units having little or no wire communication.

Six small transmitters with powers of from ten to sixty watts have been suggested for center use to contact warden command posts, mobile reconnaissance teams and those mobile units furnished by the radio amateur civil emergency service *(RACES)*. Also recommended for contact are medium-powered transmitters with 50 to 100-watt outputs, to be used as a cross-band coordinating system contacting the fire and police departments, public utilities, taxicabs, and the sheriff's office. The latter would be required to have two-way equipment, according to CD.

For communicating with adjacent communities, centers would also have to have a higher powered transmitter, with a 100 to 200-watt output.

(*Continued on page* 155)

2 YEAR ALL-WEATHER TESTS

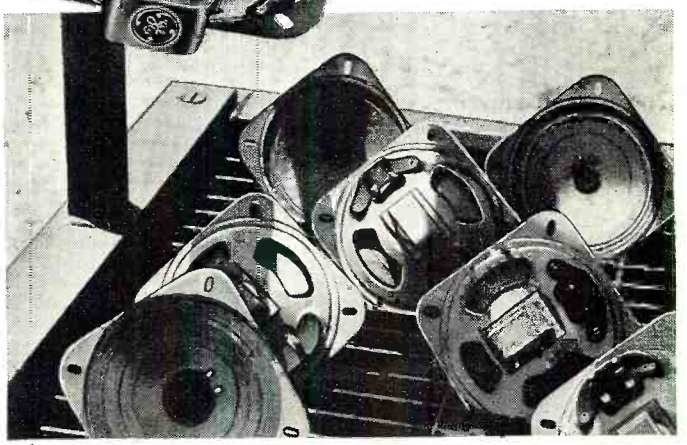
Show G-E Speakers Unsurpassed for Long-Life!

Twenty-seven sizes to choose from . . . and they're all G-E!

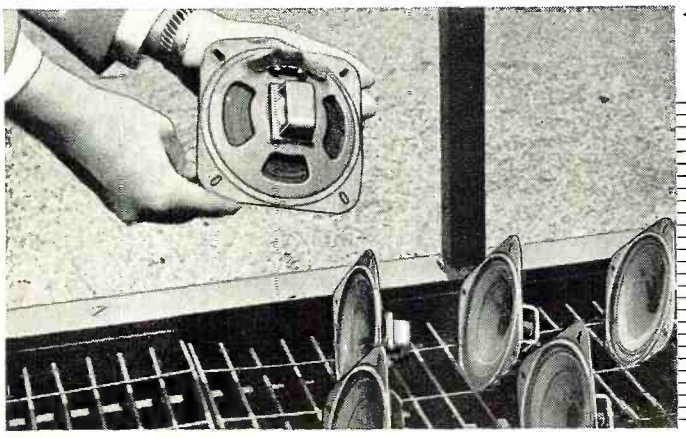
★ After two years exposure to hot sun, rain, sleet and snow — with no shelter whatever in any season — 7 out of 8 General Electric speakers played well enough to perform in your radio set!

These recent tests at Electronics Park subjected the speakers to many times the abuse they would receive under years of actual playing conditions, indoors or out. It boils down to one more dramatic proof of this fact: *You can depend on General Electric quality — in design, in engineering, in construction.*

Your customers are entitled to this quality. How are your stocks of General Electric speakers?



▲ **Unretouched photo** shows only slight tarnish on speakers. Special G-E plating gives excellent protection to steel frames, none of which were corroded after grueling tests.



◀ **Racked on exposure tray,** speakers were checked at intervals for 2 years, then taken apart and examined for wear. Outdoor-type cones were warped only slightly, G-E aluminum voice coils were like new.

General Electric Co., Section 9101
Electronics Park, Syracuse, N. Y.

Yes — send me latest speaker information plus new booklet on G-E Styli and Cartridges.

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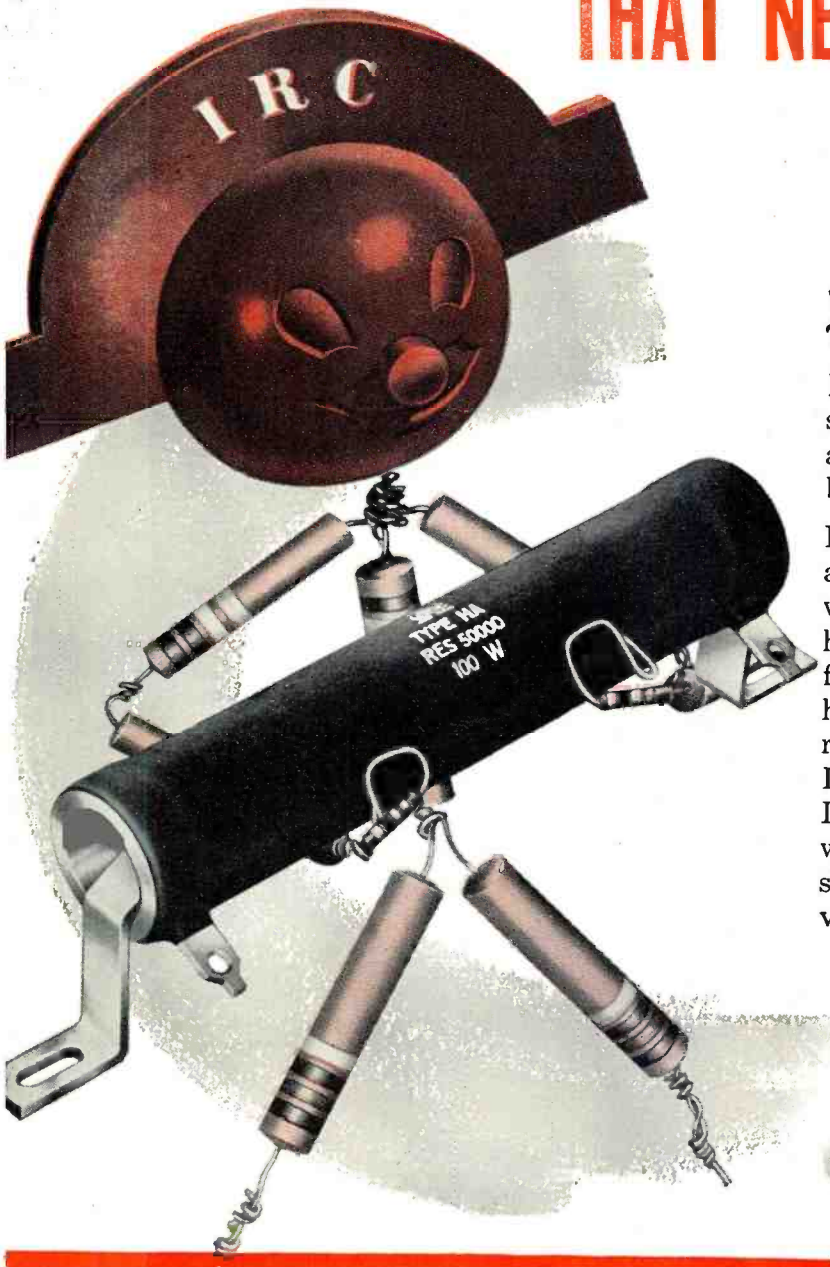
You can put your confidence in—

GENERAL ELECTRIC

HERE'S THE POWER RESISTOR THAT NEEDS NO DE-RATING

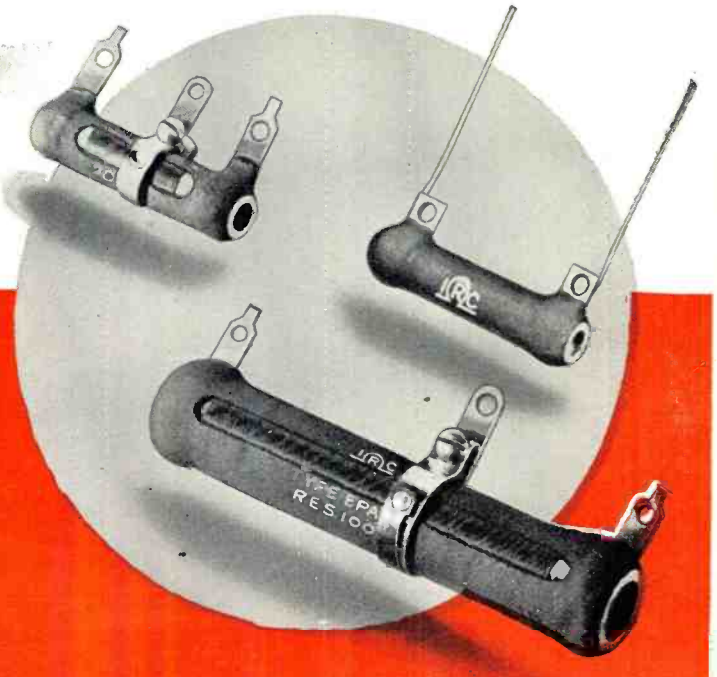


IRC PWW's Carry Full Wattage in ANY Range!

What is the function of this type of resistor? To handle POWER!

Power rating of many power resistors is derated sharply—as much as 75%—in the higher resistance values—to prevent voltage breakdown between winding turns and resultant turnouts.

IRC PWW's need no derating because of resistance value! These rugged, full size power wire wounds carry full wattage rating—even in the highest stock resistance values—without failure. Ample core sizes produce larger heat-radiating surface areas and the special rough, dark coatings dissipate heat fast—so IRC PWW's operate at lower temperatures. Low temperature processing preserves fine wires and prevents turns of windings from shifting—reduces likelihood of hot spots and voltage breakdowns.



THERE JUST ISN'T A BETTER POWER WIRE WOUND FOR CONTINUOUS OPERATION AT FULL RATED POWER FOR LONG, DEPENDABLE, TROUBLE-FREE PERFORMANCE . . .

You can get fixed and adjustable IRC PWW's in a full range of power ratings, resistance values, sizes and terminal types . . . adaptable to any rig or use. In adjustable types, contact is made by a metal band which can be positioned anywhere along the resistor. By using additional bands, various taps can be obtained —permitting the resistor to be used as a voltage divider. Tolerances: Fixed types—standard tolerance ±5% for 50 ohms and over, ±10% below 50 ohms. Adjustable types—standard tolerance ±10%.

For exacting, heavy-duty applications—high-voltage bleeders, bias supply, grid and filament-dropping resistors—leading technicians and industrial users have specified IRC PWW's for more than 15 years.

COMPARE IRC PWW's WITH ANY OTHER POWER RESISTOR

Feature by feature, IRC PWW's *prove* their superiority over ordinary resistors. PWW's give balanced performance in every characteristic. Here's why...

Uniform, High-grade Alloy Windings. Unusually rigid specifications govern resistance value, diameter, elongation, and weights. Resistor elements are wound with uniform spacing and tension, and wire is secured to terminal electrically and mechanically.

Rugged Steatite Winding Forms. Carefully selected steatite tubes have superior mechanical strength, withstand sudden variations in temperature, are impervious to moisture.

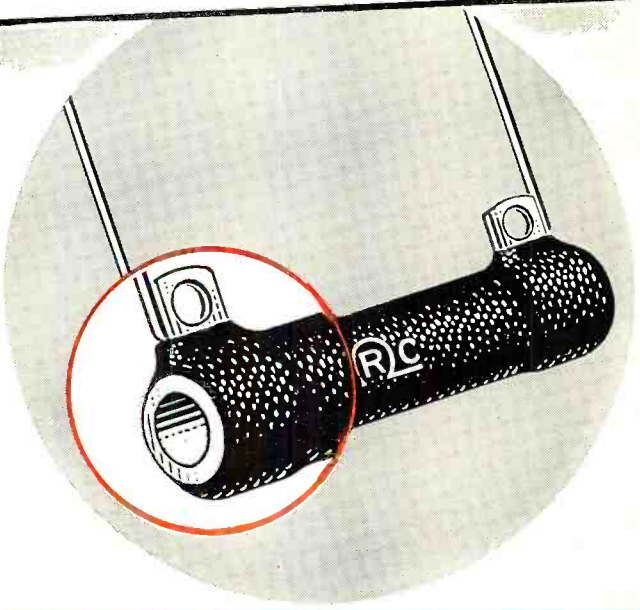
Special Heat-dissipating Cement Coatings. IRC's exclusive dark, rough coatings are used for 3 specific reasons: (1) They can be processed at lower temperature, which does not harm the wire windings or cause them to shift. (2) The rough surface provides a larger area for faster heat radiation. (3) The porous cement coatings do not trap moisture which might cause windings to corrode.

Adjustable Bands. IRC Adjustable PWW's are fitted with adjustable bands specially designed to maintain constant pressure. Bands feature a stainless steel spring with a silver contact button, which is oxidation free and cannot corrode to cause open circuits or high resistance at point of contact.

Full Size for Cooler Operation. Ample size is essential to fast heat dissipation. Because IRC PWW's are *full-size* units, they operate at much lower temperatures. This cooler operation assures long life for the resistor, and also safeguards critical components mounted nearby.

UNIQUE LUG-AND-LEAD DESIGN GIVES FLEXIBILITY IN MOUNTING

An exclusive feature of IRC 10- and 20-watt Power Wire Wound Resistors is the combination lug-and-lead terminal for flexibility in mounting. In tight space applications, lugs may be cut off without disturbing lead, and in other installations the leads may be removed. Leads are a full 1¾" and all terminals are hot tin dipped for easy soldering.



IRC

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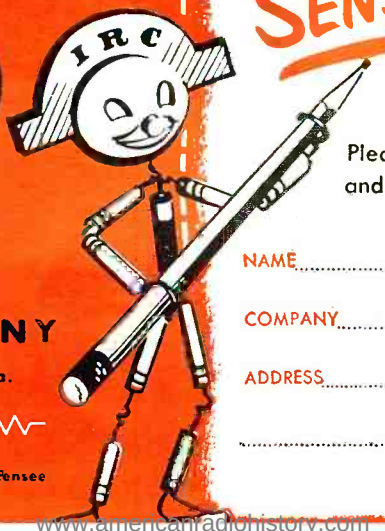
Wherever the Circuit Says —WW—

In Canada: International Resistance Co., Ltd., Toronto, Licensee



SEND TODAY

INTERNATIONAL RESISTANCE COMPANY

415 N. Broad St., Phila. 8, Pa.

Please send me full information on IRC Fixed and Adjustable Wire Wound Resistors.

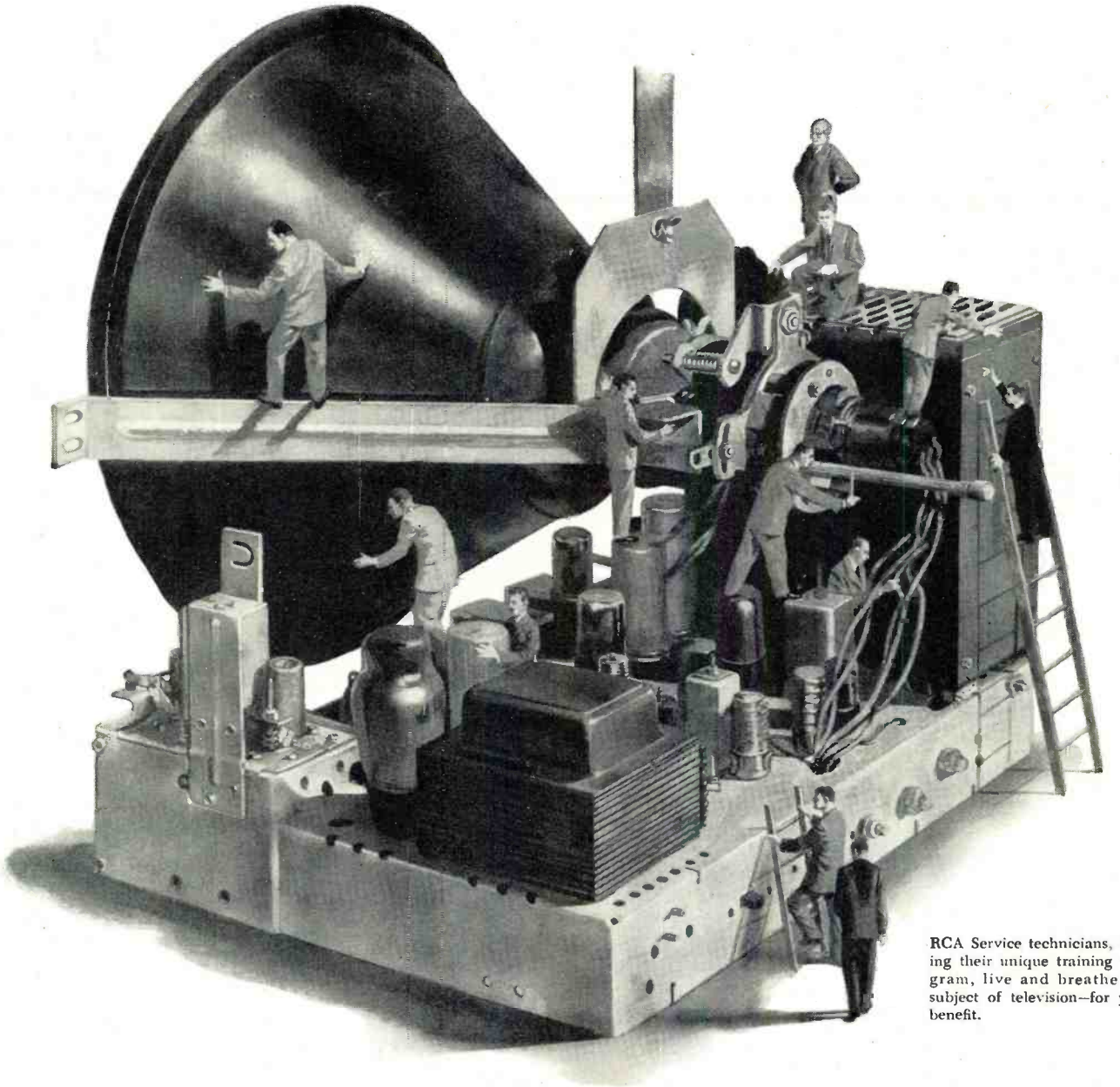
NAME.....

COMPANY.....

ADDRESS.....

.....

J. F. ARNDT & CO., ADV. AGENCY



RCA Service technicians, during their unique training program, live and breathe the subject of television—for your benefit.

These men get TV's *Inside Story*

When you buy a fine television receiver, correct installation and maintenance are as important as the set. For service technicians, RCA has developed the only training program of its kind—a *factory* program.

During their studies, these men learn the basic facts of modern, all-electronic TV...how it reached its present perfection by research at RCA Laboratories...how to build a television receiver...how to select and install the right antenna for your *home* ...all the complexities of kinescopes, electron guns, tubes, television cameras and transmitters.

When their studies are complete, they have a grasp of television's *inside story* that assures you the most perfect installation and maintenance possible—under your RCA Victor Factory-Service Contract.

* * *

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

Get all the performance that's built into your new RCA Victor home television receiver through an RCA Victor Factory-Service Contract.

RADIO CORPORATION of AMERICA

World Leader in Radio—First in Television

(Advertisement)

HOW TO STACK YAGIS WITH 100% EFFICIENCY

New System Eliminates Mismatch; Provides Higher Gain For Yagis

Acting on the complaint of installers of all makes of Yagi antennas that only a small additional gain was achieved in stacking, Channel Master Laboratories engaged in a thorough research project during the past summer. The engineers came up with the new Z-MATCH system, and, like all important discoveries, it is relatively simple.

They noted that although all *single* Yagis claim to match 300 ohm line, they are stacked one-half-wave with ⅜″ connecting rod transformers spaced about 3″ apart, with an impedance of 325 ohms. Each Yagi's impedance, therefore, was stepped up to 350 ohms, with the two in parallel totaling only 175 ohms. This meant a mismatch of almost 2:1 when used with 300 ohm line. (Fig. 1 lower right)

Channel Master engineers reasoned that in stacking, the impedance of each single 300 ohm Yagi must be reduced in order for the total stacked Yagi to match a 300 ohm line, as follows:

1. Let the single Yagi match 300 ohm line perfectly when used alone.
2. Reduce Z (impedance) of each Yagi to 200 ohms for stacking.
3. Use ⅜″ half-wave connecting rod transformers spaced at 3⅛″.
4. These connecting rod transformers have an impedance of 350 ohms.
5. These 350 ohm connecting rods transform each 200 ohm impedance to 600 ohms.
6. The two 600 ohm impedances in parallel equal 300 ohms.
7. **Therefore a perfect match is achieved in both single and stacked antennas!** (Fig. 2)

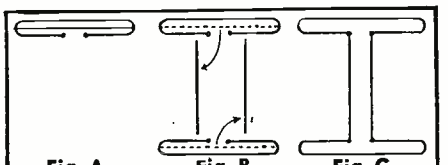


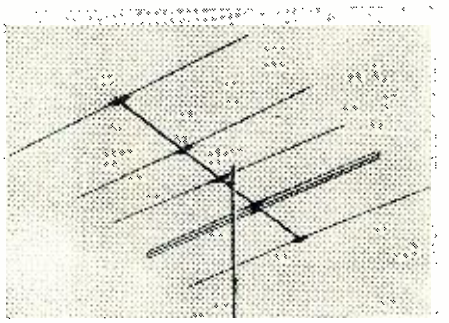
Fig. A Fig. B Fig. C

A) 3 element ½ wave folded dipole of single Yagi showing center bar. B) 2 half-wave folded dipoles with center bars removed. C) Center bars used as stacking rods.

The new Z-MATCH system *automatically* provides for lowering the impedance of each Yagi when preparing it for stacking. A 600 ohm, 3 conductor folded dipole (Fig. A) is used on the single Yagi to provide a perfect 300 ohm impedance. In stacking, the center bar is taken out of the folded dipole which lowers the impedance to 200 ohms and leaves a pair of ⅜″ rods one-half-wave long (Fig. B). These are then used as connecting rods and the result is a stacked Yagi which perfectly matches a 300 ohm line (Fig. C). In order to provide a perfect 300 ohm impedance for the single Yagi, the crossarm had to be lengthened, resulting in *higher gain for the Z-MATCH single Yagi*. The antenna is wider spaced than most other commercial Yagis which use a half-wave crossarm. Furthermore, the cost of extra connecting rods is completely eliminated. Z-Match is an exclusive feature of Channel Master Yagi antennas. Completely pre-assembled,

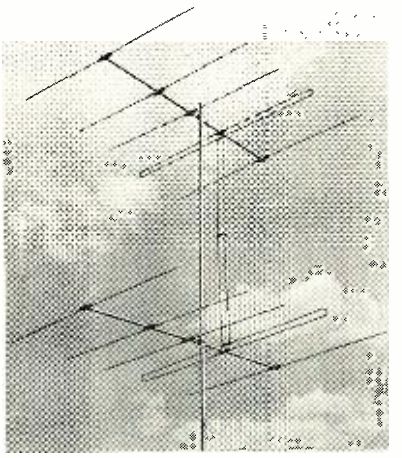
Tests Revea Serious Mismatch in Stacked Yag s

Z-Match, New Development, Achieves 100% Perfect Match To 300 Ohm Line, Single OR Stacked.



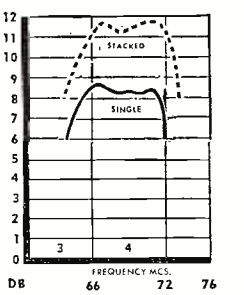
Higher Gain On All Yagi Installations Accomplished By Adjustable Impedance And Wider Spaced Elements.

Now! Stack Yagis without extra stacking bars!

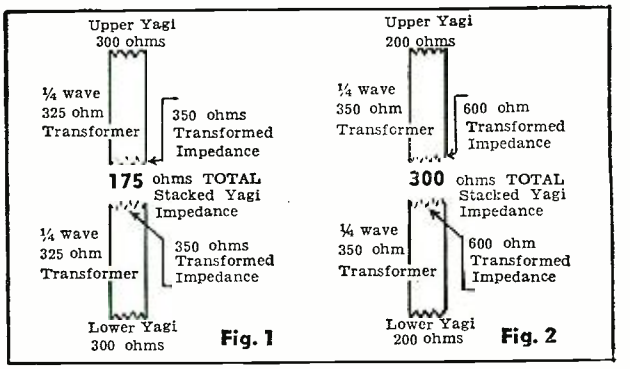


Mismatch eliminated! Now Channel Master proudly introduces Z-Match — a system that guarantees 100% perfect match in both single and stacked Yagi installations.

Single bay Yagi perfectly matches 300 ohms because of wider spaced elements. When Yagis are stacked, the center bars of the folded dipoles are removed and used as half-wave connecting rods. This reduces the impedance of each antenna, and automatically creates a perfect 300 ohm match for the complete stacked Yagi array. The Z-Match system, PLUS wide spacing, provide higher gain for Channel Master Yagis, single or stacked. No extra stacking bars result in lower cost.



Gain of Z-Match Yagi on Channel 4



CHANNEL MASTER CORP.

NAPANOCH ROAD, ELLENVILLE, N. Y.

Write for complete technical literature.

FIRST IN PREASSEMBLED ANTENNAS

Within the INDUSTRY

SOLOMON ZIMMERMAN has been named to the development engineering staff of the *JFD Manufacturing Company* of Brooklyn, New York.

Until recently, Mr. Zimmerman, a veteran in the radio and television industry, was associated with the product engineering division of *Teletone Radio Corporation*. Prior to that he was laboratory director for James Allen Tuck, consulting engineer; test equipment design engineer for *Emerson Radio and Phonograph Corporation;* and development and research engineer with *Raytheon Manufacturing Company*.

Mr. Zimmerman will devote his time to the development of new electronic equipment for the company.

* * *

PAUL H. WENDEL, managing director of the Television Technicians Lecture Bureau, has been named chairman of the National Electronic Technicians & Servicing Dealers Associations' Education and Program Committee.

In announcing Mr. Wendel's appointment, Max Leibowitz, president of NETSDA, pointed out that organized, effective education was one of the greatest needs of the mushrooming electronics service industry. In order to meet this need in the most practical fashion, the trade organization is setting up an ambitious training program, in which Mr. Wendel will take an active part.

In order to expedite the NETSDA-Bureau arrangements, an Eastern office of the Bureau has been opened at 158 N. 20th Street in Philadelphia.

* * *

GORDON GROTH has been named executive vice-president of the *Erie Resistor Corporation.* He was formerly president of *Electra Manufacturing Company* of Kansas City . . . **RAY F. SPARROW** has been elected to the post of executive vice-president of *P. R. Mallory & Co., Inc.* of Indianapolis. He was formerly vice-president in charge of sales . . . **HENRY ONORATI** has joined the *Crosley Division* as director of electronics advertising. He resigned as assistant advertising manager and national promotion manager of *RCA Victor Records* to assume his new post . . . **W. D. SCHONING,** for 30 years a leader in the distributor field, was honored recently by the *RCA Tube Department* for "his active and effective leadership in industry affairs." He has served as a director and president of NEDA . . . **MARVIN HOBBS** has been named advisor to the chairman of the Munitions Board. In this capacity he will coordinate all phases of Department of Defense planning to meet the requirements for military electronics production . . . **P. M. PRITCHARD** has been appointed general sales manager for the Parts Division of *Sylvania Electric Products Inc.* . . . **LEWIS R. ZEYHER** is the new general manager of manufacturing for the *Daystrom Electric Corporation* of Poughkeepsie, N. Y. . . . **BERNARD HECHT** has been appointed general manager of *Starrett Television Corporation* . . . The receiver sales division of *Allen B. Du Mont Laboratories, Inc.* has named **GEORGE HAKIM** to the post of advertising manager . . . **J. R. CHURCHIN** has become an active stockholder and secretary-treasurer of *The Leonard L. Minthorne Company Inc.,* export agency for several well-known electronic firms . . . *Radio Receptor Company, Inc.* has promoted **MARTIN MANN** to the post of assistant sales manager of the *Seletron Rectifier Division* . . . **WILLIAM GARSTANG** has been named administrative director of engineering and research for *Belmont Radio Corporation* . . . **WILLARD D. DUNIFON,** vice-president and factory manager of the *General Transformer Company* passed away recently. He had been associated with the company for the past 14 years . . . **GEORGE R. FAUSTMAN** has been named general factory manager of the *Bendix Radio Division* . . . *Emerson Radio & Phonograph Corporation* has appointed **STANLEY M. ABRAMS** to the post of acting director of sales . . . **MALCOLM V. FIELDS** is the new head of the Special Products Division of *The LaPointe Plascomold Corporation* . . . **JOSEPH H. KERNER** has recently taken over the post of sales manager for *Blonder-Tongue Laboratories* of Mt. Vernon, N. Y. . . . **EUGENE F. HAINES,** assistant treasurer of the *RCA Victor Division,* has retired after servicing the division and its predecessor companies for fifty years.

* * *

LINCOLN N. KINNICUTT has been named to the post of advertising manager of *The LaPointe-Plascomold Corporation* of Windsor Locks, Conn.

In his new position Mr. Kinnicutt will handle the company's large scale program of advertising and sales promotion on television antennas, electronic devices, and aircraft parts. He was formerly an account executive for

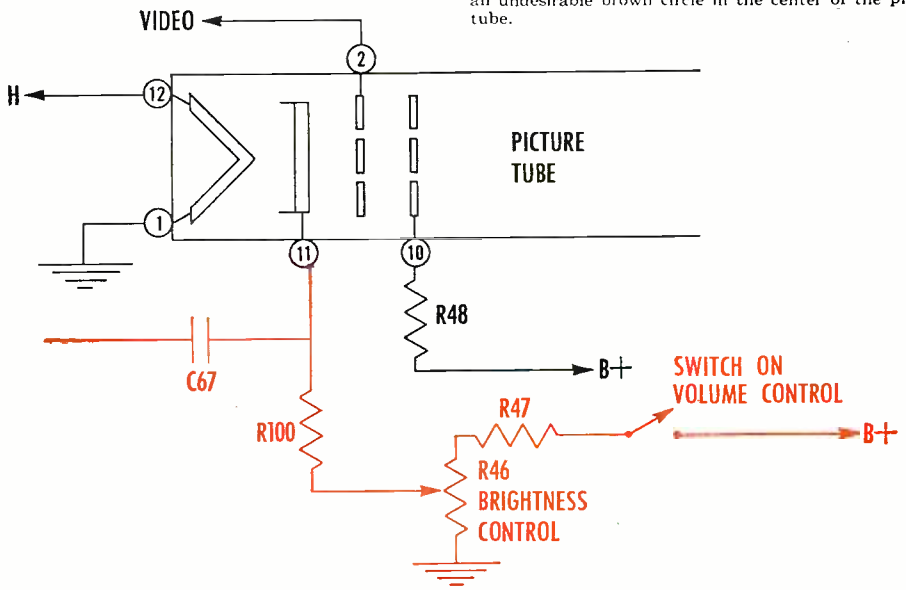
Service Clinic!

Engineering information to help you better service Raytheon

RAYTHEON'S "SPOT REMOVER" CIRCUIT

Many TV receivers, when turned off, will produce a bright spot in the center of the picture tube which will linger for a considerable length of time. The bright spot is produced by the concentration of electrons caused by the removal of deflection voltages while a charge in the high voltage filter remains.

Raytheon has incorporated a "spot remover" circuit, as shown in the diagram below, which will eliminate the bright spot and provide the three following advantages: 1. Reduce customer annoyance. 2. Eliminate high voltage shock hazard. 3. Eliminate the bright spot which might result in burning the phosphorus coating, thus producing an undesirable brown circle in the center of the picture tube.



A double section (on-off) switch is provided on the volume control to remove B+ from the brightness bias control circuit when the receiver is turned off. This reduces the picture tube bias and greatly increases the anode current while a percentage of scan still exists. The increased anode current quickly drains off the high voltage charge and removes the potential for electron attraction. Thus the spot and the high voltage shock hazard is eliminated.

This feature has also been incorporated in Raytheon's TV-AM-Phono combination receiver to eliminate corona discharge interference when switching from TV to AM.

The picture tube cathode bias resistance R100 and R46, bypassed by C67, provides a limiting device to prevent excessive current from damaging the picture tube.

NOTE: Servicemen accustomed to this reduced shock hazard should not turn off the set by pulling out the line cord at the safety interlock or the wall receptacle. This would not operate the above "spot remover" circuit.

This is another example of how Raytheon engineers have improved the quality of Raytheon TV and helped ease the serviceman's burden. And this is one of the many reasons why you can always feel free to recommend Raytheon Television to a friend or a customer.

• • •

Raytheon TV Presents JOHN CAMERON SWAYZE

Sundays on NBC. See local paper for time and station.

The F. W. Prelle Company of Hartford who will continue as advertising agency for the company.

* * *

GARDINER G. GREENE has been named vice-president in charge of the Electronics Divisions of *The Gabriel Company* of Cleveland, Ohio. The divisions include the *Ward Products Corporation* and the *Workshop Associates*.

For the past nine years Mr. Greene has been president of *Workshop Associates*, which became a *Gabriel* Division early this year.

He is treasurer of the Boston Chapter of the AFCA, a member of the executive committee of the Antenna Manufacturers Association, and a member of the RTMA and IRE.

Prior to his association with *Workshop Associates* he was with the *Chase Parker Company* and the *H. J. Dowd Company*.

* * *

MAGNECORD INC. has recently established a new engineering development laboratory at 233 W. Erie Street in Chicago. Over 7000 square feet of space will be devoted to standard equipment development and specialized research . . . **ACRO PRODUCTS COMPANY** has moved its administrative and production divisions to the newly-acquired *Acro* Building at 369 Shurs Lane, Roxborough, Philadelphia 28 . . . **NATIONAL ASSOCIATION OF ELECTRICAL DISTRIBUTORS** has opened new and larger headquarter offices at Norway House, 290 Madison Avenue, New York . . . **POLARAD ELECTRONICS CORPORATION** has added another floor to its plant at 100 Metropolitan Ave. in Brooklyn which will provide an additional 27,000 square feet of manufacturing space . . . **GENERAL ELECTRIC COMPANY** has leased the bus terminal of the *Garden State Line* in Clifton, N. J. for use as its eastern regional electronic tube warehouse . . . **AMPEX ELECTRIC CORPORATION** has built a new plant in Redwood, California which will increase production facilities fivefold . . . **GENERAL RADIO COMPANY** is constructing a new plant in Concord, Massachusetts which, when completed, will provide 72,000 square feet of manufacturing space. The company will maintain its Cambridge facilities for the present . . . **BELMONT RADIO CORPORATION** has acquired a new building in Chicago which will be devoted exclusively to research, engineering, and pilot production.

* * *

DR. IRVING A. GETTING, formerly a professor of electrical engineering at the Massachusetts Institute of Technology, has been elected vice-president of engineering and research of *Raytheon Manufacturing Company*, Waltham, Mass.

An outstanding authority on radar, Dr. Getting for the past year has held the post of Chief Scientist of the U. S. Air Force. During World War II, he headed a laboratory which developed the SCR-584, an automatic radar control for anti-aircraft guns which is credited with saving London from the Nazi buzz-bombs.

He is a Fellow of the American Physical Society, a Senior Member of the IRE, and a Fellow of the American Academy of Arts and Sciences.

* * *

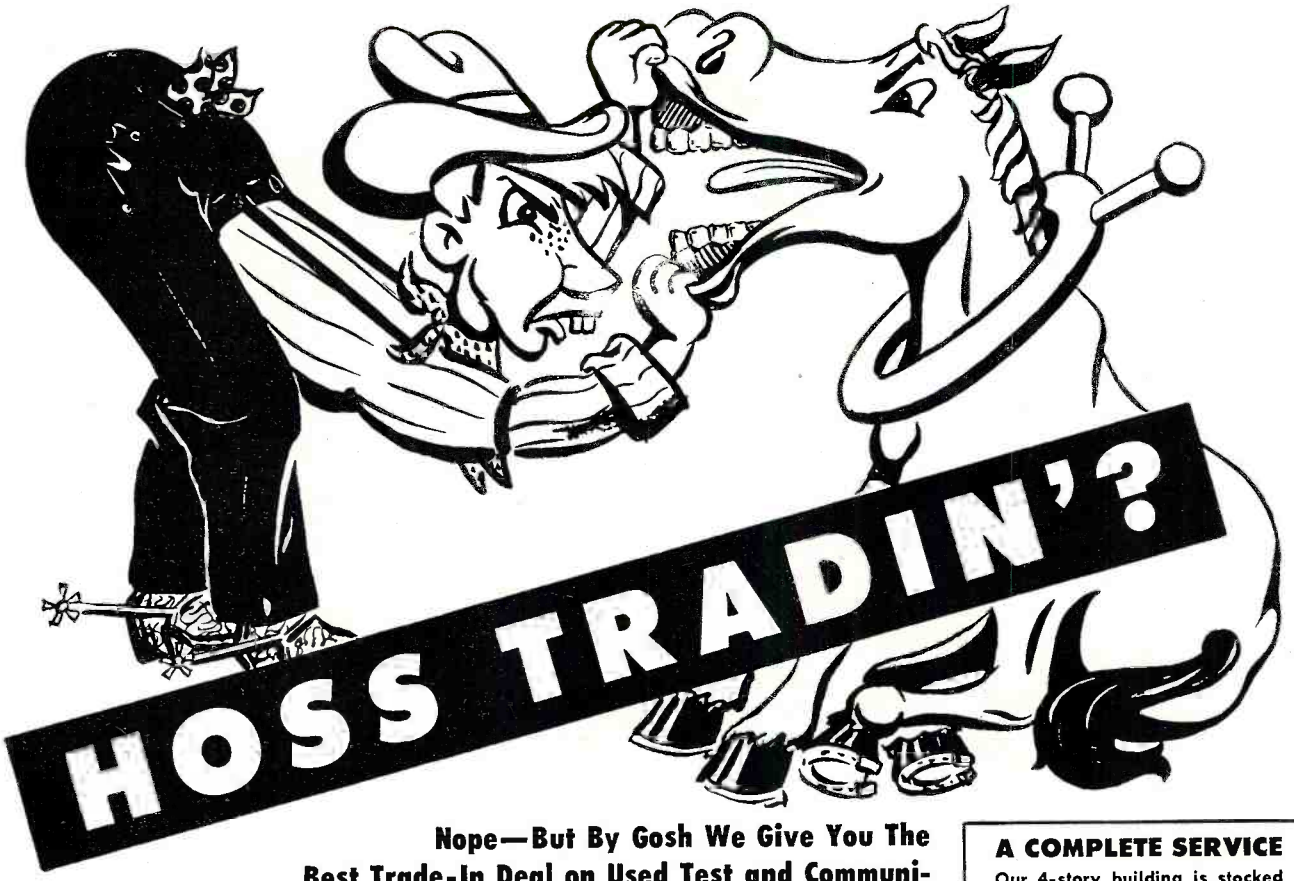
OPERADIO MANUFACTURING CO. of St. Charles, Illinois has changed its name to **DUKANE CORPORATION.** There is no change in ownership, management, personnel, or policies. The new corporate name is the company's brand name for its line of intercoms, recorders, paging equipment, etc. . . . **MARK SIMPSON MANUFACTURING CO., INC.** will now be known as the **MASCO ELECTRONIC SALES CORP.** No changes in company policy are involved. . . . The newly-formed **SIERRA ELECTRONIC AND MANUFACTURING COMPANY** has acquired the **McDONALD MANUFACTURING COMPANY,** pioneer plastics and electrical manufacturer. The combined firms will operate at 544 E. 31st Street in Los Angeles.

It's Tung-Sol for radio and tv

Quality -that keeps pace with the growth of the electronic industry
-that meets fully the performance requirements of all radio and tv set manufacturers
-that safeguards dealer service work

TUNG-SOL
RADIO, TV TUBES, DIAL LAMPS

TUNG-SOL ELECTRIC INC., Newark 4, N. J.—Sales Offices: Atlanta • Chicago • Dallas • Denver • Detroit • Los Angeles • Newark



Nope—But By Gosh We Give You The Best Trade-In Deal on Used Test and Communication Equipment In The Business For New...

A COMPLETE SERVICE

Our 4-story building is stocked with everything in Radio, Electronics, Parts and Supplies for Industry—Schools—Gov't. Agencies and Research Laboratories.

National

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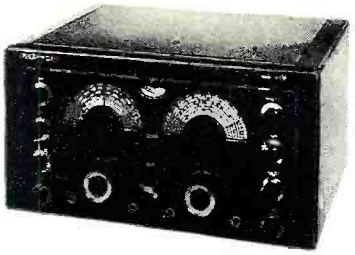
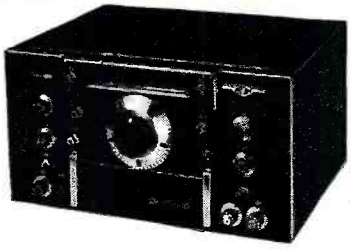
RECEIVERS

So trade used (factory-built) equipment now. Wire, write, phone or use the handy coupon today!

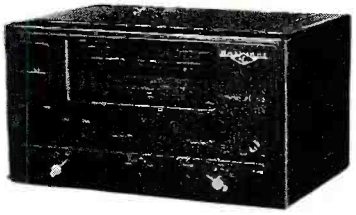


NATIONAL NC-183
Shpg. wt. 64 lbs.
Only $279.00 less speaker



NATIONAL HRO-50T1
Shpg. wt. 88 lbs. Less speaker Only $383.50

NATIONAL SW-54
Shpg. wt. 10 lbs. Only $49.95



NATIONAL NC-125
Shpg. wt. 36 lbs.
Less speaker Only $149.50

FREE CATALOG!

150 value-crammed pages of everything in Radio, Electronics and Television. The "treasure chest" of values.

All prices F. O. B. St. Louis • Phone: CHestnut 1125

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THE HOUSE OF "SURPRISE" TRADE-INS
1125 PINE ST. • ST. LOUIS 1, MO.

Walter Ashe Radio Co. RN-10-51
1125 Pine St., St. Louis 1, Mo.

☐ *Rush* "surprise" Trade-in-offer on my used_____

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(State make and model no.)

for_____
(List new National equipment desired)

☐ Rush Free Copy new 1952 Catalog.

NAME_____ ADDRESS_____

CITY_____ Zone_____ STATE_____

SEND FOR YOUR COPY TODAY!

"HOW WE SAVED THE SALE"

July 27, 1951

Hytron Radio & Electronics Co.
76 Lafayette Street
Salem, Mass.

Gentlemen:

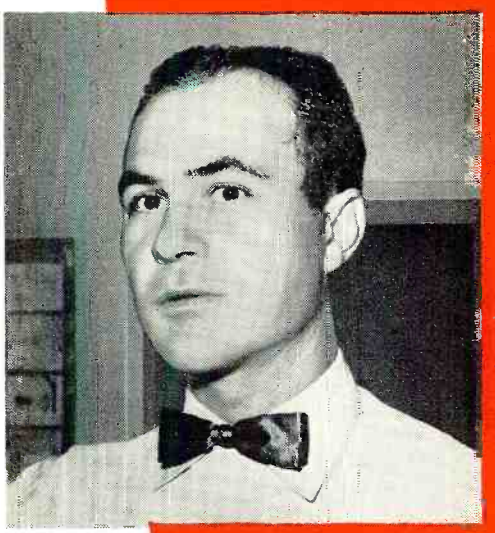
We thought you would like to know just how fine we think the new Hytron "Easy Payment Plan" is. We had a set in our shop for estimation the day this plan was first introduced to us by a salesman from Ra-Tel, Inc. This set would require a new 19AP4A picture tube and some other parts and service. The total charge would amount to about $100.00, and right then we thought we might lose the sale because our customer might not have the cash for such a repair. Then, we learned of the Hytron plan and immediately introduced it to our customer. He thought it was a wonderful plan to be able to get his set repaired without having to part with so much cash at one time. Needless to say, he accepted the job, and went away a happy satisfied customer.

We have used Hytron products for years, and have always thought them to be of the highest quality. The new rectangular picture tubes are wonderful. We feel that this new "Time Payment Plan" is another Hytron first, and will no doubt be a great asset to the serviceman as well as the customer. We recommend it highly to all.

Very truly yours,

B. W. Hodges

B. W. Hodges



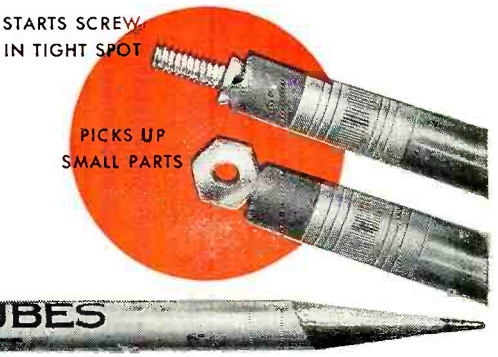
B. W. Hodges,
owner of Air Park Radio & Television, Dallas, Texas

ANOTHER HYTRON "ASSIST" FOR YOU

Dropped a screw into an inaccessible chassis? No need to fuss. Just reach in with your Hytron-CBS Pick-Up Stick. A slight pressure of its special wax tip picks up screw pronto.

Trying to start a machine screw in a tight spot? Press head of screw into wax tip of your Pick-Up Stick. Push screw into position and start nut. As easy as that!

Use this Contest winner once and it pays for itself. Triples in brass as pencil too. Only 5¢ at your Hytron jobber. Get your Hytron-CBS Pick-Up Stick today!



HYTRON-CBS

Pick-Up Stick 5¢ net

NINTH MEMBER OF HYTRON SERVICE TOOL FAMILY!

4 SERVICEMEN A HYTRON TOOL for SERVICEMEN

HYTRON RADIO TUBES

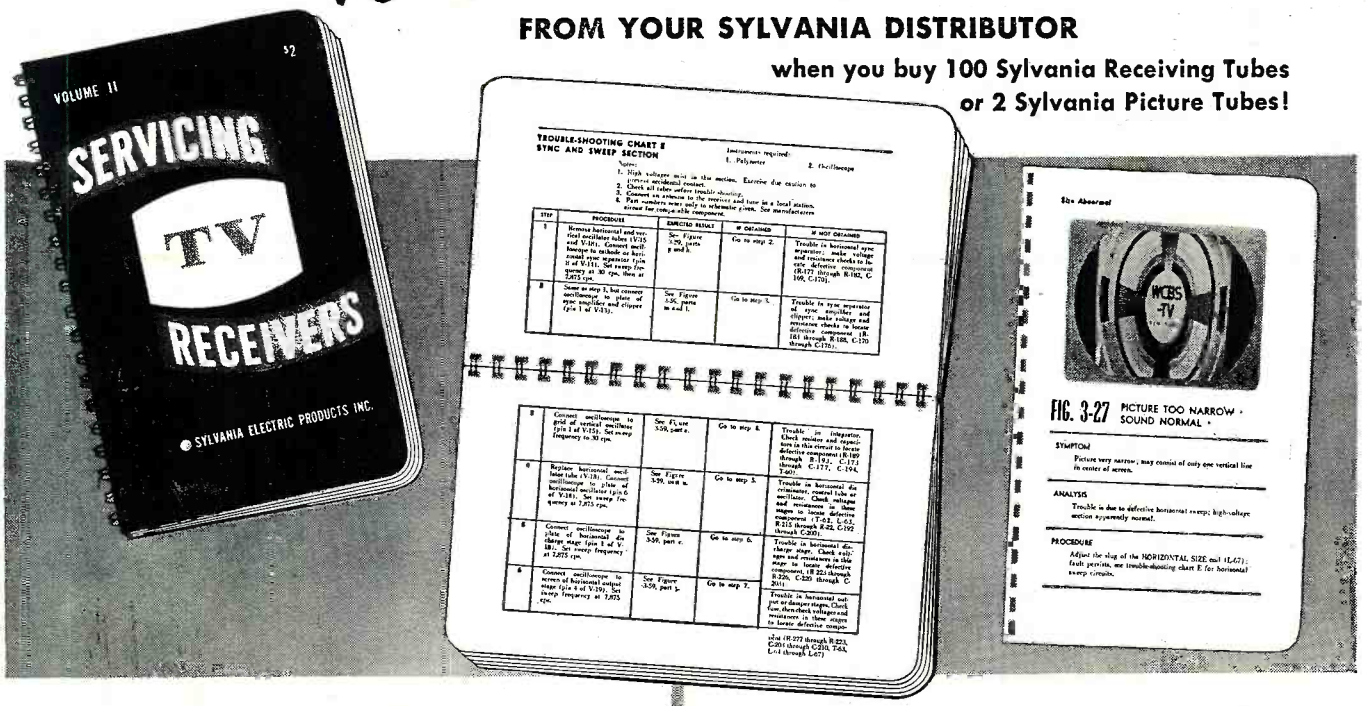
MANUFACTURERS OF RECEIVING TUBES SINCE 1921
HYTRON
RADIO AND ELECTRONICS CO.
A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

MAIN OFFICE: SALEM, MASSACHUSETTS

JUST OFF THE PRESS! YOU CAN GET IT FREE!

FROM YOUR SYLVANIA DISTRIBUTOR

when you buy 100 Sylvania Receiving Tubes or 2 Sylvania Picture Tubes!



Offer good only Sept. 15, 1951 to Nov. 1, 1951. ACT NOW!

SERVICING TELEVISION RECEIVERS — VOL. II

Not just a revised, brought-up-to-date version of last year's book . . . but a completely new, reworked volume, prepared by an expert TV servicing-writing team!

Sylvania has long recognized your need for a more advanced, more complete, more systematically organized television service manual. Now, after months of careful preparation, this book is ready . . . VOLUME II, SERVICING TELEVISION RECEIVERS. It's yours FREE OF EXTRA CHARGE when you buy 100 Sylvania Receiving Tubes or 2 Sylvania Picture Tubes.

This new book, written around a popular 1951 TV receiver, contains servicing techniques for all the most recent circuits. Its information applies to most all TV sets in use today. In addition, it contains a systematic method of locating, isolating and correcting troubles . . . by far the clearest, easiest, simplest method yet devised for servicing present day receivers.

Get your FREE service book now. Offer expires Nov. 1. See or write your Sylvania distributor today!

Here's what this volume contains, how it helps you!

How to sectionalize trouble by picture analysis. For this, 41 photographs of abnormal TV pictures and their analyses are presented.

How to isolate faulty stage by use of 6 special trouble shooting charts—one for each section of receiver. Charts give step by step procedure, expected results, action required, instruments required. Charts provided for following sections: power supply, video, sound, sync., and sweep, high-voltage.

How to locate defective part—by trouble shooting charts based on voltage and resistance measurements and tube testing. Actual voltage and current readings to be encountered are listed.

Adjustment and alignment of television receivers. Alignment procedures for rf tuner, video if, sound if and discriminator; adjustment of ion trap, focus coil, deflection coils.

150 PAGES! 5 BIG CHAPTERS!
80 PICTURES AND DIAGRAMS!
WIRE-O-BINDING keeps book flat!
HEAVY COVER, TOUGH, COATED PAGES to stand rough, constant handling!

SEE YOUR SYLVANIA DISTRIBUTOR FOR YOUR FREE COPY TODAY!

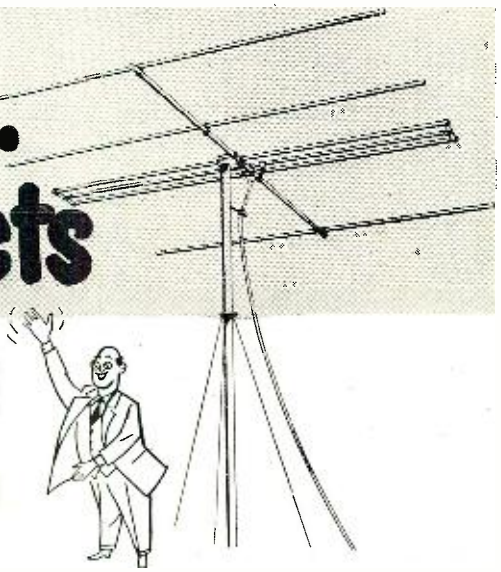
SYLVANIA

Sylvania Electric Products Inc.,
Emporium, Pa.

SYLVANIA ELECTRIC PRODUCTS INC. 1901–1951 50th ANNIVERSARY FIVE DECADES OF PROGRESS

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

Sell Satisfaction... Sell TRIO TV Products



Yes, complete satisfaction all the way around results when TRIO TV products are sold. Jobbers know their dealers recognize quality of product — dealers know TRIO products mean satisfied customers. That's why TRIO products are the most wanted TV products on the market today.

TRIO YAGIS LEAD THE FIELD

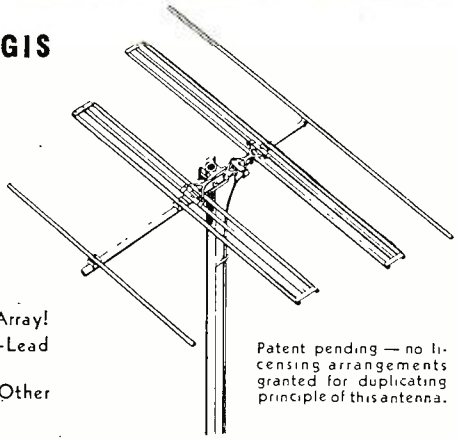
TRIO 2-CHANNEL YAGIS

Models 445 & 479

Rapidly becoming the most popular — most wanted TV antenna in America. Available for channels 4 and 5, and channels 7 and 9. Provides gain on two channels equal to any two conventional 4-element yagis!

Features

- Full 10 db Gain On 2 Channels!
- One Bay Replaces Bulky Stacked Array!
- One Lead Replaces Old-Style 2-Lead Systems!
- Less Weight Per Gain Than Any Other TV Antenna!



Patent pending — no licensing arrangements granted for duplicating principle of this antenna.

TRIO DOUBLE FOLDED DIPOLE

(Model 304)

Here is the popular TRIO Double Dipole TV Antenna. With 10 db forward gain and a front-to-back ratio of 25 db, it is unexcelled for extreme fringe areas. Available for each of 12 TV channels. Easily stacked for additional gain. Reinforced fittings for extra strength — extra rigidity!

Features

- Outperforms Conventional Large Arrays!
- Exact Impedance Match To 300 Ohm Line!
- Sturdy Construction — Light Weight!
- Partially Assembled!
- Gain Flat Over Entire Channel!

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Now Available Separately

(Model No. PC-600)

The TRIO PHASITRON, originally sold only as part of the TRIO Controlled Pattern TV Antenna System, is now available separately for TV set owners who want to get the very best results from their sets and antennas, or to hams and other experimenters.

PHASITRON acts as a continuously variable tuning stub and will provide an exact impedance match between line and booster and helpful in matching output impedance of booster to set input impedance. Due to exact matching, losses in line become negligible and set performance greatly improved.

May also be used to coordinate input from two or more antennas to provide added balanced output to set. Write for full details.

New TRIO TV ROTATOR AND DIRECTION INDICATOR

Two heavy-duty 24 volt motors — instead of one — provide a reliability of operation that makes this rotator outstanding.

One motor turns antenna clockwise — the other counter-clockwise. Even if left on continuously, a motor cannot burn out since load on a single motor is never on more than 50% of the time!

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Positive acting electrical stops at both ends of 360° turn eliminates lead damage.

Rotator Features

- Cast TENSALLOY aluminum mast holder, 11/16" steel shaft. Withstands 4500 lbs. bending movement.
- Automatic Electro-Mechanical Brake — reduces coasting to minimum.
- All-aluminum case — no cast zinc!
- Turns 1 RPM, lifetime lubricated.
- Ball-bearing end thrusts on shafts.
- Ideal for 10, 6 and 2 meter amateur use.

NEW TRIO TV ACCESSORY CONTROL UNIT

Model No. RY-1

A handy control unit that hides away inside or in back of the TV set and provides an automatic line switch for booster, rotator, TV lamp or other accessories. By plugging the line cords from these accessories into the TRIO Control Relay Unit, all accessories are turned on with the one switch controlling the TV set. Quickly installed without making any wiring changes in set.

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Write today for your free copy of "TELEVISION TOPICS" by G. N. Carmichael. It discusses items of interest to TV distributors, dealers and users, includes information on Antenna Types and Height, Lead-Ins, TV Signal Propagation, Interference, TV Set Limitations, Rotators, Mast and Towers and Future Trends in TV.

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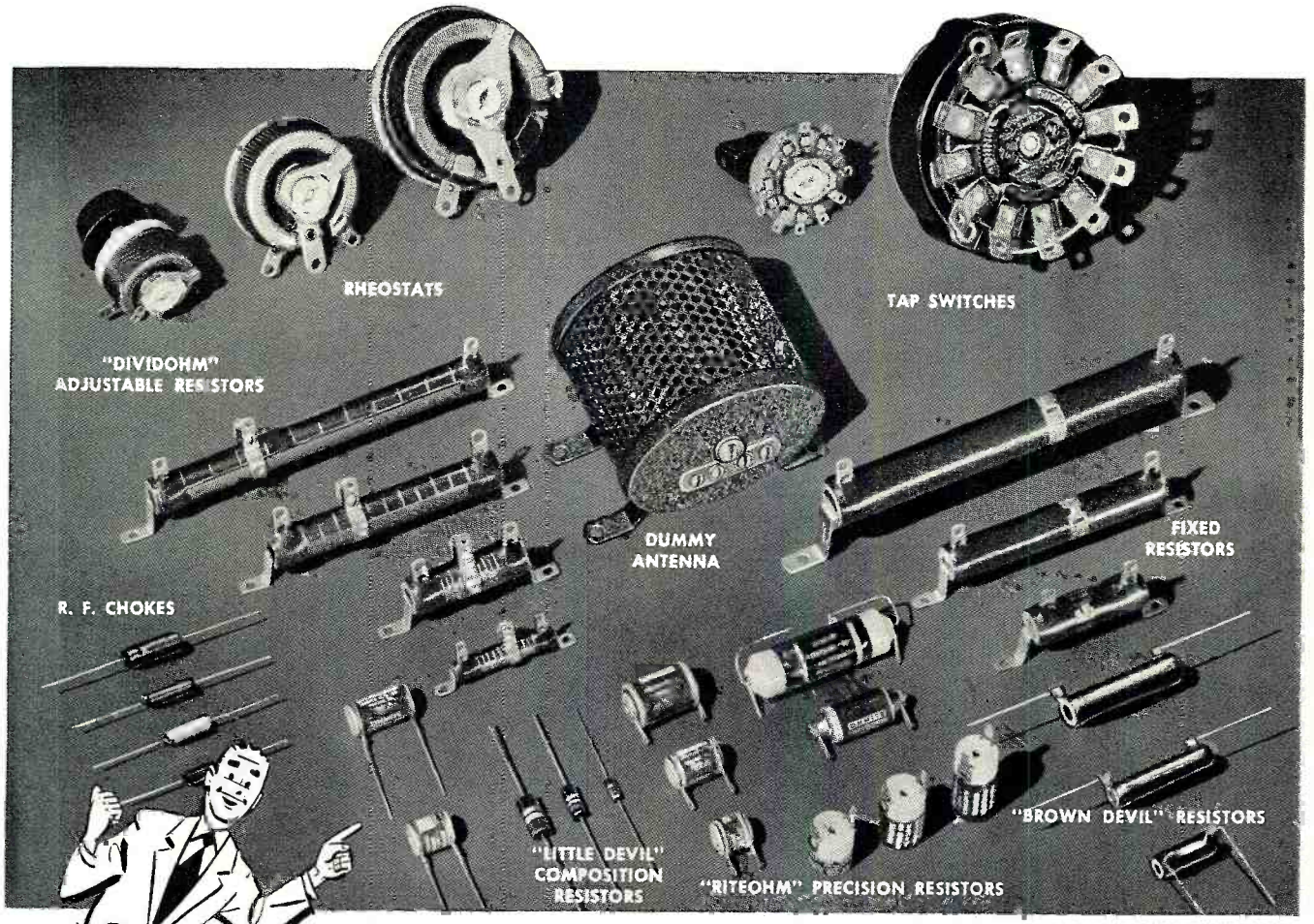

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MODEL 106 CRT TESTER* $29.95

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- High Voltage Breakdown or Leakage
- Gas between elements in Electron Gun
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- Conductance between Cathode and Control Grid
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- High Voltage on Anode
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Size: 5 ½x3 ⅞x2 ¼" Dealers Net— **$29.95**

*Pat. Pend.

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Substitutes 5 paper and 2 electrolytic condensers, 4 resistors, potentiometer, loudspeaker and output transformer.

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10,000 ohms per volt HV meter. D. C. voltages: 0-500V, 15KV, 30KV with 30KV insulated probe.

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Model 103 Signal Generator

Generates a wide range of modulated or unmodulated precision R. F., I. F., and audio-video signals for signal tracing or aligning TV receivers. (54-216 m.c., 20-48 m.c., 4.5 m.c. and 500 cycles).

Size: 5 ¾x4x2 ¼" Dealers Net— $33.50

Model 104 Syncro-sweep Generator*

Generates a combination of pulses and sawtooth waves for adjusting or tracing linearity, sync, sweep, and HV circuits. R. F. or mod. output.

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*Pat. Pend.

Model 105 20,000 OHM per Volt Multitester

1% resistors throughout. 6 DC ranges: 0-2.5V-5KV; 6 AC ranges: 2.5V-5KV; 4 current ranges: 100UA-500 MA; 3 resistance ranges: 0-2000-20 meg. Easy to read 3 ½" Multi-scalemeter.

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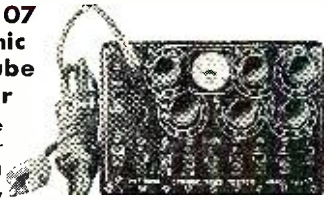

Model 107 Dynamic Type Tube Tester

Complete tube tester supplying plate, screen grid and filament voltages to check all receiving type tubes. 1.4, 2.5, 5, 6.3, 12.6, 18.9, 25, 35, 50 and 117 V filaments.

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THE *Television* BOOSTER

By

MILTON S. KIVER

Pres., Television Communications Institute

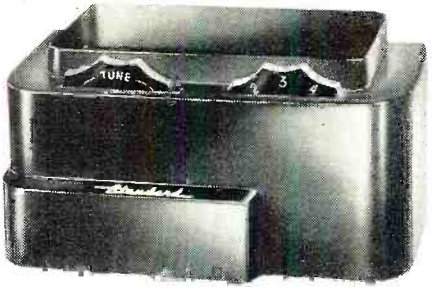
Design and application of TV boosters including a complete review of all commercial units available.

WHY do television receivers located only 25 miles from the transmitter often produce weak, snowy pictures while conventional radios play just as loudly at this distance as they do when near the transmitter? Is it because of the difference in signals (sound *vs* picture) or does it stem from some other cause? Undoubtedly, television set owners have asked themselves these questions many times, sometimes with bitterness, especially when their sets are expensive ones and the pictures they receive are far from satisfactory.

To set matters straight, the inability of television signals to travel for long distances stems not from the fact that they contain video information but because of the frequencies employed. It is an oft-proven fact that the higher you go in frequency, the greater the attenuation or loss suffered by the signal. Even though the present TV frequencies (54 to 216 mc.) are not especially high as frequencies go, receivers located only 25 miles from the broadcast station are, in most locations, considered in fringe or marginal areas.

Now, if you happen to be situated in one of these fringe areas, your immediate problem is to capture as much of the available signal as possible and bring this signal to your receiver. This would be the function of your antenna and how well you succeeded would depend upon the elaborateness of the antenna, where it was placed, the type of transmission line used, and how closely the system was matched. You might find that you obtained a good picture, in which case your problem was solved. But—and this is frequently more probable—you might find that the picture was weak, lacking in contrast, and covered with a multitude of small spots known as noise or snow.

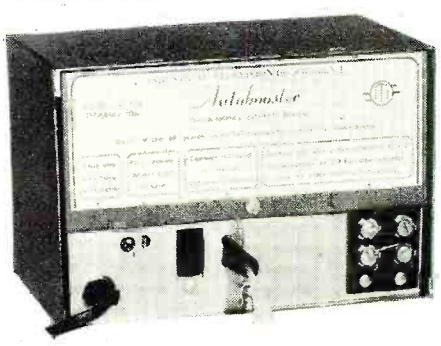
The Turner Company Model TV-1. 12AT7; 75 and 300 ohm input and output. Continuous tuning 54 to 216 mc. (slide rule dial). "On-Off" switch controls power to TV set. Designed for 50-60 cycle operation. Price $57.50.



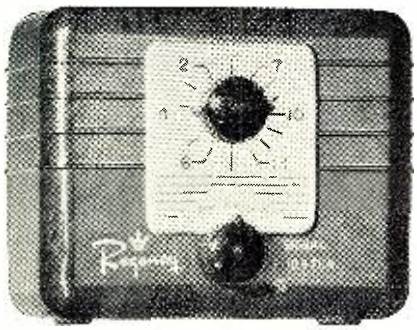
Standard Coil Products Co., Inc. Model B-51. 6AK5; channel selector switch; has fine tuning control; designed for 50-60 cycle operation. Printed circuit inductors are used. Brown plastic cabinet. Price $34.95.

National Company, Model TVB-2B. Channel selector switch (turret tuner) has fine and input tuning controls, 6AK5. Mahogany metal cabinet. Price $39.95.

Television Equipment Corp. Model S-505. 2-6AK5's, 1-12AT7; high-low band selector switch; gain control. Metal cabinet. Price $49.50. Company also makes the Model S-501 "Telecoupler" and the Model S-503A "Telebooster" for multiple set operation. The S-501 matches 75 or 300 ohm sets in any combination and will operate with high-low band antennas. Price $99.50. The S-503A covers all TV channels without switching and is designed for use with the S-501 "Telecoupler." Price of unit, $49.95.



Industrial Television Inc. Model IT-75A "Autobooster"; TV and FM bands; 6AK5, 6CB6. Completely automatic in operation, no tuning, no channel selection, relay turns booster on and off. Designed to be placed out of sight (inside of cabinet or near antenna). Brown steel cabinet. Price $44.95. Company also makes Model IT-90A "Cascode Autobooster." It is similar to the above model but has greater gain. Employs an additional 6BQ7 tube. Grey steel cabinet. Price $89.95. A third model, the IT-77A "Multibooster" is available for multiple set operation. Similar to Model IT-75A. Designed for continuous operation, automatic relay feature omitted. Price $59.95.



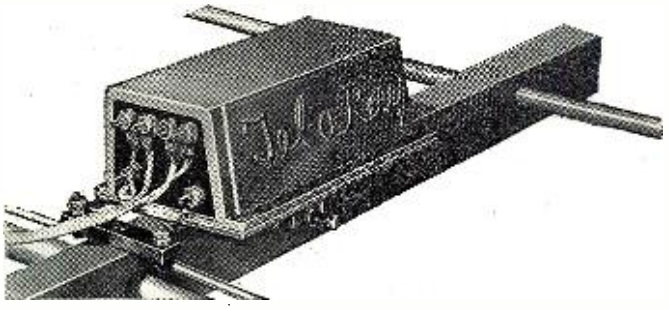
I.D.E.A., Inc.'s "Regency" Model DB410. 6J6; 73 and 300 ohm input and output; high and low band; 50-60 cycle operation. Additional control used for fine tuning. Brown plastic. Price $32.50.

Electro-Voice, Inc. Model 3000 "Tune-O-Matic (top left). 4-6J6's; 150 and 300 ohm input and output; 50-60 cycles; completely automatic in operation; TV set's "On-Off" switch turns booster on and off. Designed to be placed out of sight inside cabinet or at antenna. Maroon and grey metal cabinet. Price $59.50. Model 3002 "Tune-O-Matic" (lower left). Same as Model 3000 except uses 2-6BK7's and is housed in coppertone metal cabinet. Price $39.50. Model 3010 "Tenna Top." 4-6J6's; 150 and 300 ohm input and output; 50-60 cycles; completely automatic, relay operated; consists of two units, one mounted on antenna mast, and a junction box mounted at receiver. Metal cabinet. Price $89.50.

Alliance Manufacturing Company's "Tenna-Scope." 6J6; 72 and 300 ohm input and output; high-low band; selector switch also used as fine tuning control. TV set's power switch controls booster's "On-Off" switch. Walnut plastic cabinet. Price $29.95.

Mark Simpson Mfg. Co., Inc. Model MB-2 "Sky Chief," 2-6J6's; high-low band selector switch; 75 and 300 ohm input and output. Selector switch also used as fine tuning control. Booster's power switch turns TV set on and off. Mahogany steel cabinet. Price $40.50. Model MB-3 "Super Sky Chief," similar to above but has more gain. Uses 4-6J6's. Both channel selector switches also act as fine tuning controls. Mahogany metal cabinet. $75.55.

Tel-a-Ray Enterprises, Inc.'s antenna-mounted booster; 6J6; single channel operation only; completely automatic in operation but does require a 6.3 v. filament voltage from set or separate transformer; designed specifically for 300 ohm input and output but will operate with 150 and 75 ohm lines. List price $29.95.



It is for these latter situations that boosters were designed. Boosters are basically nothing more than r.f. amplifiers and when you attach one of them to your set, you are, in effect, adding one or more r.f. amplifiers to the one already existing in the receiver. Your purpose in doing this is to strengthen the incoming signal to such an extent that it will produce a picture possessing the full contrast range and, at the same time, improve the signal-to-noise ratio so that the picture will be clear and free of annoying noise spots. Of these two objectives, the improvement of the signal-to-noise ratio is the more difficult to attain—and yet, it is the more important. So let us pause and examine the relationship between noise and weak signals.

The ability of a receiver to amplify a signal is not limited by the amplification which can be obtained from vacuum tubes but by the noise which arises from the tubes and the associated receiver networks. This noise is known as random noise because it possesses no fixed frequency, but extends from zero to frequencies far above any being used today.

The noise that is developed in a receiver is due to two sources, thermal agitation in conductors and electron flow through tubes. Thermal agitation arises from the random motion of electrons within a conductor. There is no external voltage applied, but the electrons, using their own energy, move to and fro along a conductor. This movement of electrons constitutes a current flow. Since, at any given instant, a few more electrons are moving in one direction than in the other, a voltage is set up in the conductor which is proportional to the net current flow and the value of the conductor resistance. The polarity of the voltage due to thermal agitation changes constantly, electrons moving first in one direction then another. Because of this, there is no definite pattern to the random voltage, or, for that matter, any one frequency at which the energy changes. It has been found that the energy of this disturbance is distributed uniformly throughout the entire frequency spectrum used for communications.

The second source of receiver noise is developed in the tubes. While there are several components to this noise, the most important component is due to the shot effect. The current that flows in a tube is not a continuous fluid but a moving congregation of separate particles, the electrons. Noise voltages are produced, even when so-called steady currents are flowing, because at any single instant, the number of electrons impinging on the plate differs from the number reaching this electrode at any other instant.

Over a measurable period, the current is steady, but instantaneously it fluctuates rapidly due to the non-fluid nature of electrons. It is these instantaneous fluctuations that represent the noise.

In a receiver, the noise that is developed by the first stage (the r.f. amplifier) is actually the most important because at this point in the system the level of the incoming signal is more nearly on a par with the noise level than it is at any other point in the receiver. Whatever noise voltage appears at the grid of the r.f. amplifier is amplified along with the signal and so, to obtain the best noise-free picture, we want to have as much signal and as little noise as possible at the front end of the set.

Right here we have the reason why sometimes a booster may actually not help the set. Assume that in our regular TV receiver (without a booster), the noise voltage existing at the grid of the r.f. amplifier is 10 microvolts and the received signal is 30 microvolts. This is a signal-to-noise ratio of 3 to 1. We figure that if we place a booster ahead of our set, we should get a clearer picture. This may not be so.

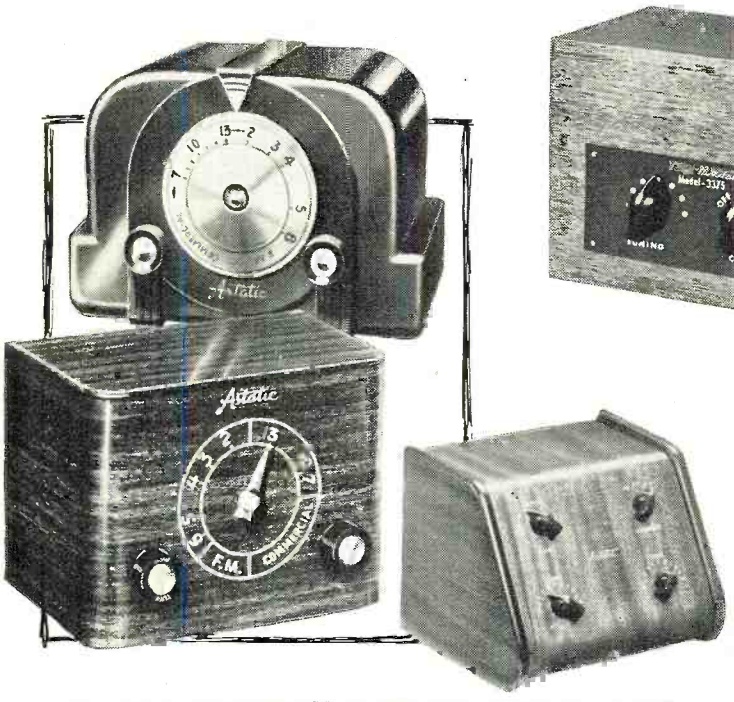
Suppose our booster, in its input circuit, develops a noise voltage of 20 microvolts. The incoming signal is still 30 microvolts. If the booster gain is 10, then what the r.f. amplifier will receive is 200 microvolts of noise and 300 microvolts of signal. What is the signal-to-noise ratio now? 3 to 2, which is not as good as 3 to 1.

So, in this instance, this booster will not help you improve the quality of your picture.

On the other hand, if the noise existing at the grid of the r.f. amplifier of the booster is less than 10 microvolts, and the same signal of 30 microvolts is received, then the signal-to-noise ratio will improve and with it, the quality of your picture.

From these facts concerning noise, we see immediately that in choosing a booster we want one which has a low noise figure. This is certainly as important as gain—because you can have all the gain in the world—yet if a large noise voltage exists at the grid of the first amplifier stage of the booster, you will get a high noise voltage out. And nothing you can do thereafter will reduce the noise.

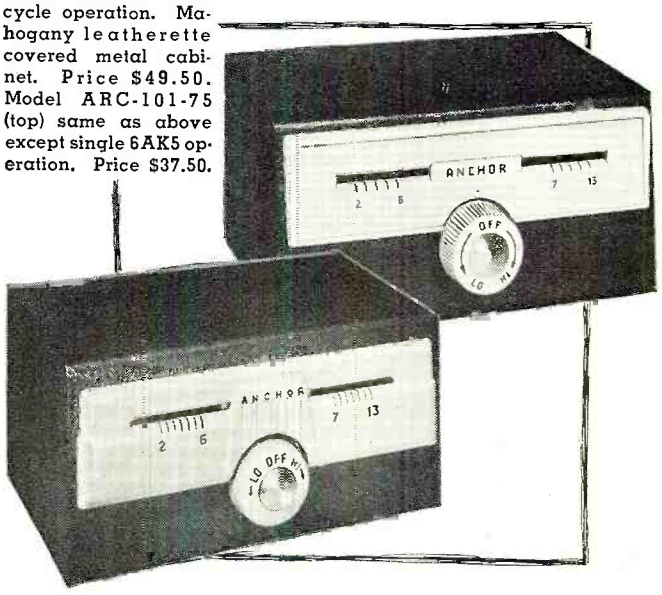
David Bogen Co., Inc., 2-6J6's; 75 and 300 ohm input and output; high-low band; selector switch also used as fine tuning control. TV set's power switch controls booster's thermal "On-Off" switch. Model BB-1 mahogany metal cabinet. Price $32.50. Model BB-2 mahogany finished wood cabinet. Price $37.00.



The Astatic Corporation Model BT-2 (top). 6AK5; 75 and 300 ohm input and output; two controls (tuning and "On-Off"); continuous tuning, TV, FM, 2-meter ham band, and several commercial services. Uses Mallory "Inductuner." Brown plastic cabinet. Price $34.95. Model BT-1 (center). Same as above except mahogany metal cabinet. Price $32.50. Model AT-1 (bottom) 4-6AK5's; high-low band; 72 and 300 ohm input and output; separate gain and two fine tuning controls. Wood cabinet. Mahogany (AT-1) $54.50, blonde (AT-1B) $56.50.

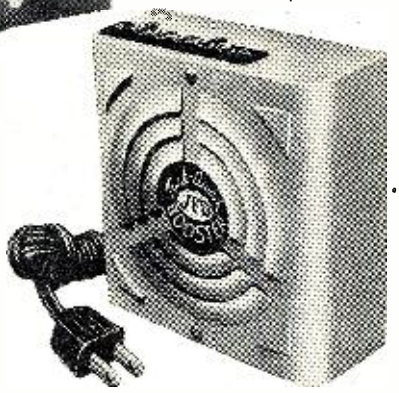
Tech-Master Products Company, Model 3375. 6AK5; high-low band; has fine tuning control. Designed for 300 ohms, will operate with 72 ohm input and output. Brown wood cabinet. Available only in kit form at $16.60.

Blonder-Tongue Laboratories Model HA-1-L "Antensifier," 12AV7, 3-6J6's. Completely automatic, no tuning, no channel selection, thermal relay turns booster on and off with set. Designed to be placed out of sight but can be used on receiver if required. Leatherette covered wood cabinet. Price $57.50. The company also makes a television distribution system comprised of three units: the Model CA-1-M (a commercial version of the "Antensifier"); Model DA-2-1-M, a distribution amplifier for two outlets; and Model DA-8-1-M; an eight outlet master distribution amplifier.

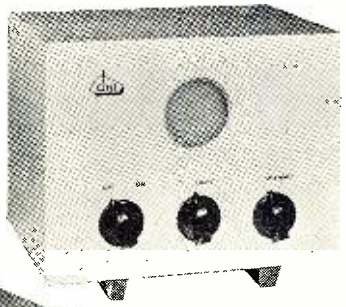


Anchor Radio Corporation Model ARC-101-100 (bottom), 2-6AK5's; high-low band; selector switch also is fine tuning control; 50-60 cycle operation. Mahogany leatherette covered metal cabinet. Price $49.50. Model ARC-101-75 (top) same as above except single 6AK5 operation. Price $37.50.

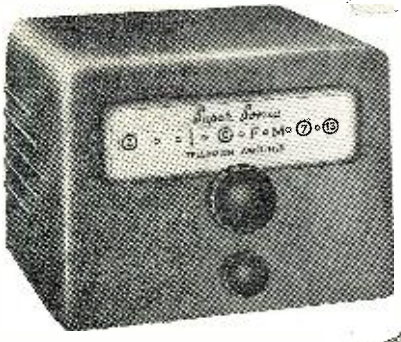
Approved Electronic Instrument Corp.'s Model A-TVB. 2-6J6's; semi-automatic in operation; requires no tuning, however, has "On-Off" switch; dual-channel operation covering 4-5 or 12-13; special boosters covering 7-8, 8-9, 10-11, 11-12 available on special order. Metal cabinet.



JFD Manufacturing Co., Inc.'s Model VB "Tuck-Away" booster. 6J6; single channel operation, factory pre-set; completely automatic in operation; designed to be used in some out-of-sight location near set or near antenna; TV set's "On-Off" switch turns booster on and off; input and output impedances not given, assumes 300 ohms; metal case. Price $19.95.



DeciMeter's Model 300. 2-6J6's; channel selector switch; separate gain control; opening (center top) lights up when booster is on and channel number to which unit is set appears on screen. Available in blonde or dark wood case.



Sonic Industries, Inc. Model IT-7. 6AK5; continuous tuning, covering all TV channels and FM; 300 and 72 ohm input and output; extra control is "On-Off" switch; 50-60 cycle operation. Price $29.95.

LaPointe-Plascomold Corp.'s Model OB Vee-D-X "Outboard" unit. 6J6; single channel operation; factory preset; completely automatic; designed to be used behind TV set or near antenna; TV set's "On-Off" switch operates booster; input and output impedances not given, assume 300 ohms. Metal Hammertone cabinet. $19.95.

☆

Sutton Electronic Company's SEC booster. 6J6; high-low band; second control is fine tuning; 75-300 ohm input and output; metal case. $34.95.

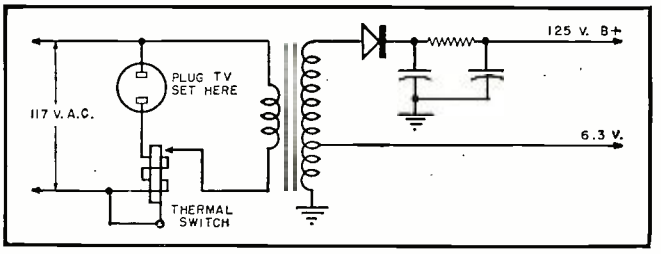


Fig. 1. Schematic diagram of a power supply that is widely used in booster designs. Most of the units on the market today operate from 110/125 volts, 60 cycles using an isolation transformer and a selenium rectifier. There is quite a variation in the use of a thermal switch. Several of the manufacturers use relays in lieu of the switch, while others have dispensed with the switching arrangement entirely. Operation of thermal switch is such that when the television receiver is turned on or off it will automatically operate the booster. On the units that employ a relay in some form or other, the operation is similar, as the television set turns the booster on or off.

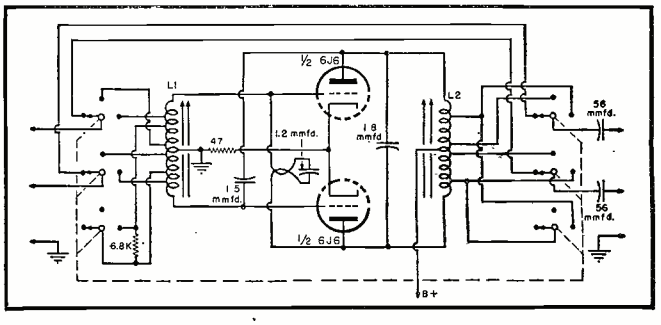
That the booster manufacturers recognize the situation is amply revealed by the following excerpt from the literature of one such manufacturer. He states, in part, that, "The noise factor of the initial amplifier stages in the TV receiver fixes the quality of reception. If the noise factor is high, reception is poor. The *"XYZ"* booster not only supplies the signal with sufficient r.f. gain to overcome the noisy television tuner, but possesses a low noise factor to furnish the best in reception." Other booster manufacturers, while not giving as extensive an explanation, do stress in their literature the fact that low-noise circuits are used.

Thus, boosters are designed with two aims in mind: To improve the signal-to-noise ratio and to amplify the weak incoming signal. Both are important and both are needed. A booster capable of high gain but incapable of providing a good signal-to-noise ratio will give a picture filled with disturbing noise spots. A booster possessing a minimum of internal noise but capable of little gain will not amplify the signal sufficiently to permit it to override the set noise. So again the picture will be covered with noise spots. Thus your booster must have both attributes or it might as well have none.

Before we leave this subject of noise, it should be pointed out that we have said nothing about noise generated outside the set or the booster. This noise, if present, comes down the transmission line with the signal and it is indistinguishable from the signal as far as the booster is concerned. To overcome this noise we must attack it at its source, or, if this is not feasible, to try to keep as little of it as possible from reaching the signal via the antenna or the lead-in line. Standard methods of attack include increasing antenna height, antenna replacement, and the use of shielded lead-in line. It has also been found helpful to position the booster at the antenna (or at least as close to the antenna as possible). This serves to strengthen the signal before it has been subjected to the noise and thus enables it, with its amplified strength, to better overcome

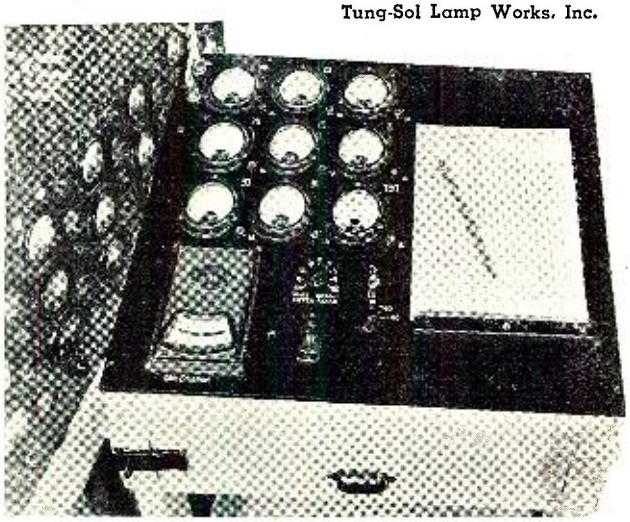
(*Continued on page* 104)

Fig. 2. Circuit that is widely used in the design of lower-priced boosters. A single duo-triode tube is used. The triode sections are connected in push-pull to provide amplification on all channels. With those boosters which employ more than one tube, the circuits vary quite widely. In all such cases, however, the additional tubes employed provide increased gain.

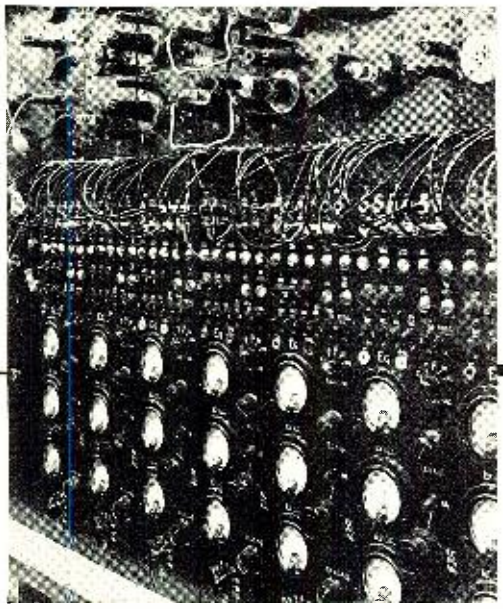


TUBE MANUFACTURER'S CONTROL OF GRID EMISSION

By
ANTON CARLSON
and
RALPH MORGAN
Tung-Sol Lamp Works, Inc.



Accuracy of readings from grid emission test set directly influences present and future tube quality. Multimeter arrangements on portable test wagon make it possible to obtain reliable data on a large number of tube types.



Meters on power supply panel indicate grid bias and a.c. or d.c. filament voltages. Seven "B+" voltages from 10 to 400 volts are available. Voltages are fed to test panels at top. Phone jacks, shown at top, deliver the various readings to test wagon.

Quality control test equipment at the Tung-Sol plant includes this test set for measuring the control grid current under adverse conditions. Data obtained predicts behavior of tubes during normal expected life. Samples of every production run are subjected to test procedures like this.

WE ALL know that electron emission results from heating the cathode, but few people realize that all elements of an electron tube, if heated sufficiently, will emit electrons. As a protection to the consumer as well as the manufacturer, grid emission testing is being performed more and more each day.

Grid emission means exactly what it implies, that is, electrons being emitted from the control grid. A complete absence of grid current would be an ideal condition since the grid of the tube is the input portion in which we place a high impedance signal. The grid emission current is independent of short time variations of applied voltages, therefore, it does not produce any loading effects in the signal circuits. However, a high grid resistor will produce a loss in bias which will easily cause distortion and tube overload to the point of destroying the tube. It is important to know the role of circuit design. For instance, a cathode bias resistor offers far better stability than a fixed bias arrangement.

Tubes under test are operated at static conditions. The commercial bias and power ratings applied are normal with the exception of heater voltage. The heater voltage is increased a minimum of 10%, the reason being that commercial ratings permit a tolerance of ±10%. After all elements of the tube are heated thoroughly a grid current reading is taken and noted. The next step is to apply a cut-off bias voltage and again note the reading. In some instances, plate and screen voltages are increased for additional heat. These changes are designed to aggravate any defects which may be present in a tube.

The instrument used to measure the grid emission currents of receiving tubes is pictured on this month's cover. Along the top are seven panels. Each panel contains sockets for testing five tubes at one time. Below this we find a group of panels which contain grid bias, plate, and screen voltages. In front of the test set, facing the operator, is a test wagon that is used for all measurements such as plate, screen, and grid currents. A cut-off bias supply is also incorporated. Each panel is independent in operation. Tests run anywhere from 20 to 65 minutes, depending on tube types under test, thus the need for a portable unit for measurements. The capacity of the test set varies from 5 to 35 tubes at any given time.

The test results derived not only indicate grid emission, but also presence of gas and leakage. Residual gas in the tube is ionized by the electrons, producing an ion circuit to the negative grid. Leakage is caused by any high resistance conductive material which may be present between elements.

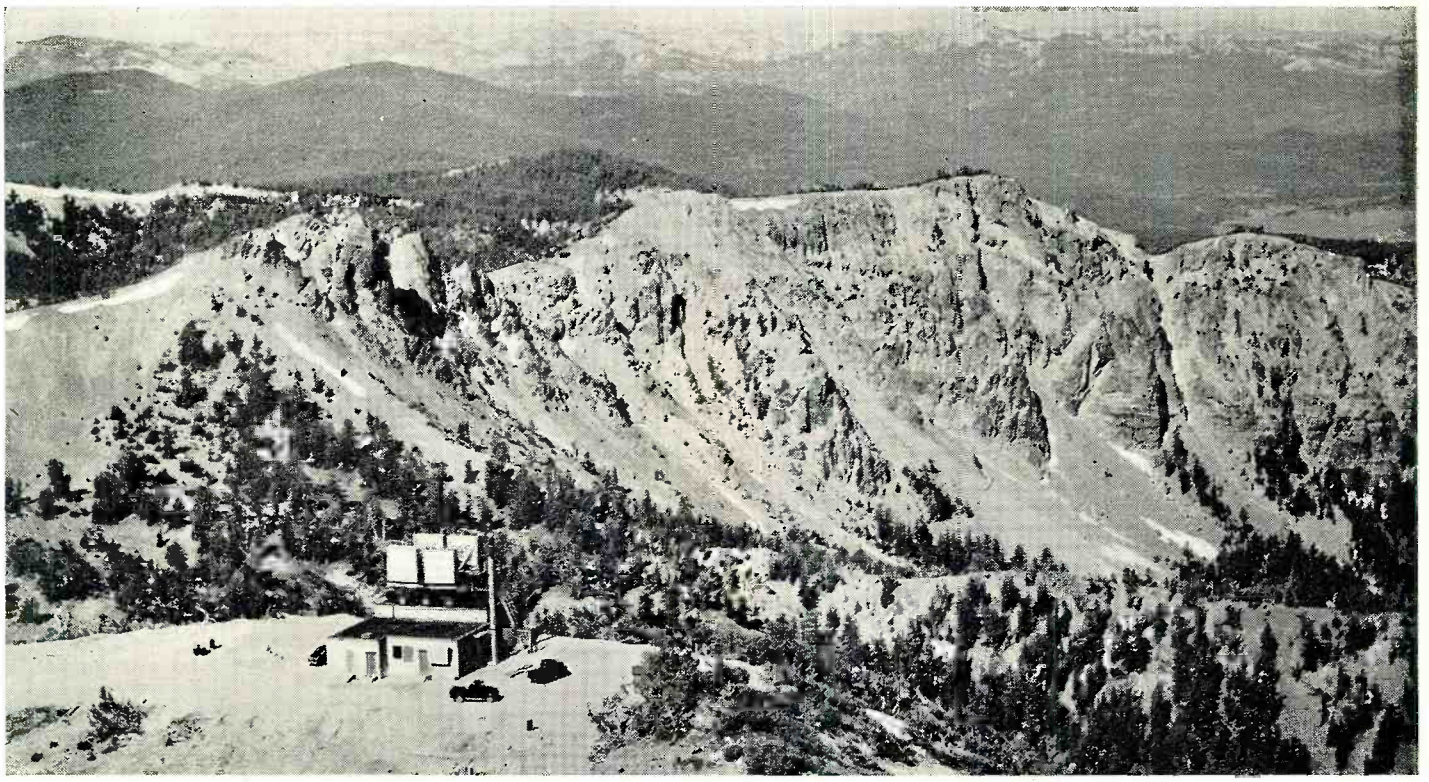
The following are a few examples of how to distinguish between gas, leakage, and grid emission.

1. When grid current at normal bias is greater than grid current at cut-off bias, tubes are considered gassy.
2. When grid current at cut-off bias is greater than grid current at normal bias, tubes are considered to have leakage.
3. If grid current is approximately the same at normal and cut-off bias, grid emission is indicated.

There are some cases, however, where results of tests cannot be determined until further analysis is made by an experienced tube engineer.

The test for grid emission current

(*Continued on page* 166)



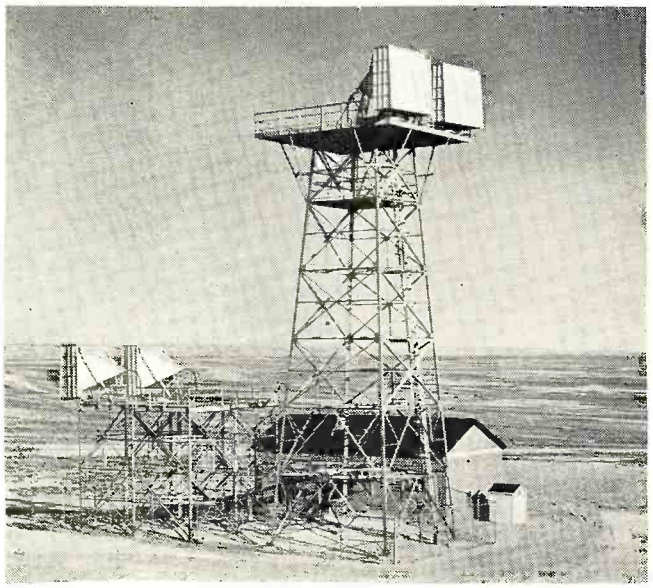
Air view of Long Lines radio-relay station at Mt. Rose, Nev. At an elevation of 10,000 ft., this is highest station in system.

BELL SYSTEM OPENS TRANSCONTINENTAL RADIO-RELAY

By WILLIAM ALBERTS

Original commercial service provides two TV channels—one east and one west. Other channels will be added as needed.

Radio-relay station at Creston, Wyoming, showing both the receiving and sending microwave antennas at two different levels.



BY THE time this issue reaches our readers coast-to-coast commercial television will be a reality. This video link has been made possible by the completion of the new microwave radio-relay built by the Long Lines Department of the *American Telephone & Telegraph Co.*

This new project is the longest microwave system in the world and is the product of years of engineering effort and cooperation by the development, manufacturing, and operating units of the *Bell System.*

The relay was put into temporary service on Sept. 4th to carry the ceremonies in connection with the Japanese Peace Treaty Conference held in San Francisco. Built in about three years at a cost of $40,000,000, the system relays telephone calls and radio and video program material along a chain of 107 microwave towers, spaced approximately 30 miles apart.

The vast distances, together with the large number of radio channels required, posed many serious problems for the *Bell Telephone Laboratories.* Three new developments provided the answers. First, a new electronic tube was developed which gave outstanding performance at the super high frequencies. Second, the *Laboratories* came up with a new improved metal lens which would handle thousands of simultaneous telephone calls. A unique system of filters, representing an entirely new contribution to the field of communications, was developed. All of this electronic equipment was built and installed by the *Western*

Electric Company, the manufacturing unit of the *Bell System*.

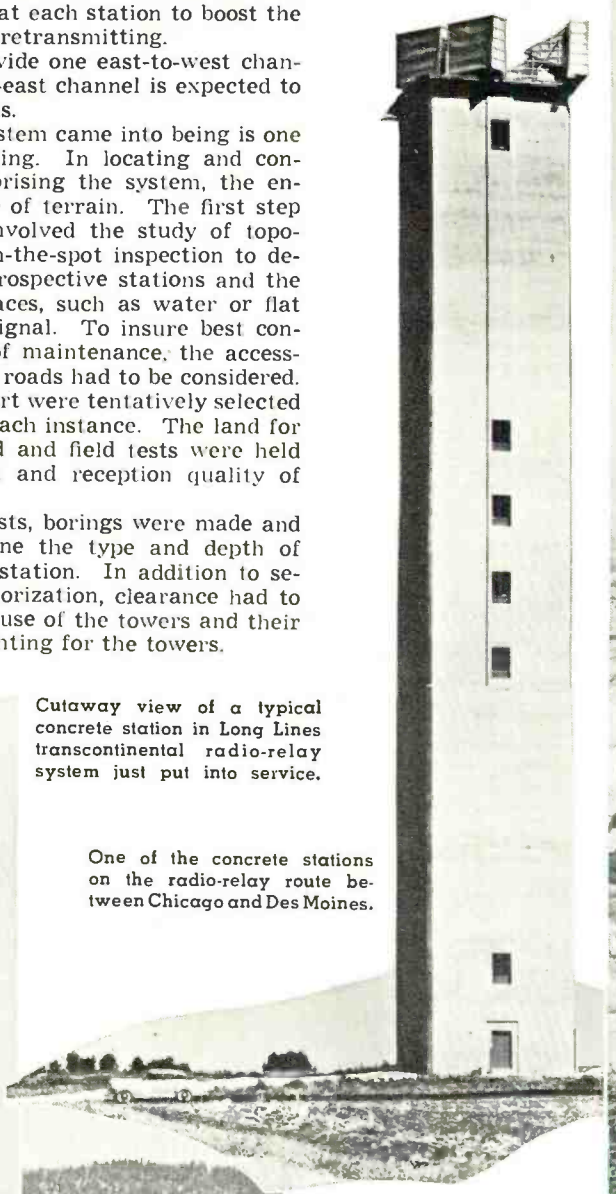
Operating in the 4000 mc. range, the new relay system employs amplifying equipment at each station to boost the signal 10,000,000 times before retransmitting.

Initially, the system will provide one east-to-west channel for television. The west-to-east channel is expected to be in service within a few weeks.

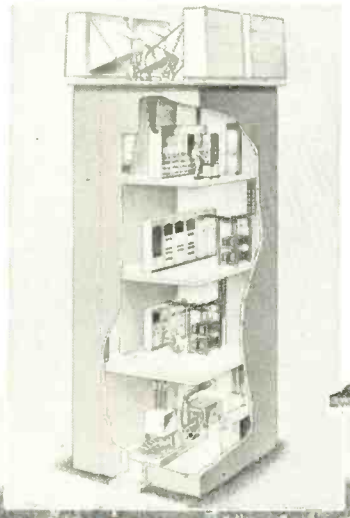
The story of how this vast system came into being is one worthy of the days of pioneering. In locating and constructing the 107 towers comprising the system, the engineers encountered every type of terrain. The first step in determining a tower site involved the study of topographical maps and then an on-the-spot inspection to determine clear paths between prospective stations and the detection of all reflective surfaces, such as water or flat lands, that might impair the signal. To insure best construction conditions and ease of maintenance, the accessibility of the site to all-weather roads had to be considered.

Next, sites about 25 miles apart were tentatively selected with alternate sites chosen in each instance. The land for each station was then optioned and field tests were held to determine the transmission and reception quality of that particular location.

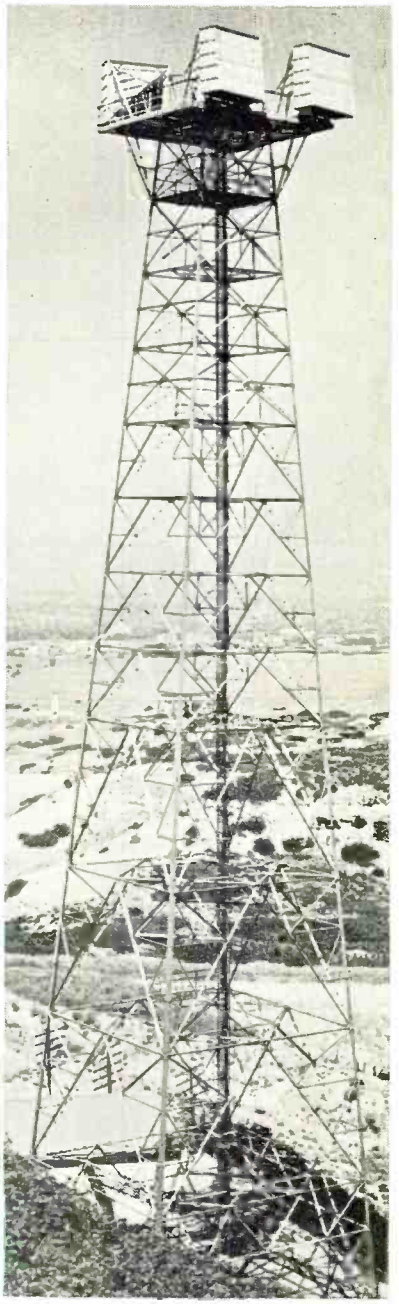
Following the preliminary tests, borings were made and soil samples taken to determine the type and depth of foundation necessary for each station. In addition to securing the necessary FCC authorization, clearance had to be obtained from the CAA because of the towers and their rulings heeded as to outside lighting for the towers.



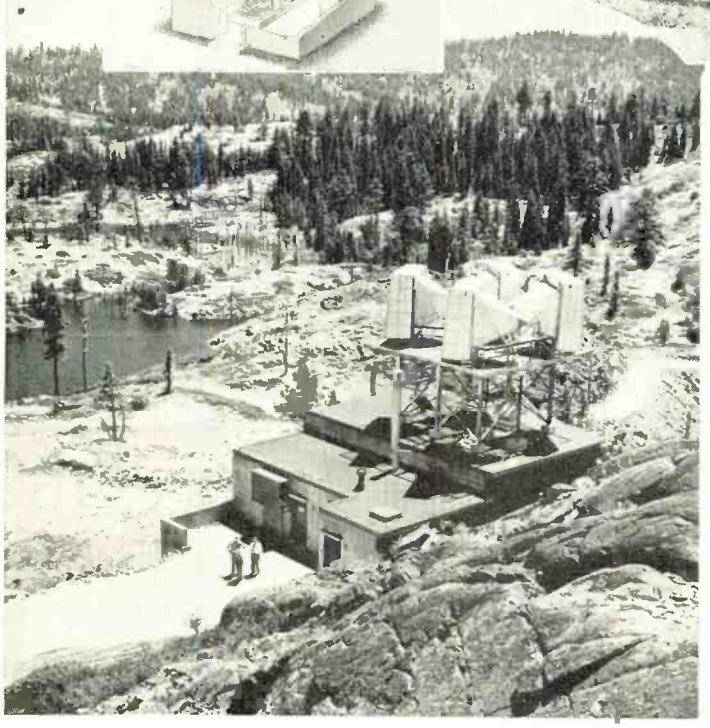
One of the concrete stations on the radio-relay route between Chicago and Des Moines.



Cutaway view of a typical concrete station in Long Lines transcontinental radio-relay system just put into service.



The 200 foot steel tower at Salt Lake City Junction overlooking Salt Lake City and Great Salt Lake. This is one of the 107 stations on the transcontinental relay system.



Unusual view of the Cisco-Butte, California station of the transcontinental relay system. This station is located in a valley high in the Sierra-Nevada mountain range.

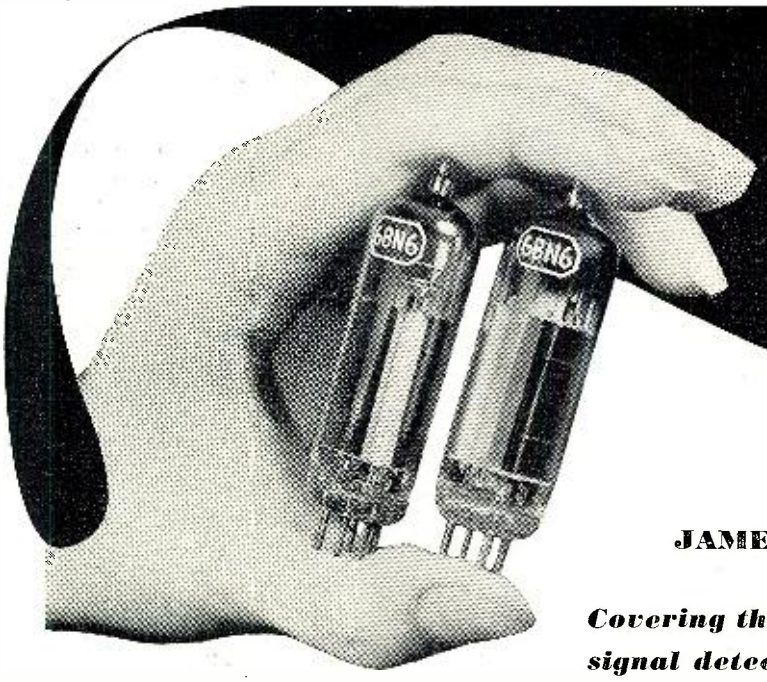
Depending on the location of the stations, the towers range in height from 40 to 200 feet. In many cases they are concrete buildings with space on the ground floor for a gasoline engine to generate emergency power in case of power line failure.

The second and third floors of the stations house the storage batteries and associated power equipment. The amplifying and testing gear is housed on the fourth floor while the top of each station carries the horn-shaped directional antennas.

All-in-all this vast engineering feat represents an important addition to the country's communications facilities for both peace and war, provides coast-to-coast network facilities for the transmission of television programs, and opens up thousands of new channels for long distance phone service.

With the completion of this new microwave relay system the country now has seven telephone highways crossing the continent. —30—

The 6BN6 GATED-BEAM TUBE



By
JAMES KAUKE

Covering the use of the 6BN6 tube as a weak signal detector and as a superhet converter on AM broadcast and short-wave frequencies.

ALTHOUGH the new 6BN6 gated-beam pentode was designed primarily for FM and TV applications, it occurred to me that its unusual characteristics would make it useful for AM applications as well. Due to its sharp cut-off and high grid slope, the first application which came to mind was as a biased detector. However, due to the extreme "top bend" in the transfer characteristics, which gives this tube its limiting properties, such a detector would obviously be useful only for weak signals. The threshold of limiting, though, is on the order of 1 volt which is ample except for extreme signals.

In view of these facts the one-tube receiver whose circuit is shown in Fig. 1A was designed and built. The circuit is fundamentally similar to the usual plate detector, with the limiter grid used as control and the quadrature grid, which is not needed here, being tied to the cathode. Due to the extremely sharp cut-off of this tube, the operating point is somewhat critical, and thus the cathode resistor has been made variable to take care of this. It is only necessary to adjust the rheostat for best reception when the set is first put into operation, although changes in "B" voltage or aging of the tube might necessitate a later readjustment. The maximum "B" voltage for this set is 100 volts, which is the maximum accelerator voltage rating. However, voltages down to 50 volts will work, with some limitation of the input tolerance. The "B" current drain is around 10 ma.

The performance of this set was right up to expectations. With a 15-foot first floor indoor antenna, 8 of the major Chicago stations were received with ample selectivity and volume. However, this circuit need not be used alone, but can be used with an audio amplifier to drive a speaker, or can be used as the detector in a t.r.f. or superhet if adequate means are provided for controlling the r.f. gain in order to avoid exceeding the input tolerance on strong signals.

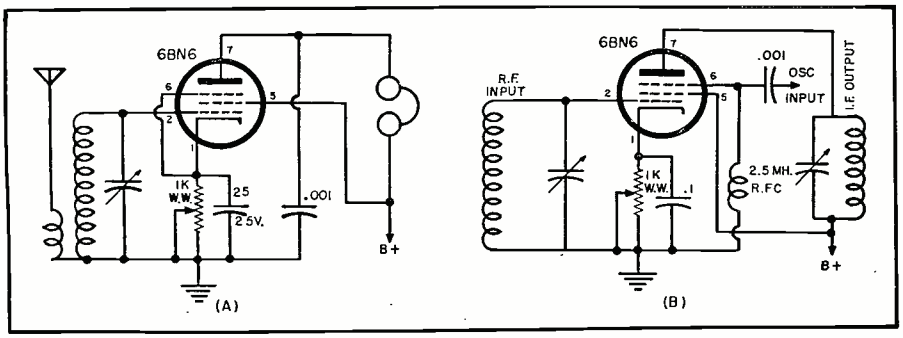
Since the superhet converter, like the plate detector, is basically a non-linear device, it was thought that the advantageous properties of the 6BN6 could also be put to use in this service. The circuit is shown in Fig. 1B. It will be noted that it is quite similar to the simple detector circuit, except that the quadrature grid is now used for oscillator injection. Considerations of input tolerance, "B" voltage, and initial operating point adjustment mentioned for the plate detector also apply here, especially noting that a.v.c. or gain control bias may not be applied to this tube. The quadrature grid return is made through an r.f. choke instead of a resistor in order that any grid current drawn might not develop a bias and cut the tube off.

This circuit is an excellent performer, giving high conversion gain due to its high slope. However, its most advantageous characteristic is the oscillator voltage requirement. Since the quadrature grid has a characteristic similar to the limiter grid, an oscillator voltage of 1 or 2 volts is sufficient to drive the tube from cut-off to saturation, and additional voltage has no more effect. This makes the design of the oscillator circuit extremely simple. First, due to the low voltage requirement, the voltage may be taken from a low-impedance point in the oscillator circuit, such as the plate of a tickler oscillator or the cathode of a Hartley, which increases stability and minimizes "pulling." Secondly, the oscillator need not be designed for constancy of output with tuning, since any variations in output are swamped by the limiting characteristic of the quadrature grid.

However, it would be much better to have a gated-beam tube designed especially for converter service, which would be similar to the 6BN6. but which would have a remote cut-off signal grid, allowing automatic volume control to be used.

—30—

Fig. 1. (A) Schematic diagram of a one-tube receiver. Basically, the 6BN6 tube is used similarly to the usual plate detector, with the limiter grid as control grid and the quadrature grid tied to cathode. (B) The 6BN6 as a superhet converter.



Synchronizing The COLOR WHEEL

By
WALTER H. BUCHSBAUM
Author, "Television Servicing"

Fig. 1. Color converter with motor control, saturable reactor, and alternator.

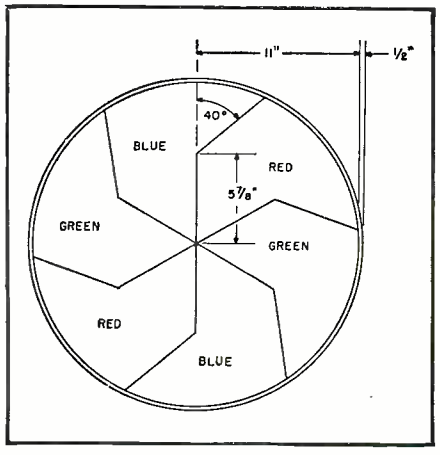
Covers both manual and automatic methods and includes complete details on the CBS system.

SINCE the inauguration of regular commercial broadcasts using the *CBS* color television system, many technicians have become interested in constructing converters or adapters to receive pictures in color. This article covers one of the most tricky aspects of this conversion, *i.e.*, the method of keeping the color wheel rotating at exactly the right speed.

In order to receive *CBS* color transmissions in black and white, the horizontal and vertical sweep frequencies of the receiver must be changed to 29,160 and 144 cps respectively. When this is done a black and white picture can be seen. To inject color, a rotating disc or drum must be placed in front of the picture tube. Since the drums for this purpose are not yet available we shall discuss only the disc or color wheel. The diameter of the disc must be slightly more than twice the diameter of the picture tube and this fact limits practical color wheels to 12 inch picture tubes at the present. In order to inject color into the black and white picture, the color wheel contains blue, green, and red filters which appear in front of the picture tube at the same time as the corresponding filter appears at the camera. As shown in Fig. 2, the color wheel contains six segments, two of each primary color. The shape of the color segments is chosen to cover a maximum screen area and keep the wheel diameter to a minimum. Since the wheel has to rotate at 1440 rpm it must be constructed to provide the least wind resistance and to prevent buckling or flapping. Commercially available color wheels are made by laminating the color filters between two sheets of clear plastic. This provides a fairly rigid disc, slightly more than 1/16 inch thick. For anyone constructing a disc we would advise a similar procedure, using a good plastic cement and clamping while drying. Needless to say, the sequence of colors must be correct. The colored filters must be the same shades as those used in the studio. *CBS* has recommended two sets of filters. One set consists of blue, green, and red filters made up of *Monsanto "E."* Set No. 2 comprises a blue filter of *Eastman* #47 (1/2 density), a green filter of *Monsanto* #61 (4/3 density), and a red filter of *Eastman* #26.

With the No. 2 set of filters the face of the picture tube should be covered with a yellow, *Eastman* #6 filter. This is not part of the color wheel but is taped or glued to the tube permanently. All of the filters are manufactured either by the *Monsanto Chemical Corp.* or *Eastman Kodak Corp.*, and should soon be available to the trade. If other colored filters, having either a different hue or light transmission characteristic are used, incorrect colors will result. The loss of color fidelity will be especially pronounced in such mixed shades as flesh and pastel colors.

Fig. 2. Color disc for a 10-inch tube.



A few words should be said here about the limitations of the *CBS* system in order to keep the experimenter from needless work. Depending on the brightness of the picture, flicker will be experienced unless there is absolutely no 60 cycle hum in the video or sweep sections. Color ringing, the effect of different colors appearing when a particular object moves quickly, is also inherent in the system. Color break-up will occur when you blink your eyes, tilt your glasses, or make any swift motion with the head. In this event the three primary colors become visible for an instant. Another thing to expect is lack of brightness. The light losses through the colored filters may amount to as much as 90%, requiring a really bright picture. This can be achieved by using an aluminum backed screen such as the 10FP4 uses, and operating the tube at about 12 to 15 kv. Turning off the room lighting will also help. As a final warning we should mention the effect of the color of the picture tube screen on the final color picture. As every service technician knows, it is rare to find two tubes that have exactly the same screen color. A wide range of purple, blue, and yellowish white is found among picture tubes. Since the screen light provides the "white" of the color picture, its color will have a considerable effect on the final picture. With the identical color wheel, entirely dif-

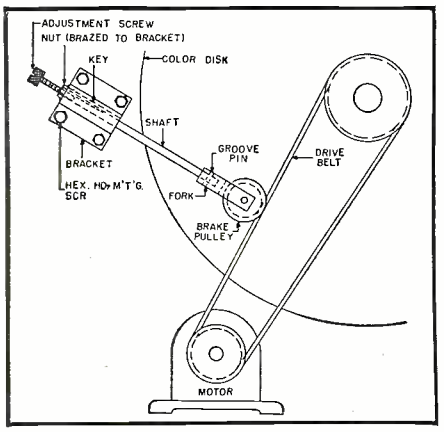


Fig. 3. One type of speed control system.

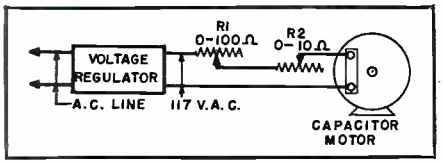


Fig. 4. Simple manual speed control circuit.

ferent flesh tones, pastel shades, and mixed colors will be obtained if different picture tubes are used. The best compromise is to select a picture tube having as pure white screen as possible.

As mentioned before, the speed of the color wheel is 1440 rpm. If only one segment of each color were used, the speed would have to be doubled. But since the six segment wheel is the most practical we will consider only a wheel speed of 1440 rpm. To get a motor operating at that exact speed is quite difficult. Most motors are designed to operate between 1600 or 1800 rpm unless they have been especially designed for a particular application. It is true that most a.c. motors can have their speeds adjusted by varying the supply voltage but this is not a practical way to get a speed of 1440 rpm since a lot of power would be wasted and the motor would operate under unfavorable conditions. Experience has shown that the best arrangement is one where the wheel is driven through gears or belts with a suitable ratio to provide proper wheel speed while operating the motor at its rated voltage and speed. For home use, a single-phase, a.c. motor is suitable. Depending on the size of the wheel and the friction that must be overcome, this motor can be either a condenser, inductance starting, or a shaded pole type. The last type is suitable for very small wheels since it has a rather low starting torque. The size of motor used again depends on the load and on the availability. In general, anything between 1/20 and ⅛ hp. can be used. At the time of writing several manufacturers are preparing to merchandise motors and control units for the *CBS* system and these, of course, are sure to do the job correctly.

Before describing the different methods of controlling the speed of the color wheel we should mention one more important thing to watch. "Color phase" means the relation between the color filters at the receiver and transmitter. For example, if at the transmitter the red picture is scanned while the blue filter is in front of the picture tube at the receiver, wrong color phase results. The singer's lips will be blue, her hair green instead of black, and her skin may have a purple tinge, etc. It is possible to lock the wheel in at the correct speed of 1440 rpm and still get incorrectly colored pictures if the color phase is wrong. *CBS* receivers have a simple cutout switch to overcome this. The a.c. is cut off for an instant, slowing the wheel down just enough to catch the right color phasing again.

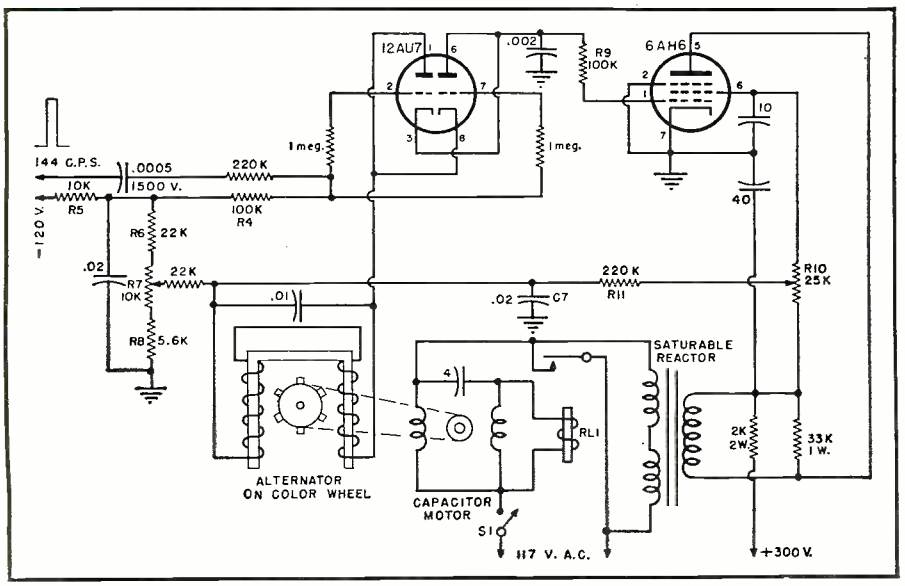
Manual Speed Control

The simplest method of controlling the speed of the color wheel is to control the voltage at its driving motor. The capacitor type a.c. motor usually used for this purpose is quite sensitive to voltage changes. It would therefore appear simple to connect a variable resistor in series with the motor and adjust it by hand until the speed is just right and correct color pictures appear. Unfortunately, even the least voltage change may shift the motor speed ever so slightly but enough to lose color synchronization. One solution is to connect a constant voltage transformer between the motor and the a.c. line, and then keep adjusting the rheostat until the proper speed is reached and maintained. This system is quite feasible for experimental purposes where constant adjustment is not objectionable. In Fig. 4 the electrical circuit for such a scheme is shown. Note that two power type resistors are used, one for rough and the other for vernier adjustments.

Another scheme for keeping the color wheel synchronized manually is shown in Fig. 3. To maintain constant a.c. voltage at the motor a constant voltage type of transformer should be used. The actual speed adjustment is made by controlling the load the motor must pull. The original arrangement of motor speed, pulleys, and wheel speed is such that the device runs slightly faster than the correct speed. When the brake pulley is then pressed against the belt, as shown in Fig. 3, the load is increased and the motor speed is correspondingly decreased. The pressure on the brake pulley is determined by the position of the screw pressing down on it and this permits a pretty exact adjustment. In actual operation we have found that this mechanical control method is somewhat better than the electrical method, although the latter permits controlling the wheel from anywhere in the room, a feature which the screw arrangement does not permit. It should be emphasized, however, that either method is usable only for experimental work and not at all suitable for commercial color receivers or converters.

The photograph of Fig. 7 shows a small color wheel with a rather simple manual speed control. The vertical motor shaft has a driving pulley mounted at the upper end. The rim of this pulley provides friction drive for another disc mounted at a right angle to the motor pulley on the wheel shaft. The control is provided by the bottom lever which actuates a screw arrangement forcing the motor shaft slightly up or down. The up or down motion determines the speed ratio between the motor driving pulley and the disc mounted on the wheel shaft. It changes the disc diameter against which the rim of the motor driving pulley works. Fig. 7 is a small viewing unit designed by *Celomat Corp.*, with *Monsanto* filters, and used in earlier days of the *CBS* color television system.

Fig. 5. Circuit diagram of the CBS color disc synchronizing system.



Automatic Speed Control

There are many different schemes available for industrial motor control, but few of these are applicable for the *CBS* color system. The main require-

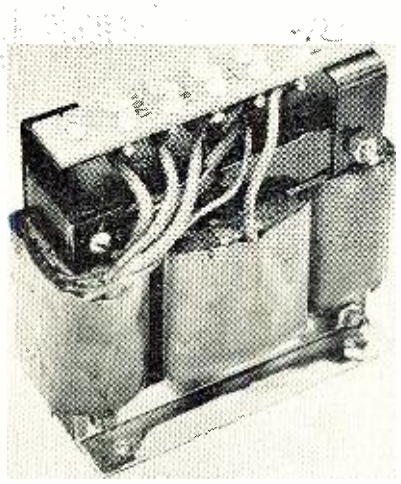


Fig. 6. The saturable reactor used by CBS in its color system.

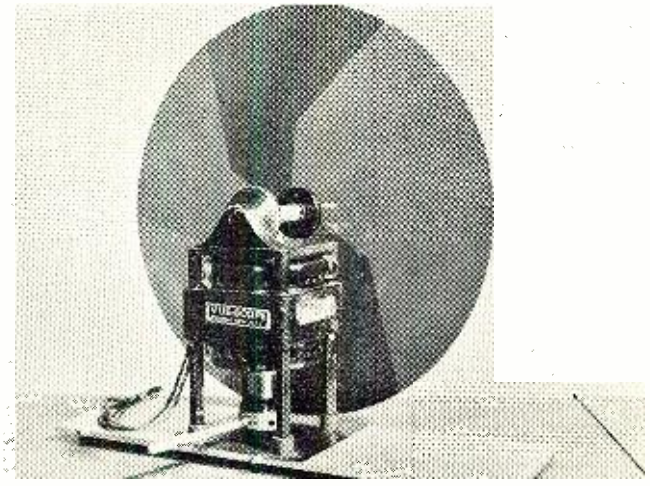


Fig. 7. Celomat Corp.'s manually-controlled color disc assembly.

ment here is that the motor speed be absolutely correct and not even a few degrees of phase difference or slippage can be tolerated. Another limiting factor in *CBS* color receivers is that the motor must be capable of operating from a single phase 60 cycle source and its speed should not vary with variations in line voltage. Many technicians felt that it would be easiest to use a motor operated from a 144 cycle source and then supply its power by amplifying the vertical synchronizing pulses. Unfortunately the current required for any suitable motor would run to several amperes and only a few transmitting type tubes that could supply so much current are available. The required "B plus" supply and the tubes themselves make this economically unfeasible.

Before going into other possible solutions of the problem, we would like to present the *CBS* method for automatic color sync. The circuit for this system is shown in Fig. 5. At the first glance it becomes apparent that this system uses two conventional vacuum tubes, a capacitor motor, and a saturable reactor. The saturable reactor is a device rarely used in radio work and therefore merits some explanation. The inductance of any iron core coil depends on the magnetic flux in the iron core. The relation of flux and coil current can be represented by a curve which rises gradually and then levels off. If the core and coil are so designed, the knee of the curve can be made either sharp or gradual. In a saturable reactor two coils are wound on one iron core. One coil is the control coil and only d.c. is passed through it. This d.c. controls the amount of flux in the iron core. The second coil is used in series with the a.c. line and represents an impedance to 60 cycle a.c. The inductance of this coil, therefore its impedance, depends on the iron core flux which, in turn, is controlled by the d.c. through the first coil. In actual operation the a.c. coil acts as a variable resistor in series with the motor and the amount of resistance is determined by the d.c. control voltage across the d.c. winding on the saturable reactor core. Refer to Fig. 4 and note that the motor speed is controlled by a series resistance R_1 and R_2. In the automatic circuit of Fig. 5, the series resistance is represented by the two-section coils at the left of the saturable reactor core while the controlling action is provided by the right hand coil and its associated networks. An over-all view of a commercially-built saturable reactor, as used by CBS, is shown in Fig. 6.

When the "off-on" switch is closed, the relay contacts will be closed and the saturable reactor will be shorted out. The full a.c. line voltage is applied to the capacitor type motor which then starts and gathers speed. The motor drives the color wheel through a belt and pulley arrangement so designed that at the approximately correct motor speed the color wheel runs at 1440 rpm. A small alternator is mounted on the shaft of the color wheel. This is effectively an a.c. generator having two stationary field poles and six rotating segments. As each segment passes between the poles it changes the magnetic flux between poles and thus a voltage is induced in the field windings. Each segment represents a segment of colored filter in the color disc. Thus the resulting a.c. induced in the alternator field coil will be an indication of the speed of the color wheel. Depending on the design of the alternator field and segments, the voltage obtained can be in the form of pulses very similar to the vertical sync pulses in the color TV set. In Fig. 5, one side of the alternator is connected to the plate and second cathode of the 12AU7 phase comparer. The 144 cycle vertical sync pulse is connected to the control grids of both sections of the 12AU7. The voltage divider, R_5, R_6, R_7, and R_8, serves to establish the fixed bias on the grids of the phase comparer tube. R_7 is usually called the "color phase control" because it sets the relationship between the sync pulse and the pulse picked up from the color wheel by the alternator. R_{10}, R_{11}, and C_7 further help in setting the d.c. operating level for the phase comparer. R_{10} is usually labeled "anti-hunt control" because it is adjusted to permit smooth action of the entire circuit. The operation of the 12AU7 as a phase comparer is basically not much different from the action of the 6AL5 phase detector in the "Synchrolock" a.f.c. system (*RCA* 630). The 6AH6 control tube obtains its grid bias through R_9, the 12AU7, and resistors R_4, R_6, R_7, and R_8. The bias voltage depends on the setting of the "anti-hunt" and the "color phase" controls and, most important, on the current passed through the 12AU7. Since this current is dependent on the phase relationship between the sync pulse and the alternator pulse, this will control the bias on the 6AH6. The 6AH6 control tube is a simple d.c. arrangement with a fixed plate current which flows through the d.c. winding of the saturable reactor. The only factor which will vary the plate current will be a variation in the grid bias. Whenever the grid bias becomes more negative, less plate current flows and the saturable reactor contains less flux. Reduced to the familiar terms of the horizontal a.f.c. circuits found in present TV receivers the action of this circuit is as follows: the incoming sync pulses are compared with the locally generated pulses. An error voltage is developed which is used as grid bias for the control tube. The plate current variation of the control tube, due to the error voltage, determines the impedance in series with the motor.

Once the motor has reached approximately full speed the relay opens its contacts and the saturable reactor is connected in series with the motor. The immediate reduction in line voltage at the motor results in reduced speed. If the speed is much below the correct one, the 12AU7 phase comparer will not be able to correct it. It may take a few seconds until the motor speed is near enough to the correct one so that the automatic control circuit can take effect. The reason for shorting out the saturable reactor during the starting period is that a relatively large starting current is required which would develop a large voltage across the reactor coil and greatly reduce starting

(*Continued on page* 124)

AUTOMATIC NOISE LIMITERS With Biased Detectors

By
CHARLES ERWIN COHN

Although diode detectors are usually used, here are some ideas on designing noise limiters using biased detectors.

ONE of the most welcome developments in modern communication receivers is the type of noise limiter which adjusts its threshhold of limiting to the carrier strength of the incoming signal, and thus needs no manual adjustment for any signal strength. However, it is commonly believed that the use of such circuits is limited to diode detectors. In this article, though, I will show that they can be used with the more efficient biased detectors as well, and can be adapted to almost any set with such a detector.

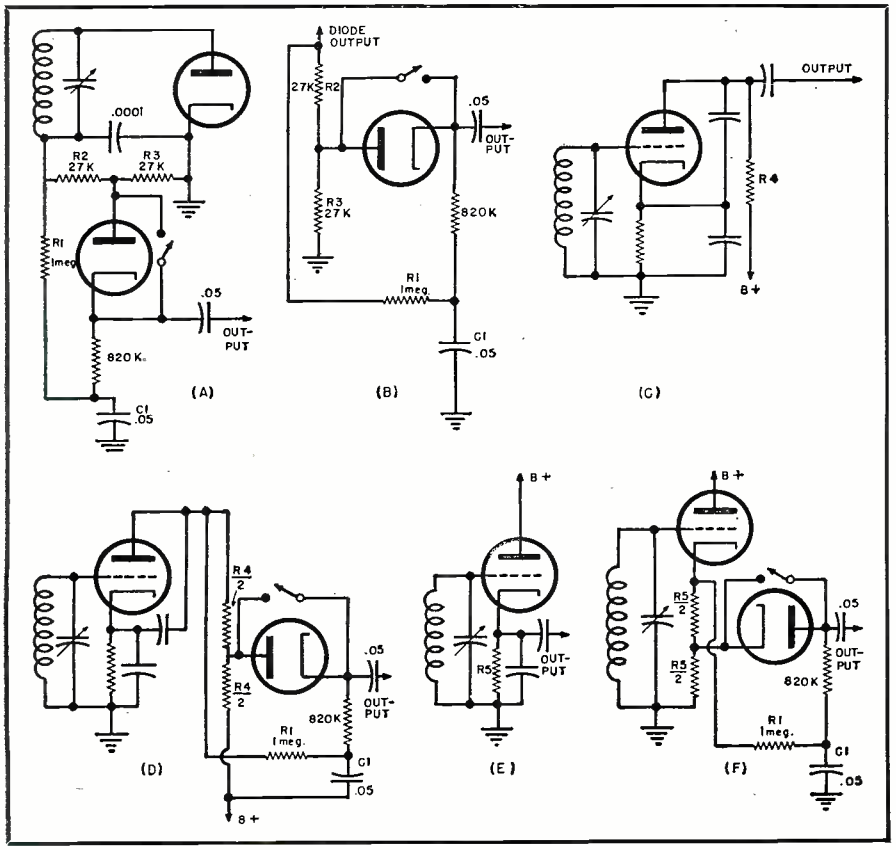
The first step in this exposition will be to take one of these circuits and show how it works. A very common form is shown in Fig. 1A, with its associated diode detector. In Fig. 1B, the circuit is redrawn without the detector, to show its fundamentals. The resistors R_2 and R_3 are the former diode resistors, and have a negative voltage across them combined with an audio-frequency component, all proportional to carrier strength, from the rectified output of the diode. The cathode of the diode is maintained at the full negative voltage through R_1 and and C_1. Since the diode plate is tapped down on the load resistor, it is less negative than the cathode, allowing the diode to conduct and pass the signal through to the output. However, if a noise pulse comes through which exceeds the carrier level of the signal, the plate will go very negative. However, the cathode cannot follow, due to the long time constant of R_1 and C_1. Therefore, the diode cuts off for the duration of the noise pulse, removing it from the output. The switch across the diode is for cutting out the noise limiter when it is not needed.

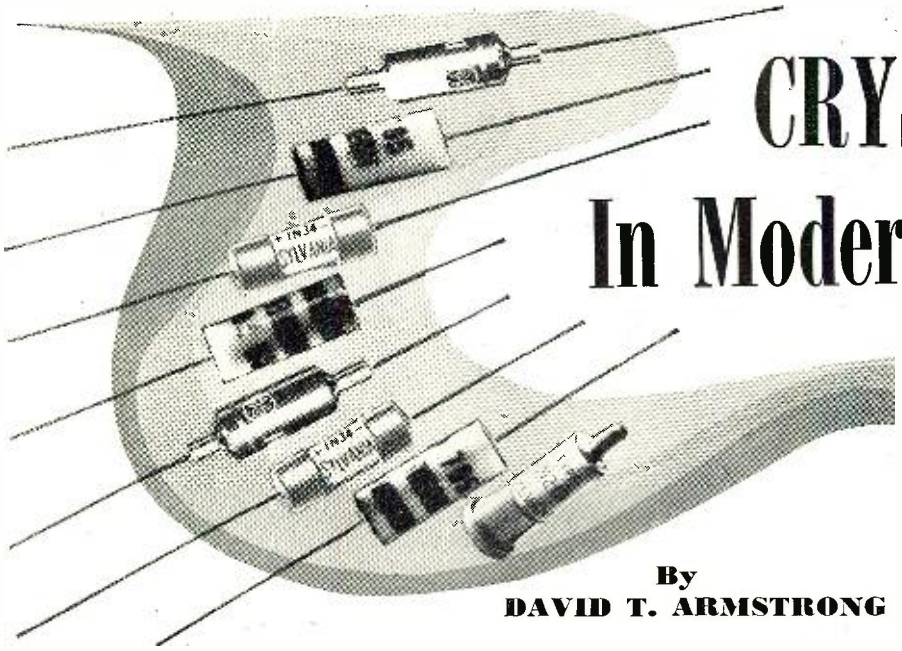
Next, let us look at the typical plate detector shown in Fig. 1C. We see that the plate load resistor has a negative voltage drop across it proportional to the carrier strength, since the plate current of any biased detector is proportional to carrier strength. Superimposed on this steady drop, of course, is the audio signal. Therefore, we see that the conditions on this resistor are the same as those on the load resistor of a diode detector. Let us replace the load resistor with the input load resistor of a noise limiter circuit, as shown in Fig. 1D. The two new resistors in the plate circuit of the detector must each be exactly half the value of the original load resistor R_4, in order to place the limiting threshold at 100% modulation. Other components are unchanged. It must be noted, however, that audio chokes or transformers cannot be used in the plate circuit, since they short-circuit the d.c. voltage drop necessary for limiter operation. The plate load must be purely resistive. Neither can this circuit be used with a grid-leak detector, since the voltage drop with this detector is not proportional to carrier input, but rather inversely proportional.

The operation of the infinite-impedance detector shown in Fig. 1E is quite similar to that of the plate detector, except that the cathode resistor R_5 carries the d.c. voltage drop and audio signal, instead of a plate load. Thus, the limiter circuit can be applied to this detector in the same manner, the result being shown in Fig. 1F. Again, the resistors in the cathode circuit are equal to half the original cathode load resistor. There is one difference, however. The voltage drop across the cathode resistor is positive, instead of negative as before, so the polarity of the diode must be reversed. This is the only change necessary.

The above changes make it possible to have the advantages of the biased detector and still use a conventional noise limiter. —30—

Fig. 1.





CRYSTAL DIODES In Modern Electronics

By
DAVID T. ARMSTRONG

Part 1. Fundamental design characteristics of germanium crystal diodes. Future articles of this series will cover actual circuit applications in AM-FM receivers, TV sets, amateur equipment, etc.

PROGRESS in electronics is sometimes peculiar. In the early 20's we had a lot of fun with catwhiskers and crystals until these were supplanted by the more efficient vacuum tubes. Recently the catwhisker and crystal have been assuming an important function by virtue of the fact that transit time (the time required for an electron to travel from one electrode to another) and noise limitation characteristics make crystals superior to vacuum tubes as detectors and mixers in microwave radar, as well as for numerous applications in AM, FM, and TV, where a diode type vacuum tube might be specified.

Research on crystals and catwhiskers, plus improved construction techniques, have made these tiny components practical circuit elements. In many instances they are outperforming vacuum tubes in special applications for which crystals are ideally suited.

The fundamental principle upon which the germanium diode crystal is based is the established fact that when a sharp metal point makes an infinitesimally small dot (or chisel point) contact with a semiconductor (usually a suitably mounted slab of crystal material), an electric current will flow more readily in one direction than in the reverse direction. Germanium and silicon are such conductors, and ways have been devised to produce satisfactory alloys of these elements so that commercial utilization of such "point contact" crystal diodes is now feasible.

The theory which has been proposed to explain the operation of a crystal is rather complicated and somewhat beyond the scope of this series. Briefly, the soldering of the crystal to the copper lead wire forms a large contact area; the tungsten wire point makes a small contact area on the germanium slab. With crystals of germanium, silicon, and a few other substances, it has been found the electrons move across such a junction more readily in one direction than in the other. Under such circumstances rectification occurs. (It is characteristic of rectifiers that current flows more readily in one direction than in the other.)

Crystals have electrical characteristics which give them advantages in certain types of electronic circuits: their ability to withstand relatively high inverse voltage and their tendency to heal a tiny rupture in cases where there has been a momentary electrical breakdown. Germanium and silicon crystals are demonstrating the capability of duplicating functions previously performed only by electronic tubes, as well as the possibility of replacing certain tube types in given circuit applications.

Either the cathode or the anode may be above ground potential by any reasonable voltage, or both anode and cathode may be above ground potential by any reasonable voltage. This is one distinct advantage the crystal has over a tube type diode. Moreover, in crystals there is no contact potential to be bucked out as there is in a tube type diode.

Commercial Use

Several million germanium diodes have been used in television receivers, and it is anticipated that approximately four to six million units will be used in current television applications, although not all factors are now known. It is anticipated that several million will be used in industrial and military projects. The armed forces are using them to a very large extent in computers. *Sylvania, Western Electric, General Electric,* and *Raytheon* report large scale sales, which is a certain indication that the application of these components is expanding rapidly.

Design and Construction

The basic construction of several types of crystal rectifiers is shown in Fig. 1. They are simplicity in miniature. There is a small wafer of specially processed semiconducting material and a fine tungsten or platinum wire catwhisker, precision ground to make a single fixed point rectifying contact with the wafer slab. The whisker is the anode; the germanium or silicon slab is the cathode.

Fig. 1. Cutaway view of (A) Sylvania's ceramic type germanium crystal diode. (B) Sylvania's glass type germanium crystal diode. (C) General Electric's germanium crystal diode. (D) Sylvania's ceramic cartridge type silicon crystal unit.

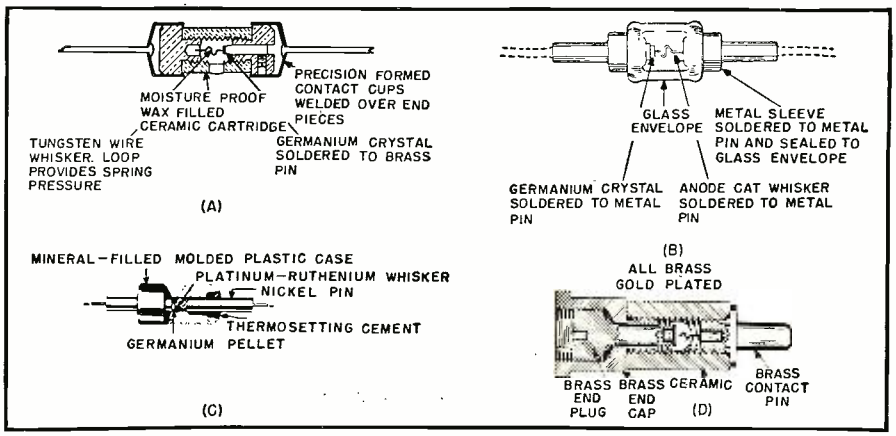


TABLE 1.—WESTERN ELECTRIC GERMANIUM VARISTORS

Type	SPECIFICATIONS AT 25° C.					MAXIMUM RATINGS AT 25° C.		
	Minimum Forward Current (d.c. ma. at 1 v. d.c.)	Maximum Reverse Current (d.c. ma.)			Minimum Reverse Voltage for Zero Dynamic Res. (d.c. v.)	Average Rectified Current (d.c. ma.)	Peak Rectified Current (sine wave) (ma.)	Rectified Surge Current* (ma.)
		at —3 v.	at —5 v.	at —50 v.				
1N43 (400A)	5	—	.02	.85	60	40	125	500
1N44(400B)	3	—	—	1.00	115	40	100	400
1N45(400C)	3	—	—	.41	75	40	100	400
1N46(400D)	3	—	—	1.50	60	40	125	500
1N47**	3	.004	—	.41	115	30	90	350

*This maximum rating is a function of pulse shape, pulse duration, and duty cycle. The values given are for low duty cycle and a pulse length of a few milliseconds.
**Also tested for a minimum rectification efficiency of 35% at 100 mc. with a 2 v. rms input, load resistance of 5000 ohms, load capacity of 20 μμfd.
NOTES: Temperature range is from −40 degrees C to + 70 degrees C. Capacity is approximately 1 μμfd.

TABLE 2.—RAYTHEON GERMANIUM CRYSTAL DIODES

Type	Description	SPECIFICATIONS AT 25° C.						MAXIMUM RATINGS AT 25° C.			
		Minimum Forward Current (d.c. ma. at 1 v. d.c.)	Maximum Reverse Current (d.c. ma.)				Minimum Reverse Voltage for Zero Dynamic Res. (d.c.v.)	Reverse Voltage (d.c.v.)	Average Rectified Current (d.c. ma.)	Peak Rectified Current (ma.)	Rectified Surge Current for 1 sec. (ma.)
			at —2 v.	at —5 v.	at —10 v.	at —50 v.	at —100 v.				
CK705	General Purpose	5	—	—	.05	.8	—	70	60	50	150	500
CK706*	Video Detector	—	—	—	—	—	—	50	40	35	125	300
CK707	150 v. d.c. Restorer	3.5	—	.008	—	.10	—	100	80	35	100	500
CK708	100 v. d.c. Restorer	3.0	—	—	—	—	.625	120	100	35	100	500
CK710**	U.H.F. Mixer	—	.5	—	—	—	—	—	5	25	75	—
1N66***	General Purpose	5.0	—	—	.05	.8	—	70	60	50	150	500
1N67	High Back Res.	4.0	—	.005	—	.05	—	100	80	35	100	500
1N68	100 v. d.c. Restorer	3.0	—	—	—	—	.625	120	100	35	100	500

*Rectification efficiency at 54 mc. is approximately 60%.
**Oscillator injection current is .75 ma. Conversion loss at 500 mc. and noise factor comparable to 1N21B.
***Rectification efficiency at 100 mc. is approximately 35% (minimum).
NOTES: Temperature range is from −50 degrees C to +100 degrees C. Capacity is approximately 1 μμfd.

TABLE 3.—GENERAL ELECTRIC GERMANIUM CRYSTAL DIODES

Type	Description	Maximum Reverse Current at —50 v. (ma.)	Maximum Reverse Current at —10 v. (ma.)	Back Resistance at —50 v.	Minimum Forward Current (d.c. ma. at 1 v. d.c.)	Forward Resistance at 1 v.	Shunt Capacitance (μμfd.)	Peak Reverse Voltage (25° C)	Continuous Operating Reverse Voltage (25° C)	Average Rectified Current (ma.)	Peak Rectified Current (ma. at 25° C)	Surge Current (for 1 sec.) (ma. at 25° C)
1N48	General Purpose	.833	—	60,000	4.0	250	.8	85	70	50	150	400
1N51	General Purpose	1.667	—	30,000	2.5	400	.8	50	40	25	100	300
1N52	General Purpose	.15	—	333,000	4.0	250	.8	85	70	50	150	400
1N63	General Purpose	.05	—	1 megohm	4.0	250	.8	125	100	50	150	400
1N64*	Video Detector	—	—	—	—	—	2.0	20	—	—	—	—
1N65	High Back Res.	.20	—	250,000	2.5	400	.8	85	70	50	150	400
1N69	General Purpose	.85	.05	59,000	5.0	200	.8	75	60	40	125	400
1N70	General Purpose	.41	.01	122,000	3.0	333	.8	125	100	30	90	350
1N72**	U.H.F.	—	—	—	—	—	—	2	—	25	75	—
1N73	Quad	—	.05	—	12.75	—	—	75	—	22.5	60	100
1N74	Quad	—	—	—	12.75	—	—	75	—	22.5	60	100
1N75	General Purpose	.05	—	1 megohm	2.5	400	.8	125	100	50	150	400

*Tested in special detector circuit for efficiency, at 44 mc.
**Design frequency is 500 mc. Operating frequency from d.c. to 1000 mc.
NOTES: Temperature range (except 1N69 and 1N70) is — 50 degrees C to + 75 degrees C.
Temperature range of 1N69 and 1N70 is −50 degrees C to + 70 degrees C.

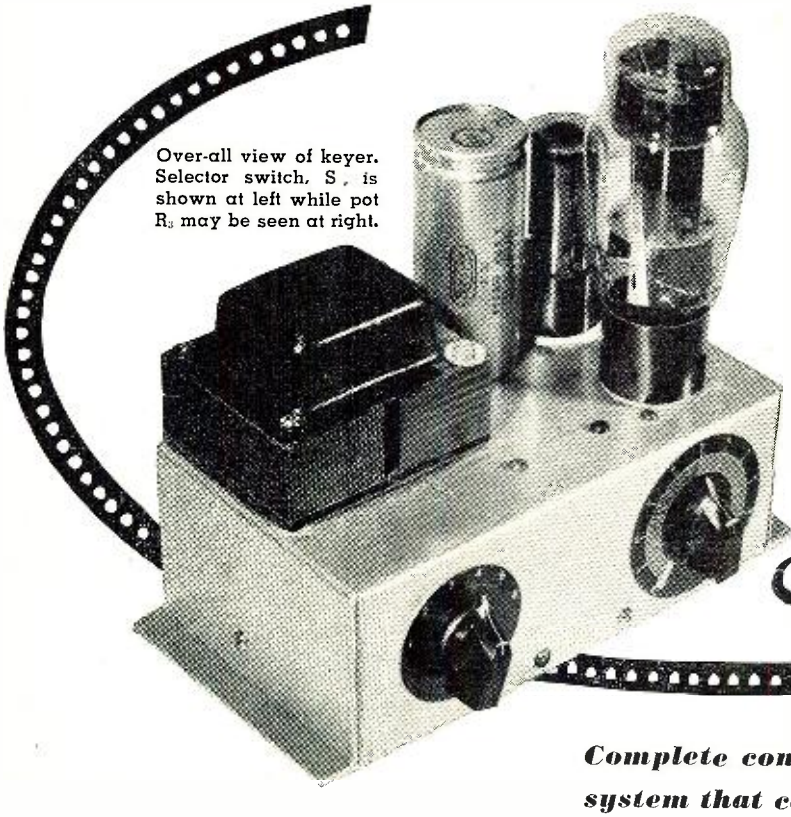
TABLE 4.—SYLVANIA GERMANIUM CRYSTAL DIODES

Type	Description	Construction	Maximum Continuous Reverse Working Voltage	Minimum Reverse Voltage for Zero Dynamic Resistance	Minimum Forward Current (at 1 v.) (ma.)	Maximum Average Anode Current (ma.)	Maximum Recurrent Peak Anode Current (ma.)	Instantaneous Surge Current (for 1 sec.) (max. ma.)	Maximum Reverse Current (μa.)
1N34	General Purpose	Ceramic	60	75	5.0	50	150	500	50 @—10v.; 800 @—50v.
1N34A	General Purpose	Glass	60	75	5.0	50	150	500	30 @—10 v.; 500 @—50 v.
1N35*	Matched Duo-Diode	Ceramic	50	75	7.5	22.5	60	100	10 @—10 v.
1N38	100 v. Diode	Ceramic	100	120	3.0	50	150	500	6 @—3 v.; 625 @—100 v.
1N38A	100 v. Diode	Glass	100	120	4.0	50	150	500	5 @—3 v.; 500 @—100 v.
1N39	200 v. Diode	Ceramic	200	225	1.5	50	150	500	200 @—100 v.; 800 @—200v.
1N40**	Varistor	Plug-in	25	75	12.75 @ 1.5 v.	22.5	60	100	40 @—10 v.
1N41**	Varistor	Lug-Type	25	75	12.75 @ 1.5 v.	22.5	60	100	40 @—10 v.
1N42**	100 v. Varistor	Plug-in	50	120	12.75 @ 1.5 v.	22.5	60	100	6 @—3 v.; 625 @—100 v.
1N54	High Back Resistance Diode	Ceramic	35	75	5.0	50	150	500	10 @—10 v.
1N54A	High Back Resistance Diode	Glass	50	75	5.0	50	150	500	7 @—10 v.; 100 @—50 v.
1N55	150 v. Diode	Ceramic	150	170	3.0	50	150	500	300 @—100 v.; 800 @—150v.
1N55A	150 v. Diode	Glass	150	170	4.0	50	150	500	500 @—150 v.
1N56	High Conduction Diode	Ceramic	40	50	15.0	60	200	1000	300 @—30 v.
1N56A	High Conduction Diode	Glass	40	50	15.0	60	200	1000	300 @—30 v.
1N58	100 v. Diode	Ceramic	100	120	4.0	50	150	500	800 @—100 v.
1N58A	100 v. Diode	Glass	100	120	4.0	50	150	500	600 @—100 v.
1N60	Video Detector	Ceramic	25	30	†	50	150	500	30 @—1.5 v.
1N71***	Low Impedance Varistor	Plug-in	40	50	15.0	60	200	1000	300 @—30 v.

*Units matched in forward direction at + 1 volt so that current flowing through the lower resistance is within 10% of that in the higher resistance unit. Ratings shown are for each diode.
**Consists of four specially selected and matched germanium diodes whose resistances are balanced within ± 2.5% in the forward direction at 1.5 volts. For additional balance, the forward resistances of each pair of varistor crystals are matched within 3 ohms. Ratings shown are for each diode.
***Consists of four specially selected diodes whose forward currents are within a range of 1 ma. with + 1 volt applied. Ratings shown are for each diode.
†Units are tested in a circuit employing an input of 1.8 v. rms at 40 mc., 70% modulated at 400 cycles. Demodulated output across a 4700 ohm resistor shunted by a 5 μfd. condenser is a minimum of 1.2 volts peak-to-peak.
The crystal number ending in "A" indicates a glass sealed type.

By
COMDR. G. L. COUNTRYMAN, W3HH

VACUUM TUBE KEYING Simplified



Over-all view of keyer. Selector switch, S_1, is shown at left while pot R_3 may be seen at right.

Complete construction details on a novel keying system that can be adapted to most any ham rig.

'T IS no secret that all transmitters have different keying requirements. Some buffer stages key beautifully in the cathode with no shunt condenser; others need a .01. Try a different circuit and there are clicks all over the band unless a 20 μfd. condenser is across the key and 30 henrys are in series with it. The author knows, from experience.

The big headache occurs when a rig that has been keying click-free for months suddenly develops the little beasties, for no apparent reason.

Ever since his first tube transmitter, the author has tailored the keying circuit to fit the transmitter in question. For some months past, several VT keyers have been built and tested. Dozens of published circuits are available, all have been tried, and all have proven to be deficient in some major or minor respects. Finally the simple circuit shown in Fig. 1 evolved, and it has responded beautifully to every test applied. It is flexible and adaptable yet has the minimum number of adjustments necessary to adapt it to different circuit requirements.

Let's discuss the deficiencies in other published circuits for a minute. With few exceptions, these employ one or more 45's, 6A3's, or 6B4G's but few of the articles describing keyers using these tubes point out that the use of a VT keyer employing such tubes with high d.c. plate resistance will result in a plate voltage drop on the keyed tube of over 100 volts.

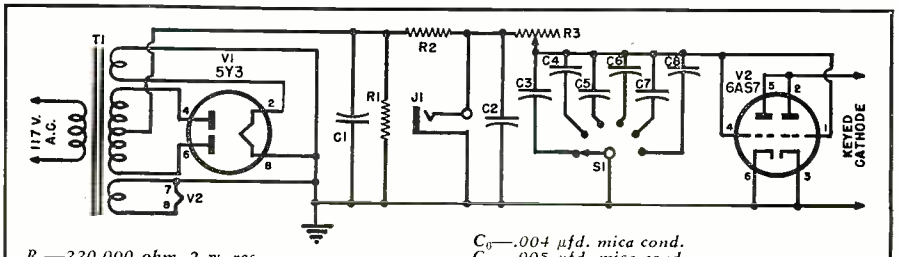
Common transmitter practice is to start with a crystal or variable frequency oscillator, run through isolation or doubler stages as necessary to a driver (often an 807). This stage is cathode keyed and the following amplifier, if used, is biased to cut-off. With the advent of television, it became necessary to use minimum drive on all stages to eliminate TVI. Accordingly, the author and most amateurs designed the stages before the final amplifier, especially the 807 driver referred to above, to operate at the lowest level which would give the necessary drive to the final amplifier. When a keyer is subsequently added to such a stage, it is necessary that the output of that stage not be decreased appreciably as it is already operative at the minimum acceptable level.

The little unit described herein does just one job—it keys a transmitter. It does not turn on an oscillator or the high voltage to the transmitter. It does not silence the receiver during transmission nor put out the cat at night but it does the job for which it was designed. beautifully. The experimentally inclined lads can incorporate this keying unit into other gear to fill additional requirements. In fact, the author is now using the keyer in conjunction with a simplified "Monitone" circuit for perfect break-in. Don't let anyone tell you that a v.f.o. and associated low level isolation and buffer/doubler stages running continuously will interfere with reception even on the frequency to which they are tuned. At W3HH you can't hear 'em unless the receiver r.f. gain is opened so wide that a signal is distorted or the receiver blocks. Use of good electronic engineering practices in connection with the transmitter construction, and a balanced antenna to the receiver are all that is necessary.

Fig. 1 shows the keyer circuit. The 6AS7G is expensive but with its low plate resistance the plate voltage on

(*Continued on page* 94)

Fig. 1. Circuit diagram of keying unit. Keyed cathode output terminates in cord and plug.

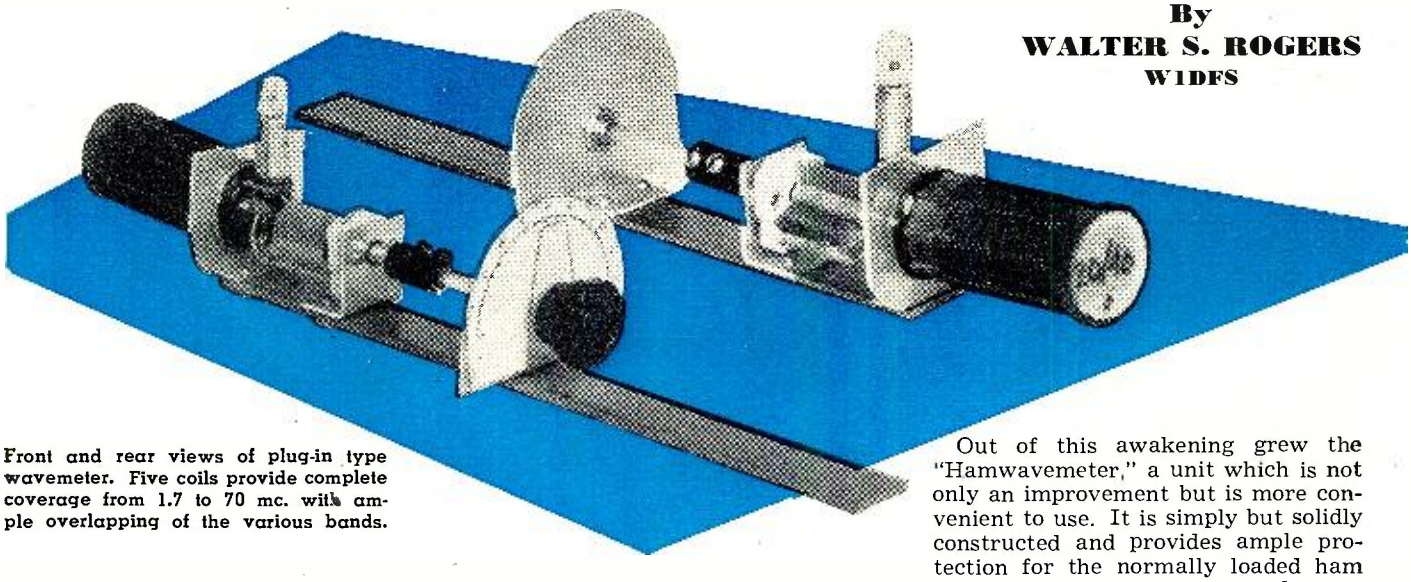


R_1—220,000 ohm, 2 w. res.
R_2—5 megohm, 2 w. res. (see text)
R_3—2 megohm pot
C_1—16 μfd., 450 v. elec. cond.
C_2—.01 μfd. mica cond.
C_3—.001 μfd. mica cond.
C_4—.002 μfd. mica cond.
C_5—.003 μfd. mica cond.
C_6—.004 μfd. mica cond.
C_7—.005 μfd. mica cond.
C_8—.006 μfd. mica cond.
J_1—Open circuit key jack
S_1—S.p. 6-pos. rotary sw.
T_1—Power trans. 550 v. @ 50 ma. center-tapped; 6.3 v. @ 2.5 amps.; 5 v. @ 2 amps.
V_1—5Y3 tube
V_2—6AS7 tube

A Practical "HAMWAVEMETER"

Complete details on an easy-to-build wavemeter covering 1.7 to 70 mc. A permanent-coil unit is also discussed.

By
WALTER S. ROGERS
W1DFS



Front and rear views of plug-in type wavemeter. Five coils provide complete coverage from 1.7 to 70 mc. with ample overlapping of the various bands.

IN THE "spark days" the practical way of measuring wavelength was by means of a wavemeter consisting of a variable condenser and inductance coil. For greater sensitivity a detector and headphones were often needed for checking distant or weak signals or a buzzer was required to act as a receiver signal generator. This basic condenser-coil and measuring instrument is still the first and most important radio tool that every amateur or other serious technician should have on hand for checking modifications and repairs.

Even the Federal Communications Commission license examinations often include questions on what is usually called the "absorption type wavemeter."

The writer's first wavemeter was built around a variable condenser made by one of such old-time concerns as *Electro Importing Company, Wm. B. Duck, Clapp-Eastham,* or *Wm. J. Murdock,* and a cardboard tube wound with many turns of bell wire. Later a *General Radio* broadcast type wavemeter was secured. This instrument covered down to 200 meters which was shortwave enough at that time. It is still among the "antiques" stored away as a friendly reminder.

As the higher frequencies were assigned for amateur radio operation, more modern versions were built using plug-in coils and featuring calibration charts rather than direct readings.

The necessity for checking every major transmitter change with such a wavemeter came with "greetings" from Grand Island (FCC). The wrong harmonic was getting out, even with low power. It was DX to be sure, but not the kind one desires when trying to hold the privileges of a ham ticket.

Now that the problems of those "Tennessee Valley Indians" have been brought upon all radio amateurs, the necessity for cleaning up unwanted harmonics and "gremlins" (caused by continuous or impact oscillations which must be located before being cured) is more urgent than ever. In order to do this it is often necessary to use the wavemeter near high voltage circuits and with the equipment going full blast into a dummy.

Several years ago, the sudden realization dawned on the author that the nice aluminum-boxed wavemeter—a pride and joy with its careful calibration—was not the instrument to use. It is a danger trap if used near high voltage circuits and "high voltage" starts at 22½ volts. The rotor of the condenser is grounded to the aluminum box and the plug-in coils cannot be adequately insulated for real r.f. or d.c. Fortunately, no shocks had been incurred which might have brought the point home rather tragically.

Out of this awakening grew the "Hamwavemeter," a unit which is not only an improvement but is more convenient to use. It is simply but solidly constructed and provides ample protection for the normally loaded ham transmitter. Its range extends down to the TV bands.

The author has built two versions of this instrument, as shown in the photographs. The first is a plug-in type and the second is a fixed coil type. The plug-in type covers from 1.7 mc. to 70 mc. with ample overlapping of the bands although it uses only one small variable condenser. If one is operating in the higher frequencies, or prefers to have a set of "standards," the fixed coil design is recommended. For frequencies above 70 mc., a much smaller tuning capacity—possibly butterfly type tuning condsensers—will be required.

Before building this instrument some tests were made with the help of W1MOG and it was found that the 2 volt, 60 ma. pilot light in series with the circuit was the most sensitive of the simple indicators. See Fig. 1G. The bayonet type bulbs were easier and faster to replace if one did burn out. With reasonable caution, after the first two burnouts, the losses have been nil. The small neon indicators showed considerably less sensitivity, but at very high frequencies the r.f. seems to be more favorable and thus the *General Electric* NE-2 glow lamp type neon, such as is used in ignition and other test prods, was wired across the *LC* circuit as shown in Fig. 1H. The use of fixed crystal rectifiers and sensitive microammeters would make the in-

strument more cumbersome but can be incorporated if the builder wants a very sensitive unit.

Construction

The construction of this unit is straightforward and simple. Having built several, the author suggests that readers construct this instrument in the sequence outlined since the fitting of parts is rather important.

The support or handle should be cut and drilled to the desired size. Bakelite stock which runs thicker than the ⅛" and longer than the 10" specified may be used, especially if greater clearance between the coil and condenser circuit is desired. The dimensions given in Fig. 1A, however, work out well in the finished model, if the transmitter is not capable of arcing over more than two inches of bakelite—amateur unloaded transmitters should not do that. The sizes given are considered safe.

Upon completion of the support or handle, the next part to be fabricated is the insulating or isolating rod. See Fig. 1B. Good bakelite, lucite, polystyrene, or similar shafting which can be made to fit directly, or by means of couplings, on the 100 $\mu\mu$fd. tuning condenser and tuning knob will do. Regular ¼" lucite rod, with one coupling at the condenser end, was used in this model. See Fig. 1F. In another model, a short piece of ¼" i.d. fiber tubing was pinned on the condenser and tuning shaft.

Three pieces of sheet aluminum, brass, or other stock (about 1/16" thick), can be drilled and formed as shown in Figs. 1C, 1D, and 1E. It is usually easier to bend the piece after drilling. It is important to have the holes for the shaft and condenser shaft in good alignment. In the dial end support, Fig. 1D, a shaft bushing is made from a scrap phone jack to provide a better bearing than the sheet stock alone provides.

A list of the additional parts required to complete the instrument is given in Table 1, along with data for winding the plug-in coils.

The coil mounting plate shown in Fig. 1D should be bolted in place with the 90 degree bracket lip toward the dial but only after the four-prong *Amphenol* socket has been installed. The two larger prongs of this socket should be toward the handle as these were chosen as the coil connection pins.

Next mount the coupling shaft and the *APC* type condenser with the bracket lip toward the socket bracket. The condenser was mounted with the stator plates nearest the handle.

The final assembly is the dial plate, Fig. 1C, with its associated shaft bushing. This was mounted with the 90 degrees away from the handle toward the coil bracket, which leaves over two inches between it and the condenser mounting.

The bayonet pilot light socket is soldered on the two small socket prongs and then wired in series as shown in Fig. 1G, using solid wire which is heavy enough to stay in place and thus be more impervious to accidental bending.

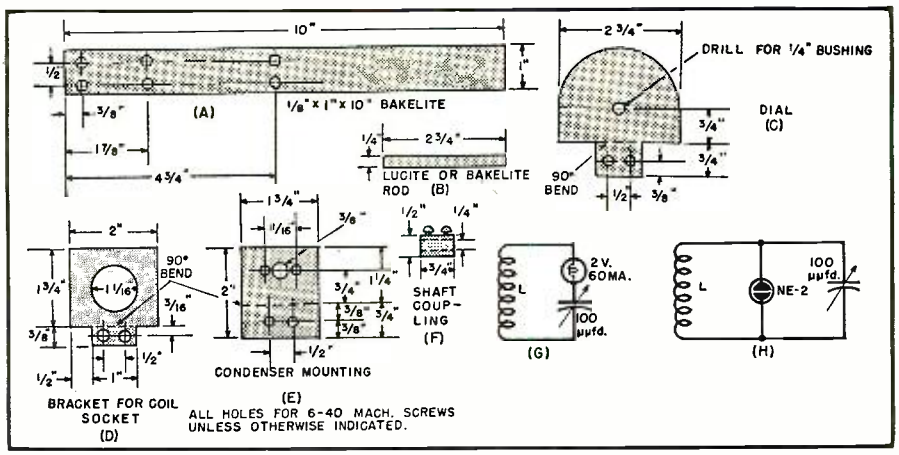


Fig. 1. Mechanical details show how various parts of wavemeter are fabricated. As explained in the text, circuits G and H are simplest forms of wavemeters.

PARTS

1	100 $\mu\mu$fd. tuning cond. with ¼" shaft (APC type but not screwdriver adj.)
1	Bayonet pilot bulb socket
1	Bar knob for ¼" shaft
1	Four-prong socket and ring (Amphenol)
5	Four-prong coil forms, 1¼" effective dia. (Bud #CF594 or equiv.)
1	Shaft bushing (made of scrap phone plug)
1	Small spool of No. 24 en. wire
	6-40 x ½ brass roundhead machine screws with hex nuts, as required
	Coil form lacquer
1	2 volt, 60 ma. pilot bulb (buy several as spares)

COILS

1	1.7 to 4.2 mc.	62 t. #24 en., closewound about 1⅜" long
2	3.3 to 7.5 mc.	32 t. #24 en., spaced to 1⅜" long
3	6.8 to 15 mc.	17 t. #24 en., spaced to 1½" long
4	13.5 to 31 mc.	7 t. #24 en., spaced to ½" long
5	26 to 70 mc.	2 t. #24 en., spaced to 3/16", opposite prongs or far end of coil

Complete parts list and coil data for building your own "Hamwavemeter."

The front of the dial is covered with plain paper, held in place with rubber cement. A thin coat of coil lacquer may be applied later to keep the calibration markings clean.

Finally, the knob is adjusted in place. Flats were placed on the shaft so that there would be no chance of the calibration being lost if the set screws should be accidentally loosened.

The settings of the coils were checked with a *Millen* Type 90651 grid dip meter before the turns were lacquered in place. The dial was calibrated and marked in India ink, then given a light coat of lacquer to keep it clean.

Operation

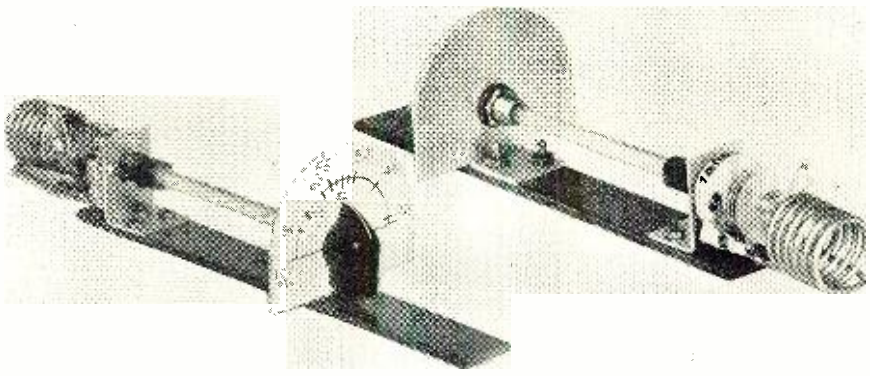
In using any wavemeter or grid dip oscillator, it must always be remembered that the careful calibration will be lost if the instrument is too closely coupled to the *LC* circuit to be measured. In other words, the reading will be affected by mutual inductance with the circuit to be measured. Thus in calibrating and reading this instrument, use as loose coupling as possible. After nearing resonance, as indicated by the pilot light or dip in the meters in the circuit being measured, remove the coil or lengthen the distance between the coil and the circuit being measured while still maintaining a positive reading.

It will undoubtedly require the sacrifice of a pilot light bulb or two to learn that the coil should be brought into coupling with the oscillator circuit slowly so as to get an indication rather than a burned out bulb.

It pays to be careful and it is sincerely hoped that this simple and improved "Hamwavemeter" will keep some of our fellow hams from joining the ranks of the "Silent Keys."

—30—

Permanent-coil type wavemeter, ideal when only single band coverage is required.



Eliminating Ignition Interference In TV Receivers

By
ROBERT GARY

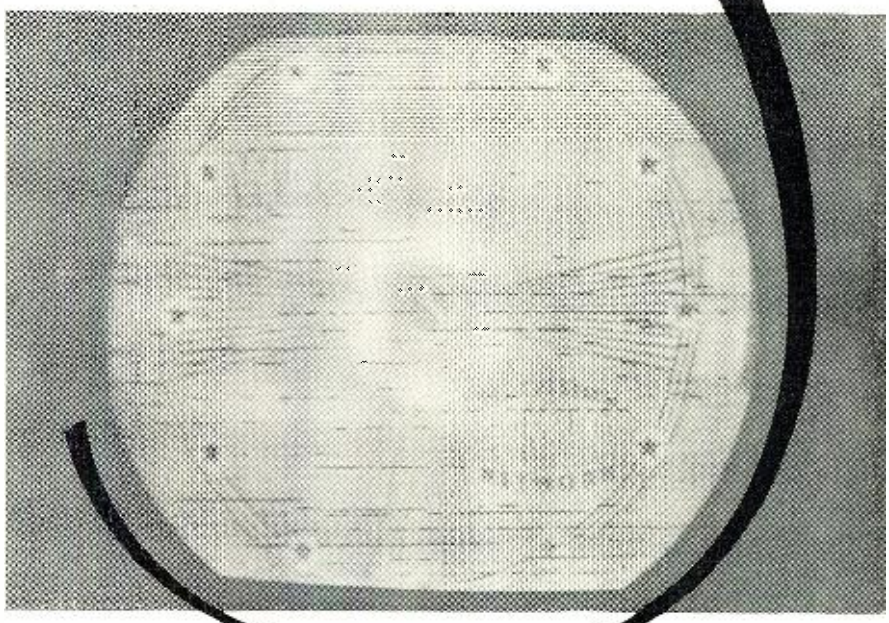


Fig. 1. Automobile ignition interference appears as black streaks in set under test. See text for details.

A review of possible methods which can be used to eliminate a serious cause of TV interference.

AS WE come to accept the miracle of television, we grow more critical of its performance and many "minor" defects which are overlooked in the first rush of enthusiasm become important enough to warrant calling a technician. One of the most frequent sources of interference is ignition noise. At certain times, especially during heavy traffic hours, streaks race across the screen, sometimes apparently tearing or blotting out the picture. Fig. 1 shows heavy ignition noise as it appears on the tube. If we connect an oscilloscope to the grid of the picture tube we observe a pattern like the one in Fig. 2. The long lines are noise pulses which ride in with the picture and synchronizing signal and, because they are so much stronger, dominate the operation of the picture tube. Usually these pulses are picked up either by the antenna or by the lead-in wire and are amplified right along with the picture signal. In some receivers these pulses can also be heard, but if a good limiter and properly aligned discriminator are used, the sound section should not reproduce ignition noise, at least not as badly as the picture tube will.

Theoretically, the balanced input type of tuner should cancel out noise pulses at the r.f. amplifier and the low impedance. shielded cable type of tuners should shield out all noise. Few tuners ever have a perfectly balanced input and perfect shielding is also the exception rather than the rule, so that in most cases where strong ignition noise is present it will affect the picture.

In Fig. 1, the ignition noise manifests itself in the form of black streaks, because the pulse extends into the "blacker than black" region and cuts the tube off. In some receivers the noise will show up as a white dot followed by a black streak or else only in white. This depends both on the polarity of the video signal, as it is applied to the picture tube, and the video amplifier circuit. In most amplifiers there will be some clipping of strong pulses at either polarity and that will determine their appearance. In the receiver used for Fig. 1, plate saturation on strong positive pulses helped suppress the white portion of the noise so that only its part in the black region is visible. In either case the ignition noise will have a great effect on both the a.g.c. circuit and the sync section.

If conventional a.g.c. is used, the noise pulses will be rectified and filtered along with the picture signal and, if they are strong and frequent enough, will materially affect the amount of bias generated. In a weak signal area this additional bias can reduce the gain of the set enough to suppress the picture signal considerably. Such a condition is shown in Fig. 1 where the picture appears weak due to the extra bias generated by the noise. Look at Fig. 4 and compare the contrast of that picture with Fig. 1. Ignition noise has been eliminated from Fig. 4 by using some of the methods described later in this article.

The sync circuits of the receiver used for these experiments were especially stable and only a slight tearing can be observed on the top and bottom portions of Fig. 1. In other receivers whole sections of the picture may be lost or the picture may fall out of either or both horizontal and vertical synchronization. Generally speaking the sync circuits can often be stabilized and most recent models are designed so as to be immune to any amount of noise that will give a usable picture. Some hints for stabilizing sync circuits are given in a later paragraph.

Ignition noise is not always caused by the ignition system of trucks and cars but can also stem from such innocent sources as electric razors, vacuum cleaners, and any other device that has a commutator type motor or generates a spark. It can be picked up either by the antenna and the lead-in, or else it can come from the power line and, in rare cases, it is radiated directly into the receiver. Knowing the effects, source, and method of travel of ignition interference we can now look for ways of eliminating it.

Eliminating Noise at the Source

The simplest procedure would be to eliminate ignition interference right at the source and, in some cases, this is possible. Naturally we cannot require all cars passing a particular house to use suppressor type spark plugs, but

we can re-route the antenna lead-in or relocate the antenna in such a way that it will face away from the highway so that the house acts as a shield. In addition, the use of shielded antenna line, either the coaxial type or shielded twin-lead, can further reduce ignition noise before it reaches the receiver. Coaxial cable should be used only for receivers having 72 or 50 ohm input impedance and in those sets the shield is connected to the chassis. Where 300 ohm input is specified and shielded twin-lead is used, the two inner conductors are connected to the antenna terminals. The outer shield should go to a free terminal from which a .1 μfd. condenser is then connected to the chassis. In this manner the shield is grounded for r.f. interference but not for the 60 cycle power line which is sometimes connected directly to the receiver chassis.

There are no receivers of the "hot chassis" type using 72 or 50 ohm input to our knowledge.

In the case of household appliances it will help if the commutator and the brushes are cleaned and set for minimum arcing. In some cases a suitable condenser can be used across the a.c. line. Where it appears that the interference is transmitted through the power line, regular a.c. line filters should be used. In the rare instances where direct radiation to the TV set occurs, a bottom plate or shielding of some kind may help. We know of one instance where the receiver was against a wall in the living room and on the other side of this wall stood an old type refrigerator. Whenever the motor started up, the picture would be lost entirely and as the motor got up speed ignition interference appeared. Installing an a.c. line filter helped only slightly, but putting a piece of sheet metal, grounded to a nearby waterpipe, behind the refrigerator reduced the interference substantially.

Reducing Noise in the Video Section

To get the best possible picture the signal-to-noise ratio should, naturally, be high. This means that we would like the picture signal to be amplified as much or more than the noise. At least the effect of the noise on the a.g.c. bias should be a minimum. With conventional a.g.c. systems, where the entire video signal is rectified, it is impossible to differentiate between noise and signal. The keyed type of a.g.c., however, where only the amplitude of the synchronizing pulse determines the bias, has definite advantages in noisy locations. The duration of the sync pulse is only 5% of one line, therefore only 5% of the entire noise can appear in the a.g.c. In addition, the top of the sync pulse is usually clipped before it is fed to the a.g.c. tube, further reducing the influence of ignition noise on the a.g.c. bias. Some receivers use a fast acting type of a.g.c. which is not keyed, but which utilizes only the sync pulses for the a.g.c. bias. In these sets a threshold control is usually provided to set the operating level of the a.g.c. system. If this control is set for best picture under noise conditions, the effect of ignition noise on the a.g.c. will be very small and a good signal-to-noise ratio can be obtained.

The only way in which ignition noise can be minimized in the video amplifier is to clip it off and reduce it to the level of the video signal. Clipping or limiting can be accomplished by three different methods: Grid clipping because of high bias; plate limiting or saturating due to low plate voltage; and, finally, inserting a diode to rectify and thereby clip pulses. Depending on the circuit of a particular receiver either or all of these methods can be used to reduce the effects of ignition interference.

A simple method of reducing ignition noise is shown in Fig. 3. This could be a single stage video amplifier or else it could be the first of a two stage circuit. Coupling condenser, C_1, can be shorted out with the following results. First, the d.c. voltage across R_1, the detector load, will range from 2 to 10 volts depending on the signal strength and the value of R_1. This negative voltage will place a constant bias on A, the grid of the video amplifier. R_2 will normally be so much greater than R_1 that it can be neglected. On strong signals, such as ignition noise, the bias at A will increase and cut off the tube when the negative portions of the pulses go beyond the cut-off value. If the "B plus" voltage on the plate is fairly low, this tube can be made to operate as a clipper and limiter, permitting only the video signal to pass and removing everything of greater amplitude. If the bias is too high, or the plate voltage too low, portions of the video or sync signal may be clipped off. The proper values depend on the type of tube used, but for a 6AU6, a tube commonly used in this circuit, the following will permit satisfactory operation: Grid bias— —3 to 5 volts; plate voltage—120 to 150 volts; and a screen grid voltage of about 120 volts. If the grid bias with the coupling condenser shorted out is too high, reduce the value of R_1. The second effect of this change is that on strong, persistent noise condenser C_1 charges up, causing some portion of the screen to be brighter than the rest for a short period. This flashing is removed when a directly coupled arrangement is used.

The effect of fixed bias may be obtained in some receivers where a negative type of power supply is used. If a negative voltage between —3 and —6 volts is available, the grounded side of

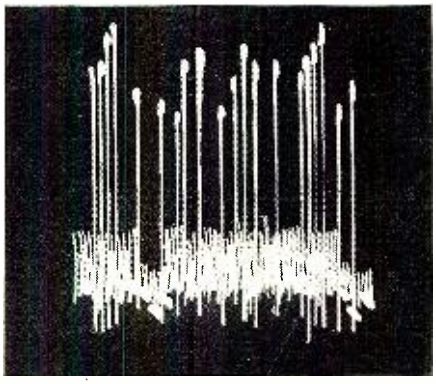


Fig. 2. Pattern of the ignition noise as it appears on the grid of the CR tube.

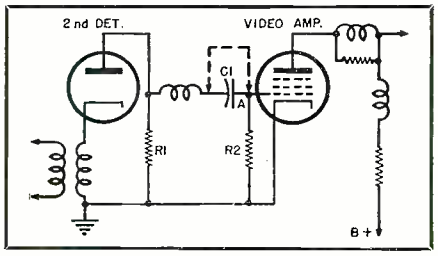


Fig. 3. One simple method of reducing television interference caused by ignition noise.

Fig. 4. Pattern on the cathode-ray screen after ignition noise has been eliminated. Notice how the black streaks which were visible in the pattern of Fig. 1 have now been eliminated and how the over-all picture contrast has been considerably improved.

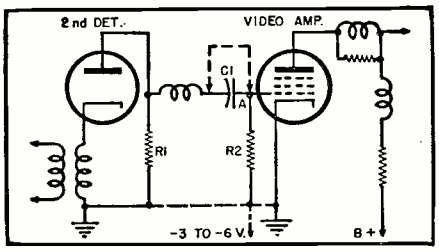


Fig. 5. Variation of Fig. 4 with fixed bias.

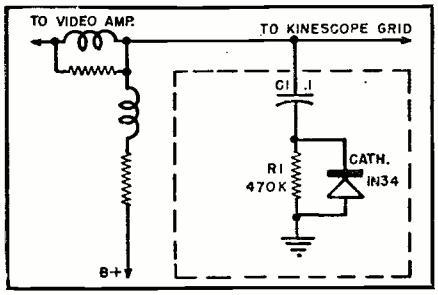


Fig. 6. The 1N34 used as a noise clipper.

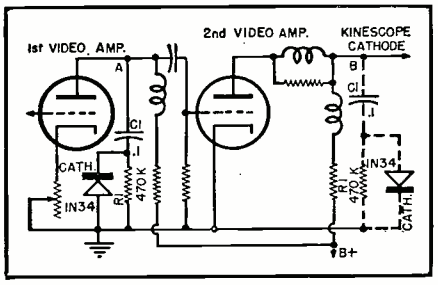


Fig. 7. Double triode used as video amplifier.

R_2 is lifted off and connected to the negative line as shown in Fig. 5. It is very important to make sure that the negative voltage point is bypassed to ground with a sufficiently large electrolytic since otherwise 60 cycle hum or even low frequency phase shift may result. If it is desired to get a negative voltage from a set not now having it, remove the power transformer center-tap from ground and connect a low value, high wattage resistor between it and ground. For example, in a receiver drawing 200 ma. "B plus," a negative voltage of 5 volts is obtained if a 25 ohm, 2 watt resistor is used between the center-tap and ground. Adequate bypassing of this resistor would require at least a 100 μfd., 10 volt condenser. Remember, in this case, the positive terminal of the condenser goes to ground.

The results of a fixed bias on the video amplifier in Fig. 5 are substantially the same as for the circuit in Fig. 3, except that here the bias is fixed and can be so arranged that on a strong signal the sync and picture elements will not be clipped, while on strong noise interference the noise pulses will be reduced. This is accomplished without affecting the detector load resistor R_1. In some receivers R_1 is part of the a.g.c. system and the voltage developed across it may be too great for a directly coupled circuit. Reducing the value of R_1 will reduce the a.g.c. bias which will upset the entire i.f. section. In such a case it is preferable to use fixed bias as in Fig. 5, although the charging action of the coupling condenser and the subsequent flashing may not be removed. Another case where fixed bias would be advantageous is where the detector load is taken from the cathode, resulting in a positive d.c. voltage. This cannot be utilized as bias and a direct connection cannot be used.

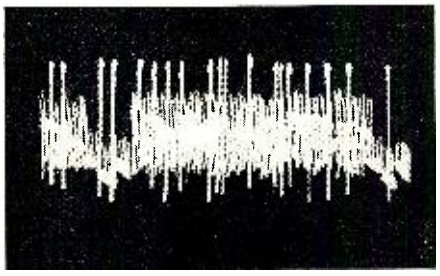
The method of direct coupling and fixed bias shown in Figs. 3 and 5 can be applied in different ways in the case of two-stage video amplifiers. Direct coupling might be used in the first stage and fixed bias in the second or else the entire circuit may be directly coupled, a system used successfully in the new 1951 *RCA* models. The best way to determine which combination of circuits to use in a particular set is either by trial and error or by consulting the tube manual, measuring all voltages, and then making the changes accordingly. Since the latter involves some calculations and study, most technicians may be tempted to use the trial and error method. They should, however, keep in mind that the operating voltages of all tubes must be maintained at their proper levels. If you appear to get detrimental effects, such as loss of sync or overload, in the video amplifier, better recheck the various voltages.

Diode Noise Clippers

The use of a diode as a noise clipper, especially in mobile receivers, will be familiar to the ham. The application of this method to television requires a little consideration and some very special precautions.

Fig. 6 shows one circuit in which the 1N34 crystal diode is used as noise clipper, directly at the kinescope grid. In this case the most annoying portion of the ignition noise pulses was in a negative direction, causing black lines across the screen. Looking at Fig. 6, we find that a negative pulse will drive the cathode of the diode more negative than the plate, causing current to flow through it. In effect, the noise pulse is being clipped. To prevent sync and blanking pulses from being clipped, the *RC* time constant of C_1 and R_1 is chosen so that the 15,750 cycle pulses are not affected. In addition, since they are of constant amplitude and frequency, they will merely set up a d.c. voltage across R_1 sufficient to prevent their being clipped. Noise pulses, in order to be removed, must be of greater amplitude than the sync pulses and overcome the d.c. voltage across the diode. Furthermore, these noise pulses are never so repetitive as to set up their own d.c. level. The result of using the diode clipper is shown in Fig. 8, as it appears on the oscilloscope. Fig. 2 shows the signal before the noise diode was added. A very important consideration in this circuit is the extra capacity introduced by this clipping network. The capacity of the tube and various strays are balanced out by the video peaking coils to provide the proper video frequency response. If C_1 were large and R_1 small, a substantial shunt capacity would be introduced which would reduce the high frequency response and result in loss of picture detail. That is why a 1N34 and a 470,000 ohm resistor are used with a .1 μfd. condenser. The total capacity of this network is less than 12 $\mu\mu$fd. and therefore will not substantially affect the video response.

Fig. 8. Oscilloscope pattern obtained by using the 1N34 diode circuit shown in Fig. 6.



In Fig. 7 a double triode is used as a video amplifier and the two noise clipping circuits are shown in their respective locations. Note that the polarity of the one in dotted lines is opposite the polarity of the one used in Fig. 6. The reason is that in Fig. 7 the video signal is applied to the cathode of the kinescope and the most annoying pulses go in a positive direction. At the left of Fig. 7 the polarity of the crystal diode is the same as in Fig. 6 because the signal at point *A* must have a negative picture phase.

The location and polarity of the noise clipping network is best determined by trying out different arrangements while the noise is present and checking which diode connection gives the best results.

In some receivers the sync signal is taken at the output of the last video amplifier stage and connecting a noise clipper will affect the sync pulses in such a circuit. If the *RC* time constant of R_1–C_1 is correct, the sync pulses should not be clipped but noise pulses riding on them will be removed. In actual service practice it would be a good idea to make up a noise clipping network on a piece of insulating material, or else tape it up with a low-loss tape, and provide clip leads to permit quick connections wherever it might be desirable. After the best point for the noise clipping circuit has been determined, another network is installed, using available terminal posts and making regular soldered connections.

Stabilizing Sync Circuits

Reducing ignition noise in the antenna lead-in and clipping it in the video amplifier often eliminates most noise pulses before they reach the sync amplifier, clipper, and separator sections. In some instances, however, the horizontal and vertical stability is still poor even after all these measures have been taken. To get good horizontal stability it is imperative that the horizontal oscillator be perfectly

(*Continued on page* 158)

A Miniature MUSIC MAKER

Although strictly a novelty, the instrument covers a complete octave. Simple nursery tunes can be played.

By
JIM KIRK, W6DEG

Over-all views of miniature music maker. Both hands are used in playing instrument; as soon as one key is released another is pressed, in a continuous melody.

LIKE most children with fond parents and doting grandparents, my granddaughter Margie is plentifully supplied with toys of all kinds. Generously endowed with dolls and doll equipment, the problem arose last Christmas as to what to give Margie that wouldn't be a duplicate of toys she already owned or would receive from other members of her family.

In casting around for a unique gift, I struck on the idea of building her a toy electronic organ. After the original experimental work was done, the unit wasn't much of a job to build so all of you fond papas, uncles, and grandfathers might consider building such a toy for your favorite boy's or girl's birthday or for next Christmas.

None of the parts used in this toy need to be purchased. Most junk boxes will contain all of the required components. Originally I had planned to use fixed resistors for the tuning resistors and calibrate each unit separately. This proved to be a time-consuming and wholly unsatisfactory procedure so surplus potentiometers were used instead.

The switches used as keys are single-pole, double-throw surplus units with a spring return. No contact is made when they are in the "center" position. It would be more convenient if keys, similar to regular piano keys, were used with a separate key for each note. This type of key would also serve to teach the child the regular piano keyboard.

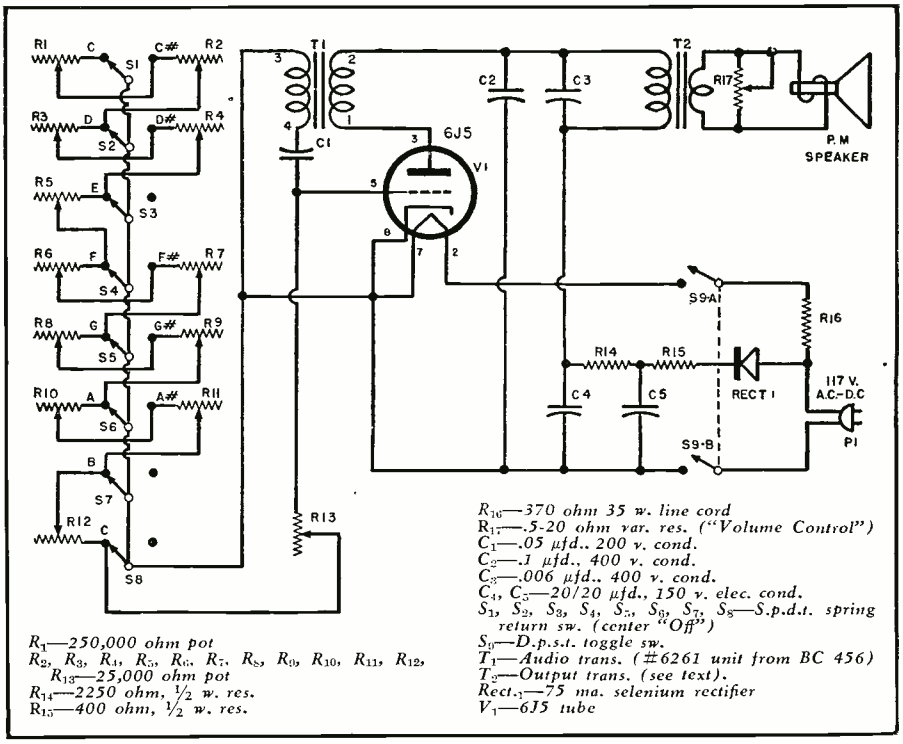
A possible source of such keys would be one of the small toy pianos sold for children's use. Contacts made of spring brass or phosphor bronze could be affixed to the keys in various ways. The entire instrument could be dressed up by placing it in a wooden case, possibly the case that housed the toy piano from which the keys were obtained.

If a metal case or chassis is used, care should be taken to prevent accidental contact with the case if it is used for a common ground. It is preferable to use a separate ground bus rather than use the case or chassis as grounds. This precaution will eliminate any possibility of shock.

In tuning up this instrument, set the potentiometers at the following values and then make the necessary adjust-

(*Continued on page* 122)

Schematic diagram of a musical novelty that can be built from junk box parts.



R_1—250,000 ohm pot
R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12}, R_{13}—25,000 ohm pot
R_{14}—2250 ohm, ½ w. res.
R_{15}—400 ohm, ½ w. res.
R_{16}—370 ohm 35 w. line cord
R_{17}—.5-20 ohm var. res. ("Volume Control")
C_1—.05 μfd., 200 v. cond.
C_2—.1 μfd., 400 v. cond.
C_3—.006 μfd., 400 v. cond.
C_4, C_5—20/20 μfd., 150 v. elec. cond.
S_1, S_2, S_3, S_4, S_5, S_6, S_7, S_8—S.p.d.t. spring return sw. (center "Off")
S_9—D.p.s.t. toggle sw.
T_1—Audio trans. (#6261 unit from BC 456)
T_2—Output trans. (see text).
Rect.$_1$—75 ma. selenium rectifier
V_1—6J5 tube

PUTTING THE CLAMP TUBE TO WORK

By
F. R. CANNING,
W2GCB

Dual operation combines good keying characteristics with a method of modulating a tetrode or a pentode amplifier.

WHILE the clamp-tube system for keeping an amplifier's dissipation within bounds without excitation is well-known, some other applications of this useful device are not. With the addition of a few parts, it can be used to modulate the tetrode or pentode amplifier, and also to key it with a practically perfect keying characteristic.

The circuit shown combines these two functions, giving either AM screen-modulated phone or absolutely clickless c.w. by throwing a single switch. While neither idea is original, the combination of them in one unit does seem worthy of description.

In the circuit diagram, only those parts essential to the operation of the clamp circuit are labeled. The others are of the usual value for an 807 class C amplifier.

With the phone/c.w. switch on the c.w. side, the following conditions prevail:

The 6L6, as the grid is at ground potential, draws a heavy plate current through R_3. This, in turn, produces a large voltage drop across R_3, and the resulting voltage on the 6L6 plate is too low to fire the VR-150. Hence, the screen of the 807 is at ground potential, and practically no plate current can flow.

When the key is closed, the rectified grid voltage across the 807 grid leak is applied to the 6L6 grid, and cuts off the plate current. The voltage drop across R_3 decreases to the point where the VR tube ignites, thus applying voltage to the 807 screen. The actual screen voltage is the plate voltage minus the drops across R_3 and the VR-150, and is set at the normal value for c.w. by varying R_3.

The superiority of this method over the conventional clamper circuit lies in the time-delay inherent in the VR tube. With no other delaying components at all, the slight lag in ignition of this tube gives just the right amount of lag for a smooth, perfectly clickless keying characteristic. With a well-filtered oscillator, the signal has a chiming, bell-like tone which has elicited many compliments on the air. In addition, the 807 screen voltage drops to zero with no excitation while the conventional clamper merely lowers it to some value which allows a fairly large plate current to flow.

If amplifier keying rather than driver or oscillator keying is desired, merely plug the key into J_1. Then the d.c. grid voltage across the 807 grid leak is applied to the 6L6 grid through the key, and the clamp-tube circuit operates as before. This method, in fact, is greatly to be preferred on the higher frequencies.

When the phone/c.w. switch is thrown to phone, the clamp-tube functions as a class A modulator having the 807 screen circuit for its load. In this position, the VR tube is disconnected, as it would introduce intolerable distortion when the negative audio peaks reached its extinguishing voltage point. As disconnecting the VR increases the 807 screen voltage by 150 volts, a second dropping resistor, R_2, is introduced into the supply circuit. This resistor is adjusted so that the plate-to-cathode potential on the 6L6 is about 250 volts. Cathode-to-ground potential of the 6L6 should be 25 volts, and may be adjusted if necessary by changing R_1. The 807 screen voltage, with zero audio input, should be half the normal c.w. value, or about 140 volts. This value may be obtained by adjusting R_1.

Although a triode-connected 6L6 is certainly not operating under optimum conditions in this circuit, so little power is required from it that distortion is negligible. The tube works more like a variable screen resistor than as a power-delivering modulator.

It is still true that you can't get something for nothing in this world, and this system is no exception. While doing away with costly and bulky modulation transformers and power supplies, it also does away with their high

(*Continued on page* 111)

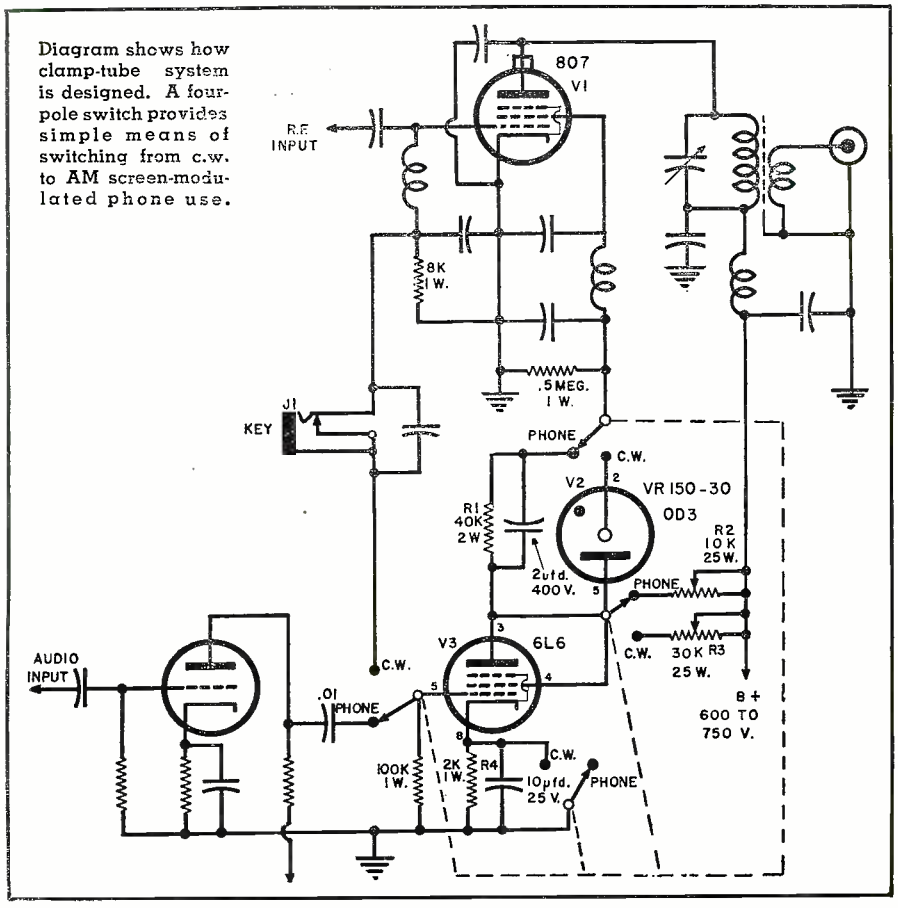
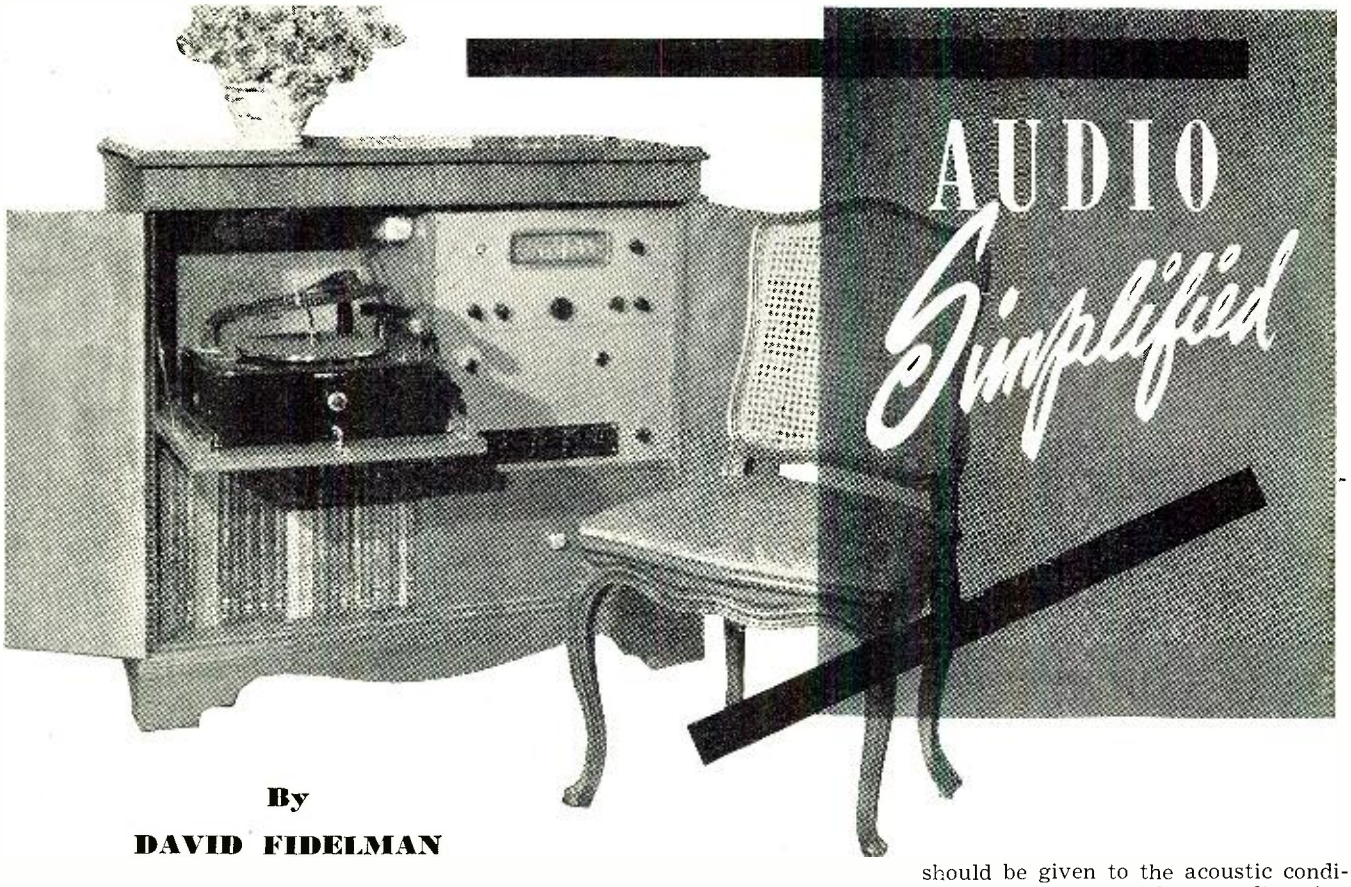


Diagram shows how clamp-tube system is designed. A four-pole switch provides simple means of switching from c.w. to AM screen-modulated phone use.



AUDIO Simplified

By
DAVID FIDELMAN

Part 2. How room acoustics influence the quality of a sound reproducing system. Author emphasizes how such acoustical properties affect the final selection of your audio equipment.

THE serious listener to reproduced music and speech is interested in attaining as nearly perfect reproduction as possible with the present state of electronic engineering. For truly good reproduction he should have a basic understanding of the factors involved in the reproduction of sound, in the basic requirements for good reproduction, in the capabilities and physical limitations of sound reproducing systems and their components, and in the practical applications of these various considerations to his own specific conditions. To obtain the best performance from the reproducing system with the most efficient use of equipment and at the least expense, he should also understand the operation of the various components and their interrelationships.

The basic considerations which are important in the reproduction of sound have been discussed in the first article of this series. The factors which affect the setup of the reproduction system, the manner in which they must be taken into account, and their application to the actual design and construction of the various phases and components of the system will be described in this article. This article will discuss the over-all setup and design of the complete sound reproduction system according to the listener's specific requirements, in accordance with the fundamental principles and requirements of good reproduction.

Because conditions vary so widely in each individual application, each installation should be set up with the particular requirements in mind. Usually a single complete unit cannot be purchased which will give results as satisfactory as can be obtained by a system set up from an intelligent consideration of these various factors. The best approach for the audio experimenter to follow is to study the conditions which exist in his own case and compare them with the results he wants to achieve as outlined in the first article of this series. (Of course, economic as well as physical factors must be given important consideration.) Then consider the various component parts of the system which are capable of giving the desired results and performing the necessary functions. Certain of these units may be constructed and others purchased, according to the individual circumstances. The interrelations between the various components must then be considered in combining them to form the complete system.

Before even starting to set up the reproducing system, first consideration should be given to the acoustic conditions in the sound pickup and listening rooms. The electronic and electromechanical components of the system may all be physically perfect, yet bad room acoustics can completely destroy the quality of the reproduced sound. The techniques of controlling acoustic conditions in rooms are quite well known and are widely used in the design of theaters and broadcast studios, but they have not been very widely applied in the home even when great care and considerable expense have been involved in setting up a high-quality sound reproduction system. The quality of reproduction will be considerably improved if proper consideration is given to room acoustics.

The important factors which affect the quality of sound in a room are the size, acoustical reflecting quality, and the noise level. Normally the size and the noise level are factors which cannot be controlled without considerable expense, and must, therefore, be compensated. The sound reflecting characteristics, on the other hand, can be controlled and cannot be compensated for if they are not good. Two important effects depend upon the sound reflections in a room—one is the reverberation, the other the spatial distribution of sound in the room.

When any sound starts, its intensity does not immediately reach maximum because it takes an appreciable time for some of the sound to reach the walls and undergo one or more reflections before reaching the listener. The intensity reaches its maximum when the steady-state condition is attained —the listener hearing both the direct and the reflected sounds at the same

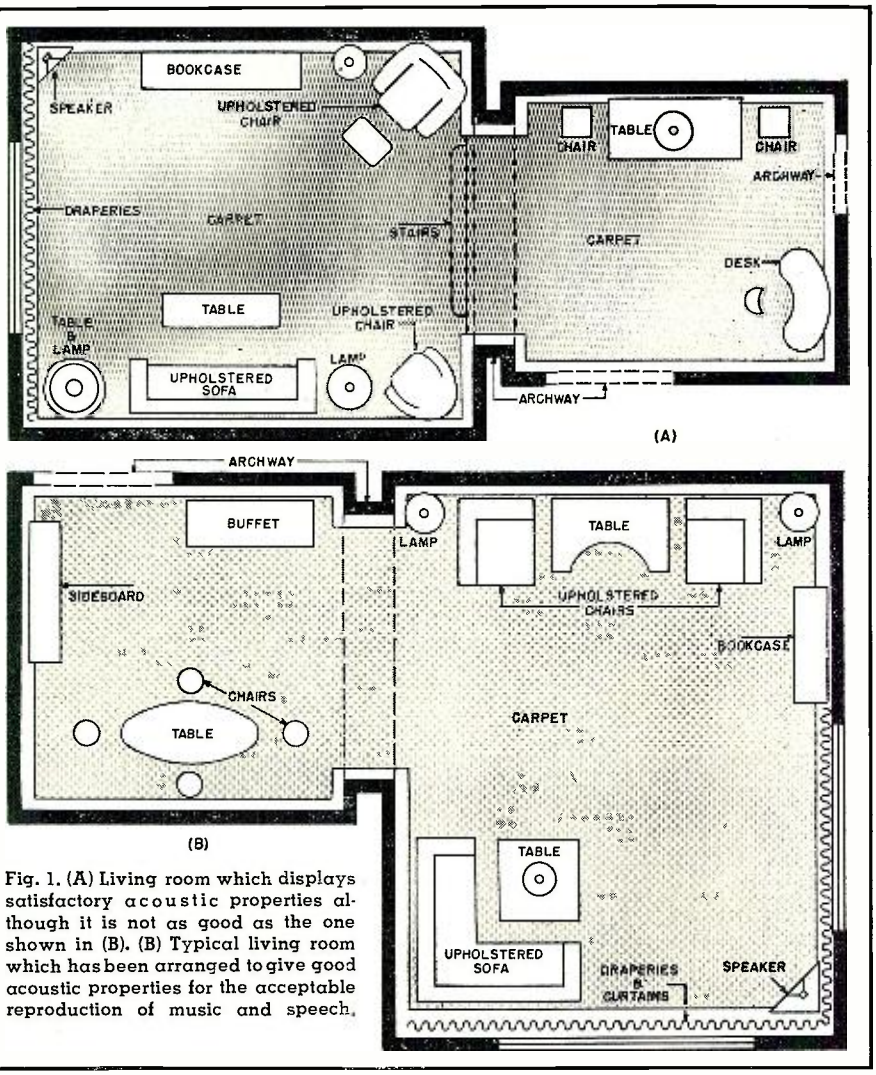


Fig. 1. (A) Living room which displays satisfactory acoustic properties although it is not as good as the one shown in (B). (B) Typical living room which has been arranged to give good acoustic properties for the acceptable reproduction of music and speech.

time. After the sound source stops, it also takes an appreciable time for the various reflections to be completely absorbed so that they can no longer be heard. This persistence of sound due to multiple reflections is called *reverberation*. When sounds are heard with too little reverberation they appear unnatural, while too much reverberation causes them to lose in intelligibility due to overlapping of the various reflections.

The space characteristics of the sound reflections are also important in determining the acoustic quality of a room. The behaviour of sound presents a very complex problem since a room is actually an acoustic resonant cavity of fairly large dimensions with many resonant frequencies. At the frequencies of resonance the sound is over-accentuated, while at other frequencies the sound may be suppressed. With parallel walls, transient vibrations known as "flutter echo", occur due to the reflections between the walls. Concave surfaces tend to focus sound towards their center of curvature, giving a greater sound intensity at that point than at other points in the room thus creating the impression that the sound originates at the concave surface. For a room to have good acoustic properties, the spatial sound pattern should be as diffuse as possible at all frequencies, with no standing-wave patterns and no points of excessive sound concentration. If acoustic frequency response measurements are taken in rooms with good and with poor sound diffusion characteristics it will generally be found that those rooms with diffuse sound patterns show response curves which are fairly smooth with not too many irregularities, while rooms with poor diffusion have a great many irregularities in their response curves.

Sound diffusion and reverberation are best controlled by using the proper quantity and quality of absorbing material, correctly placed so as to eliminate sound concentrations and resonances. Diffusion without absorption can be obtained by adding irregularities (such as convex projections on a wall, and panels which are not parallel to opposite walls) to give more diffuse rather than direct sound reflections. Use of the proper proportion of absorbing material and diffusion techniques serves the dual purpose of diffusing the sound pattern and preventing an excessive amount of room reverberation. One type of wall treatment, which gives good results where it can be employed, is to arrange some decorative pattern of serrated or convexly curved reflective surfaces alternated with absorbing areas. Another method is to have absorbing surfaces, such as heavy draperies, rugs, or large openings opposite the large flat reflecting surfaces.

These various techniques can also be combined in many ways, and generally the actual room layout and design will be a combination of the various sound diffusion techniques, tailored to fit the particular requirements. For example, a typical living room having good acoustic properties might be one laid out as shown in Fig. 1B. The two adjacent walls are fairly good reflectors of sound, but opposite one of these walls is a large archway leading into another room, while the fourth wall is covered with heavy draperies. Thus, any tendency toward resonances between the walls is considerably reduced. A rug on the floor reduces reflections between the floor and ceiling. The room shown in Fig. 1A is another layout which has demonstrated satisfactory acoustic properties, although the layout is not quite as good as that of Fig. 1B. One wall is covered with curtains and draperies; opposite this is a large archway leading into another smaller room; the floor is covered with a fairly thick rug under which is a soft pad; the ceiling and the two remaining walls are reflective. There would seem to be some tendency toward resonance between the two opposite reflecting walls in this room, but the furniture layout seems to provide sufficient absorption and diffusion to eliminate any marked resonances. If any wall treatment had been found necessary, a panel with either an absorbing or a diffusing effect in one of the walls would have been enough to correct the difficulty.

Numerous listening tests have shown that there is an optimum reverberation time for rooms of various sizes. It is not desirable to make the walls of a room too absorbent, since when there is too little reverberation the sound has a dull, lifeless effect; however, too much reverberation results in a loss of intelligibility. The most desirable reverberation times of various size rooms for frequencies from 500 to 1000 cycles-per-second have been found to be those shown in Fig. 2. The reverberation times for reproduced music should be less than for the same live music, since the reproduction already contains the reverberation of the production studio. The desirable amount of reverberation as a function of frequency, relative to the 1000 cycle value, is shown as the "optimum time" curve in Fig. 3.

Some reverberation time measurements have been made in rooms like those shown in Figs. 1A and B, with results as shown in the "measured time" curve of Fig. 3. The most important factor which can be observed as a result of this measurement is the considerable lack of low-frequency reverberation. The reason for this effect is that the wall and room reso-

nant frequencies occur in just this frequency range, so that sound energy which should be reflected is, instead, dissipated in friction due to the wall and room structure vibrations.

The net result of this reverberation-frequency effect is to make reproduced music in small rooms sound deficient in bass. However, this deficiency cannot be completely compensated by simple bass boost, because reverberation adds color as well as volume to the sound. Listening tests readily demonstrate these conclusions. Another effect which occurs in small rooms arises from the fact that a small room has more reflection than a large room or auditorium. The main impression of sound quality is formed in the first 250 milliseconds of reflection; therefore because of the greater number of reflections during these first 250 milliseconds the smaller room has a greater opportunity to impose its characteristics on the reproduced sound. A listening comparison of the same material reproduced in the small room whose measurement is given in Fig. 3 and in a motion picture theater showed it to sound definitely better in the theater.

The lack of low frequency reverberation in small rooms represents a serious problem in setting up a high quality sound reproducing system. Years of listening to sound reproduction have, to some extent, made us accustomed to this factor in listening to sound reproduction in the home—but this is certainly no solution to the problem since it merely means accepting inferior quality of reproduction. One compromise is to use a certain amount of bass boost to overcome the apparent deficiency in bass. Although this does not give the complete effect of the desired reverberation, with a good loudspeaker system fairly good sound will be obtained. The best method of compensating for the lack of low frequency reverberation is by means of a frequency-selective synthetic reverberation system, which can give complete compensation for the room defects. The details of such a system will be given in a later article in this series.

Once the room acoustics are considered satisfactory, attention can be given to the details of the electronic reproducing system. Any system for reproducing sound consists essentially of (*a*) a microphone for picking up the sound in the air and converting it into some more convenient type of vibration, (*b*) a means of transferring this signal either in time by recording or in space by transmission, and (*c*) a loudspeaker for converting this vibration back into sound.

At the present time, sound reproduction systems operate almost exclusively by means of electrical signals. The basic system for recording or transmitting sound is essentially that shown in the block diagram of Fig. 4A. A microphone converts the sound vibrations in the air into electrical signals which are then amplified by a sensitive preamplifier. This signal may then have its frequency-amplitude characteristics changed in any manner which may be desirable for the reproduction process. Further amplification supplies the power to operate whatever type of transducer or converter is required for the particular type of recording or transmission system being used. The final component of the system is the recording or transmission itself. The basic components of any system for reproducing sound are shown in the block diagram of Fig. 4B. The reproduction process starts with the recording or transmission, which is converted into an audio-frequency electrical signal by the appropriate type of transducer (such as a phonograph pickup or radio receiver). The electrical signal is then amplified, and passed through an equalizer to give the required frequency response. A power amplifier supplies the energy for the loudspeaker to convert the electrical audio signal into sound again. The various units and components of these systems will be discussed in greater detail in future articles of this series.

The availability of simple and inexpensive disc recording equipment and the development of magnetic recording have made the recording process as simple as the reproduction process, therefore many serious listeners and experimenters are now interested in recording as well as reproduction. The program material may originate either in the experimenter's home or studio or, more often, may be a broadcast from a radio station. A versatile system which can be used for recording from either an actual performance or from a radio broadcast is shown in Fig. 4C. The audio signal may originate either in a radio receiver or from a microphone, with the specific signal to be recorded at any specific time being selected by means of an appropriate switching or mixing unit. The microphone output would be amplified sufficiently so that the two signals are switched at the same level, and the rest of the recording channel can be the same as shown in Fig. 4A.

If a completely new system is being set up, it is generally desirable to consider both the recording and the reproducing channels at the same time. In this way both economy of equipment and simplicity of operation are obtained, since the entire system is better integrated as a whole. Usually the signals which are to be recorded will be either directly picked up by a microphone or from some remote point of origin by a radio receiver, whereas the program material which is listened to in reproduction will be obtained from records or from radio broadcasts. However, there are occasions when duplicates are to be made from other records, and where one wants to listen to certain original sounds in order to hear how they sound when reproduced through a loudspeaker. The complete system can be set up to permit simultaneous recording and reproduction from any of the three types of sound signal sources in the manner shown in Fig. 5. This particular setup is quite simple and flexible, and at the same time combines all the essential functions for both recording and reproduction.

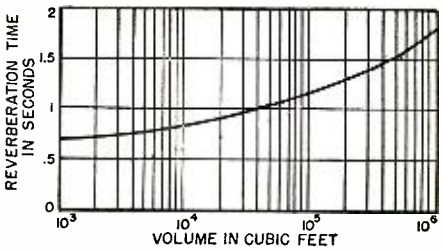


Fig. 2. Optimum reverberation time for rooms of various sizes for frequencies of from 50 to 1000 cycles-per-second.

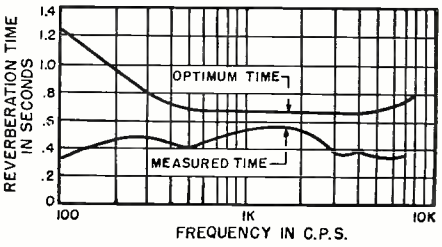


Fig. 3. Reverberation time as a function of frequency in a small room, similar to those shown in Figs. 1A and 1B, showing optimum reverberation time compared with the measured reverberation.

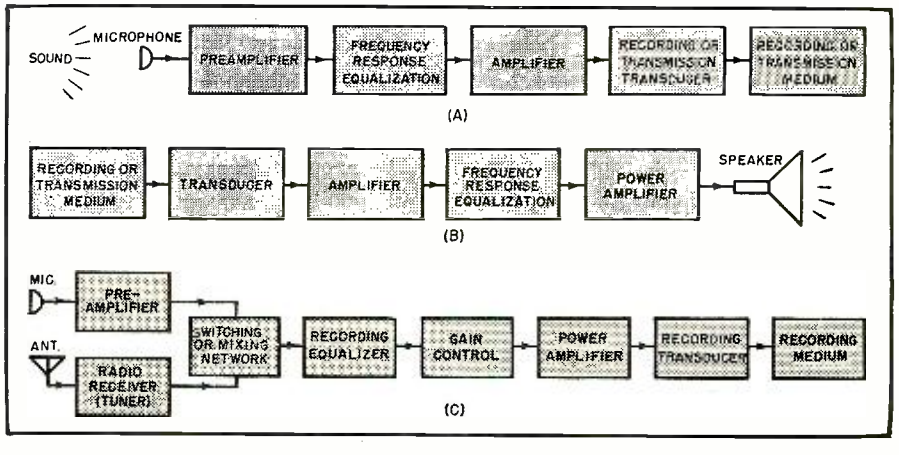


Fig. 4. (A) Basic system for the recording or transmission of sound. (B) Components of the basic system for reproduction of sound from a recording or transmission. (C) Setup of system for recording from either direct pickup or from a radio broadcast.

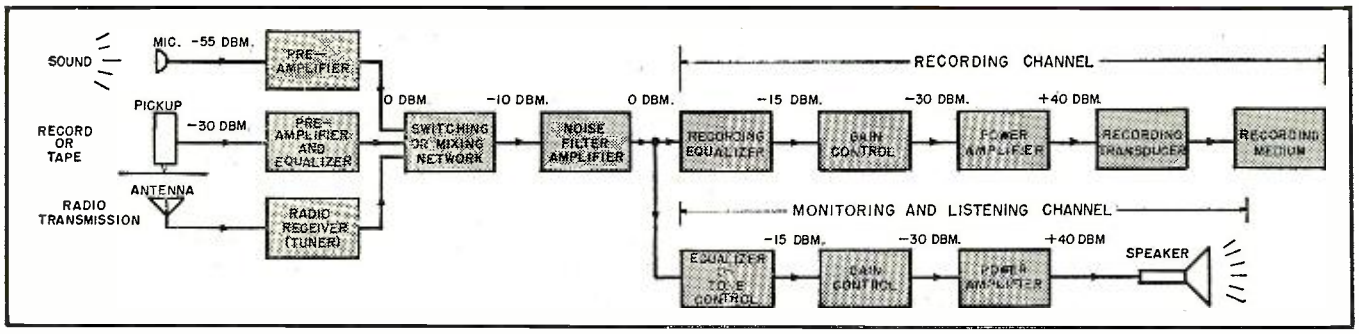


Fig. 5. Setup of system which can be used for simultaneous recording and reproduction from either reproduced sound or direct pickup.

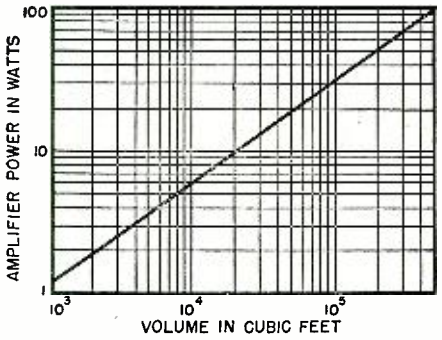


Fig. 6. Approximate amplifier power requirements for rooms of various sizes.

The precise form which the various components will take, and their specific characteristics, will depend upon the particular conditions which are to be met.

The setup of the channel itself will be one of the four basic setups described in Figs. 4A, B, C, and 5, depending upon the functions which are to be performed. The basic characteristics of the various units will always be more or less the same, but certain essential characteristics (such as power output, voltage gain, sensitivity, etc.) must be chosen specifically for the particular application. In setting up the system, considerable care must be taken in matching the various units correctly. The major points which must be considered are:

(*a*) Type of signal
(*b*) Input and output impedances
(*c*) Signal levels and d.c. voltages

Good reproduction will be obtained only if all of these factors are properly considered.

The type of signal at any point in the system may take any one of several different forms. The original signal, of course, is the sound in the air which is a mechanical vibration. Signals on discs are in the form of a mechanical groove, and on magnetic tape or wire it is in the form of a magnetized medium. Radio signals consist of an amplitude-modulated or a frequency-modulated high-frequency electromagnetic field. The correct type of unit must be used to pick up each of these signals, as indicated in Fig. 5, and to convert them to an audio-frequency electrical voltage or current. This audio-frequency voltage or current is then the signal which is present throughout the rest of the reproducing system until it is again converted into sound by the loudspeaker.

Every electronic unit is designed to operate best when the unit to which its output is connected has some specific impedance. These input and output impedances will depend entirely upon the design of the unit, and when a commercial unit is purchased this information must be obtained from the manufacturer. The impedances may be as low as 2 to 4 ohms for a loudspeaker, or as high as 1 to 2 megohms for the input of a voltage amplifier. Mismatching the input and output impedances will usually introduce distortion or result in a loss of signal level, and should, therefore, be avoided.

Careful consideration must also be given to matching the input and output voltages of the various components of the system. If the output voltage of one unit is too high for the required input of the unit to which it is applied, serious overloading and distortion will result, and often the equipment itself may be damaged. If too little signal voltage is supplied, a high noise-to-signal level may result, and it may not be possible to obtain a sufficient sound output from the system. Attention must also be paid to the d.c. voltage levels at various points in the system, since some units can be operated with high voltages applied to their inputs, while others would be damaged by such voltage.

An examination of the literature furnished with the units will indicate proper operating conditions.

More specific details and information about these various considerations are

(*Continued on page* 161)

Table 1. Input and output characteristics of the various components in a sound reproducing system.

COMPONENT OR FUNCTION	INPUT				OUTPUT				GAIN OR INSERTION LOSS (in db)
	Type of signal	Impedance	Signal level (approx.) Volts	Signal level (approx.) DBM*	Type of signal	Impedance	Signal level (approx.) Volts	Signal level (approx.) DBM*	
Microphone	Sound	——	——	——	Electrical	High/low	——	−55	——
Pickup lead	Record	——	——	——	Electrical	High Low	1.0 0.01	−30 −30	——
Radio receiver (Tuner)	Radio transmission	——	10^{-6} to 0.01	——	Electrical	High Low	2.0 ——	—— 0	——
Preamplifier	Electrical	High/low	——	−60 to −30	Electrical	High/low	——	0	+30 to +60
Switching and mixing networks	Electrical	High/low	——	0	Electrical	High/low	——	−12 to 0	0 to −12
Noise filter amplifier	Electrical	High/low	——	−15 to 0	Electrical	High/low	——	0	0 to +15
Equalizer or tone control	Electrical	High/low	——	0	Electrical	High/low	——	−15	−15
Gain control	Electrical	High/low	Any		Electrical	High/low	Any		0 to −∞ Usually set at −15
Power amplifier	Electrical	High/low	——	−30 or higher	Electrical	Low	1 to 100 W.	+30 to +50	Approx. +70
Recording transducer	Electrical	Usually low	1 to 50 W.	+30 to +47	Mechanical or magnetic	——	——	——	——
Loudspeaker	Electrical	Low	1 to 100 W.	+30 to +50	Sound	——	——	——	——

*Reference level: 0 dbm = 0.001 watt.

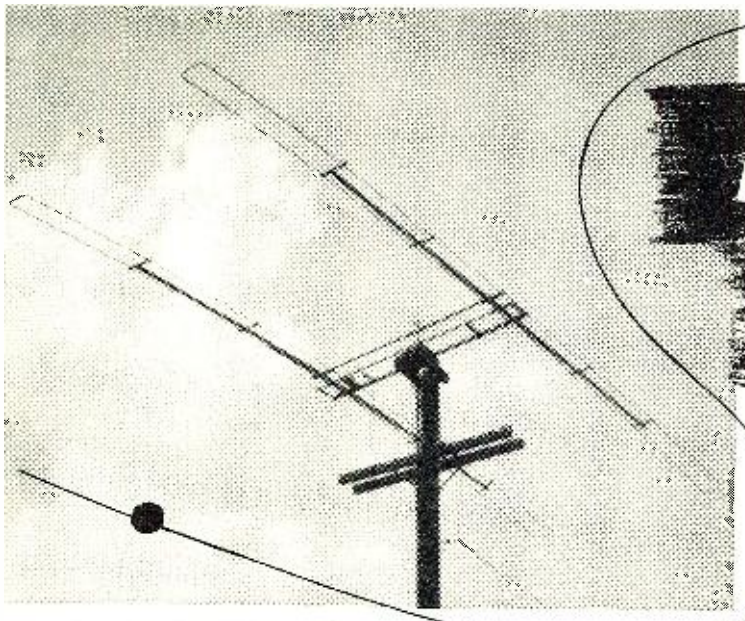


Fig. 1. Over-all view of 20 meter beam built by author.

A COMPACT 20-METER BEAM

By
HAROLD J. GRUBER,
W8MGP

Featuring high forward (8 to 10 db) gain, up to 50 db front-to-back ratio, and broad loading over entire band, this beam has no critical adjustments.

FOR years the author was a strong advocate of the 8JK type of beam - - antenna since it was compact, not critical in adjustment, and had good forward gain (5-6 db for a single section). The big drawback, at least in the Midwestern section of the country, was its bi-directional properties and lack of front-to-back discrimination. Having heard much about the type beam herein described from amateurs all over the U.S.A. and after gathering data from quite a few enthusiastic users (their R 9 plus signals were proof enough) the author constructed the twenty meter beam shown in Fig. 1.

The beam consists of a pair of folded dipoles spaced one-eighth wavelength apart with both dipoles driven 135 degrees out-of-phase by means of an eighth wave matching section which is transposed. For maximum front-to-back ratio or maximum forward gain vary the length of this matching section. In this beam, using 300 ohm *Amphenol* twin-lead, the calculated length of 7′ 1″ for the center of the phone band seemed to work best. In actual tests on the air it measured better than 35 db front-to-back with excellent forward gain. To calculate the length of this matching section use the formula: $L = 123V/f$ where V is the velocity factor for the transmission line being used; L is length in feet; and f is the frequency in megacycles. Any transmission line from 50 to 150 ohms seems to match the beam satisfactorily without a matching transformer (this was determined by checking with different stations using this type beam). Quite a few stations were using RG/8U and some two pieces of RG/8U. The beam pictured is fed with RG/22U twin coax with an impedance of 95 ohms and the line is connected directly to the folded dipole. This line has a very low standing wave ratio.

Like the 8JK beam, here is a beam that can be constructed, erected, and made to operate at high efficiency without laborious tuning, critical measurements, matching of stubs, etc. But unlike the 8JK it has a front-to-back ratio of at least 35 db (many stations reporting up to 60 db) while still maintaining a forward gain of 8 to 10 db over a dipole antenna. The loading is broad over the entire twenty meter band so the dimensions will remain the same for phone or c.w. operation.

Now to get into the constructional details of the beam. Fig. 2 gives full dimensional data as well as the schematic diagram. The dipoles are made of 61ST aluminum tubing ½″ o.d. with .035 wall thickness (this material is usually stocked in twelve foot lengths) which is joined together with short pieces of brass rod (could be aluminum) as shown in Fig. 3B. The nuts and bolts are also aluminum. The four end pieces are the only difficult pieces to make and can either be a half circle or shaped with a small radius as shown

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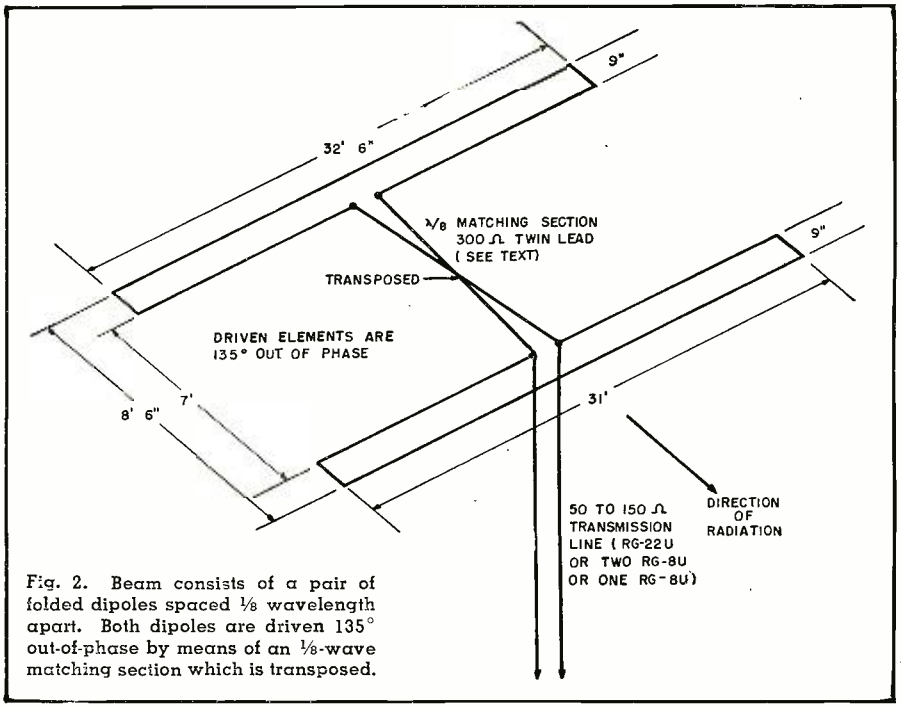

Fig. 2. Beam consists of a pair of folded dipoles spaced ⅛ wavelength apart. Both dipoles are driven 135° out-of-phase by means of an ⅛-wave matching section which is transposed.

By
LOUIS E. GARNER, JR.

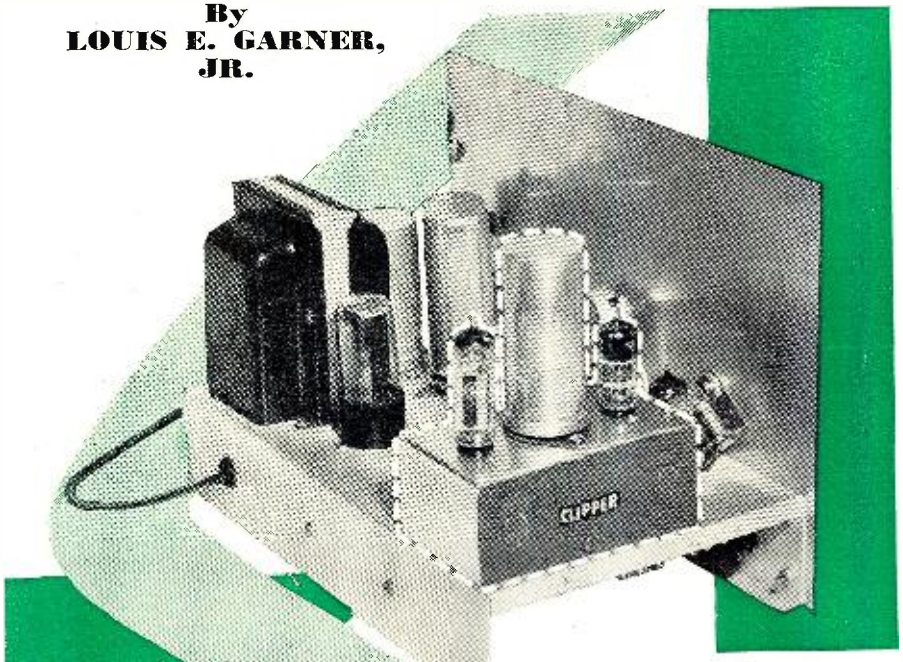

Fig. 1. Clipper-amplifier (shown dotted) mounted on chassis of "Deluxe Pulse Generator" unit.

CLIPPER for Deluxe PULSE GENERATOR

This simple two-tube clipper-amplifier can be used by itself, or, as the author did, in conjunction with "The Deluxe Pulse Generator" described in last month's issue.

THE instrument described in the author's article, "A Deluxe Pulse Generator," appearing in the September 1951 issue of RADIO & TELEVISION NEWS, supplies a pulse with a waveform suitable for almost all normal experimental purposes. The pulse width, pulse repetition rate, and pulse polarity may be easily varied to suit the experimenter.

However, when the output signal is viewed on a scope with a "slave" sweep so that the pulse may be expanded, it is found to be rounded somewhat, as shown in Fig. 2B. As the pulse width is reduced to a minimum, the pulse gradually assumes the form indicated by the dotted line.

For certain refined laboratory applications, it is desirable that the pulse have a "flat" top, as shown in Fig. 2A. As the "Pulse Width" control is adjusted, the trailing edge of the pulse should gradually move inward, with no change in the leading edge, general waveshape, or amplitude of the pulse, until, with minimum pulse width, the waveshape is as shown by the dotted line.

By the addition of a simple clipper-amplifier circuit to the original pulse generator, the waveshape of the output pulse obtained may be changed from the form shown in Fig. 2B to that shown in Fig. 2A. At the same time, a much flatter output is obtained, with the output remaining fixed irrespective of pulse width, pulse repetition rate, or pulse polarity.

The clipper may be assembled and wired on a small sub-chassis, and then mounted on the original pulse generator chassis as shown in Fig. 1. No changes are necessary in the front panel, and the appearance of the instrument, number and location of controls and switches remains unchanged. Power for the clipper is obtained from the pulse generator power supply. Connections of the clipper into the pulse generator circuit are made through the chassis.

Virtually no changes are necessary in the pulse generator circuit proper, except for increased filtering capacity in the power supply, and for the change in the size of coupling condensers to provide a somewhat less crowded chassis. The final schematic diagram for the complete pulse generator, including clipper, is given in Fig. 4. The clipper circuit is indicated by the dotted lines, and these parts are included in the sub-chassis visible in Fig. 1. If the pulse generator is being built for the first time, it is not necessary to wire the clipper circuit on a sub-chassis. It may be incorporated right on the main chassis, and a suitable layout chosen.

Circuit Description

Although the operation of most of the pulse generator circuit has been covered in the previous article, a brief review may be appropriate at this time.

Referring to the schematic diagram, a 6J6 dual triode is connected as an unsymmetrical cathode-coupled multivibrator, with a pulsed waveform appearing across the 1000 ohm plate load resistor. Frequency of operation and hence the number of pulses-per-second is determined by the grid-condenser-resistor combination. Various grid condensers may be selected by adjusting S_1, while the grid resistance may be changed by adjusting the 2 megohm potentiometer ("Frequency" control). With the values shown, the number of PPS may be varied from approximately 1 per second to better than 100,000 per second.

If desired, the multivibrator may be synced with an external signal by applying the signal to its free grid, with a 50,000 ohm potentiometer used as the "Sync" control.

The pulsed signal appearing across the 1000 ohm plate load resistor is applied to a differentiating circuit consisting of a 39 $\mu\mu$fd. coupling condenser, a 4700 ohm resistor, and a 50,000 ohm pot, with the double-pulsed differentiated signal appearing across the resistors. Pulse width is varied by changing the time constant of this circuit by means of the 50,000 ohm "Pulse Width" control.

After amplification by half of a 12AU7 tube connected as a conventional resistance-coupler amplifier, the double-pulsed signal is passed through the other half of the 12AU7 connected as a clipper, where the negative-going pulses are removed. Thus, only unidirectional pulses appear after the 12AU7 "Clipper-Amplifier" stage.

Additional amplification of the pulses is provided by another 12AU7 twin-triode connected as a two-stage cascaded resistance-coupled amplifier.

The pulses are then applied to the new clipper circuit. The clipper proper consists of a 6BN6 gated beam tube. Here, the tops of the pulses are "clipped off," leaving the pulses with a flat top but much lower amplitude. The pulses are brought back to approximately their original amplitude by means of a wide-band pentode amplifier (6CB6), and then applied to the phase-splitter output tube used in the original generator.

The 6BN6 tube is a comparatively new tube, designed primarily for application as a combination limiter and discriminator in FM receivers and in

the sound circuits of TV receivers. It has extremely sharp cut-off characteristics, making it especially suitable for application as a single tube clipper. To obtain most effective clipping action with this tube, it is desirable to operate the tube with comparatively low plate and screen voltages.

When connected in this manner, a signal applied to its grid causes the plate current to rise quickly to a maximum value (on positive half-cycles). The plate current will not rise higher than this despite further increases in applied signal amplitude. On negative half-cycles, the plate current is just as quickly reduced to zero. How this may occur can be easily seen by referring to the static characteristic curve for this tube shown in Fig. 3.

Construction Hints

Whether the clipper is built on a sub-chassis and then mounted on the pulse generator chassis, or is incorporated directly into the circuit on the main chassis, it is important that all signal leads be kept as short as possible. Distributed capacities in signal circuits throughout the pulse generator must be kept to a minimum if good pulse waveshape is to be preserved, with minimum rise time.

Parts values, except in the 6J6 and 6BN6 circuits, are not especially critical. The values of the grid resistors and coupling condensers may be reduced without appreciably affecting the pulse waveshape or amplitude. If desired, 1 megohm grid resistors may be used throughout, except in the differentiating circuit and in the grid circuit of the 6BN6. Similarly, .01 μfd. interstage coupling condensers may be used.

The power supply voltage is not critical, but if a voltage other than 300 is supplied by the power supply used, it may be necessary to change the values of the series plate resistor and the screen grid resistor of the 6BN6 tube to obtain optimum operation. In general, these resistors should be increased if higher "B" voltages are provided, and reduced with lower voltages.

Layout is not too critical, but care should be taken to avoid interstage coupling. Due to the number of amplifier stages used, the least feedback may cause over-all motorboating and low frequency oscillation. For this same reason large filter condensers are necessary in the "B" supply unless individual decoupling filters are used in each stage.

Specifications

With the parts values indicated, the frequency coverage is from approximately 1 PPS to 140,000 PPS in five ranges, as follows:

RANGE (Fig. 4)	FREQUENCY (As R_{18} is adjusted)
1	1-20 PPS
2	9-160 PPS
3	108-1725 PPS
4	1080-17,250 PPS
5	10,800-142,000 PPS

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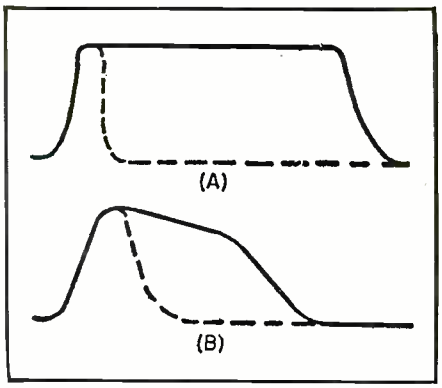


Fig. 2. (A) Waveshape of pulse generator using clipper-amplifier described. (B) waveshape of original pulse generator described last month. The waveshape (B) is entirely satisfactory for general, all-around testing. For those who desire a more refined instrument, adding this clipper-amplifier will provide a test unit having a much flatter output and one that remains fixed regardless of pulse width, pulse repetition rate, or the polarity of the pulse.

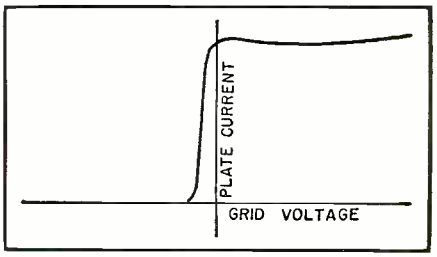
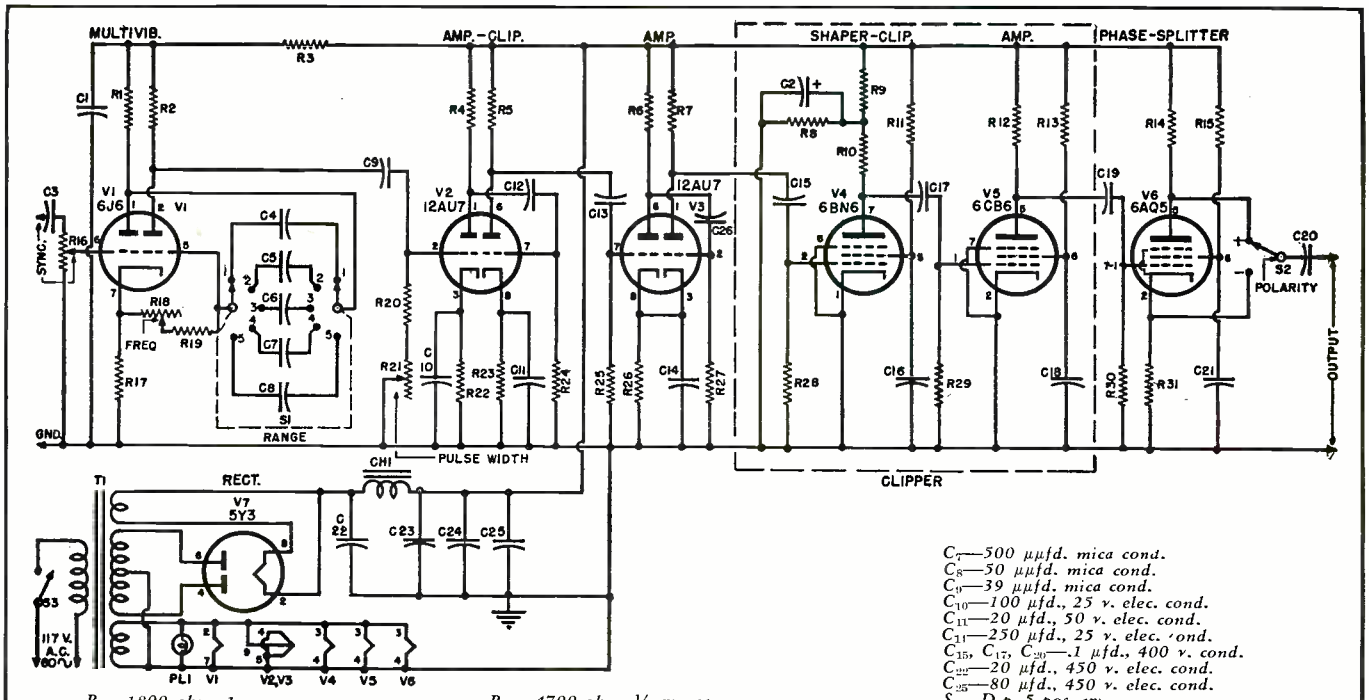


Fig. 3. Characteristic curve of 6BN6 tube.

Fig. 4. Clipper-amplifier circuit is shown within dotted lines. Balance of circuit is similar to last month's "Deluxe Pulse Generator."



R_1—1800 ohm, 1 w. res.
R_2, R_4, R_5, R_{12}—1000 ohm, 1 w. res.
R_3, R_{15}—22,000 ohm, 1 w. res.
R_6, R_7—2200 ohm, 1 w. res.
R_8—68,000 ohm, 1 w. res.
R_9, R_{13}—47,000 ohm, 1 w. res.
R_{10}—510 ohm, ½ w. res.
R_{11}—18,000 ohm, 1 w. res.
R_{14}—680 ohm, 1 w. res.
R_{16}, R_{21}—50,000 ohm pot
R_{17}—100 ohm, ½ w. res.
R_{18}—2 megohm pot
R_{19}—120,000 ohm, ½ w. res.
R_{20}—4700 ohm, ½ w. res.
R_{22}—200 ohm, ½ w. res.
R_{23}—27,000 ohm, 1 w. res.
R_{24}, R_{27}, R_{29}, R_{30}—2.2 megohm, ½ w. res.
R_{25}, R_{26}—3.3 megohm, ½ w. res.
R_{28}—470 ohm, 1 w. res.
R_{31}—560 ohm, 1 w. res.
C_1, C_2, C_{10}, C_{15}, C_{21}, C_{23}, C_{24}—40 μfd., 450 v. elec. cond.
C_3, C_{12}, C_{13}, C_{19}, C_{26}—.01 μfd., 400 v. cond.
C_4—.5 μfd., 400 v. cond.
C_5—.05 μfd., 400 v. cond.
C_6—.005 μfd., 400 v. cond.
C_7—500 μμfd. mica cond.
C_8—50 μμfd. mica cond.
C_9—39 μμfd. mica cond.
C_{11}—100 μfd., 25 v. elec. cond.
C_{11}—20 μfd., 50 v. elec. cond.
C_{11}—250 μfd., 25 v. elec. cond.
C_{15}, C_{17}, C_{20}—.1 μfd., 400 v. cond.
C_{22}—20 μfd., 450 v. elec. cond.
C_{25}—80 μfd., 450 v. elec. cond.
S_1—D.p. 5-pos. sw.
S_2—S.p. 2-pos. sw.
S_3—S.p.s.t. sw.
T_1—Power trans. 325-0-325 v. @ 100 ma.; 6.3 v. @ 2.5 amps.; 5 v. @ 2 amps.
PL_1—6.3 v. pilot lamp
CH_1—10 hy., 100 ma. filter choke
V_1—6J6 tube
V_2, V_3—12AU7 tube
V_4—6BN6 tube
V_5—6CB6 tube
V_6—6AQ5 tube
V_7—5Y3 tube

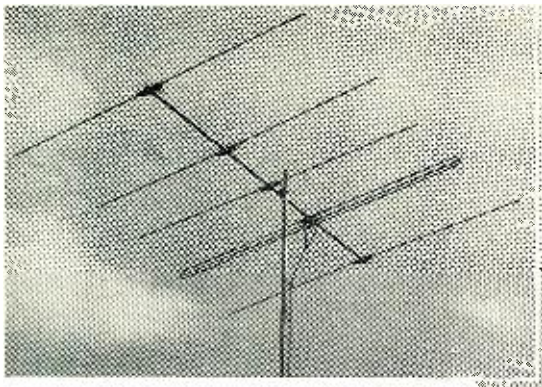


Fig. 1. A five-element yagi using a 3-conductor, 600 ohm folded dipole. Feed points are in the lower conductor of the folded dipole.

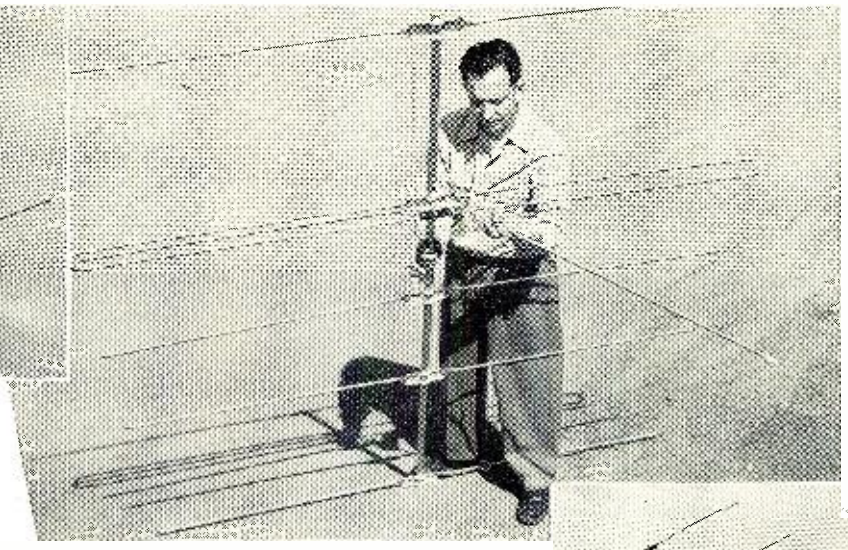


Fig. 2. How the center conductor can be removed from folded dipole in order to permit its utilization as a connecting rod in stacking.

By
HAROLD HARRIS
Channel Master Corp.

The YAGI ANTENNA

One of the best TV fringe area antennas. Article covers methods of stacking and details on how to obtain correct antenna-receiver impedance match.

THE emergence of the yagi antenna as one of the most popular television receiving antennas for use in the fringes of one or two-channel service areas has been one of the most interesting antenna developments of the year.

The yagi antenna was developed by Hidetsugu Yagi, a Japanese physicist, and, ironically, it found widespread use against the Japanese as a mobile radar antenna during World War II.

The unique feature of the yagi antenna is that only one element is driven and the one or more elements in the field of the driven element are parasitically excited. Due to length and spacing, these parasitic elements act as directors or reflectors. The term "yagi" was originally used to designate any antenna using a parasitic element but present terminology applies to antennas having two or more parasitic elements.

The success of the yagi as a television receiving antenna has been somewhat dimmed by the difficulty involved in stacking commercial models so that the additional gain contributed by the second bay can be fully realized.

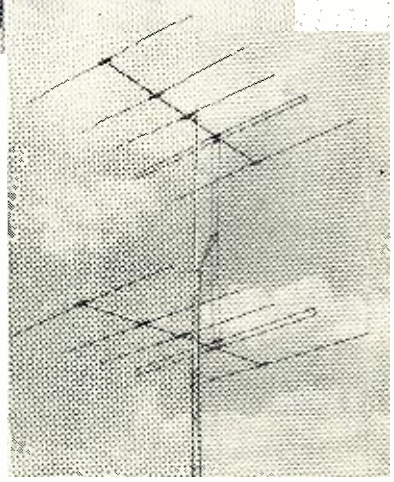


Fig. 3. Stacked five-element yagi antennas with center conductors removed from folded dipoles and used to provide half-wave stacking.

Since the problem lies chiefly with impedances it might be well to review the characteristics of the various dipoles used in yagi antennas.

In a simple folded dipole (Fig. 4B) the current divides equally between the two conductors. Thus, at the feed point only one half the current is flowing that would flow in a straight dipole being fed with the same power. Since the impedance varies with the square of the current the reduction of the current by half means that the impedance is raised four times.

A straight dipole (Fig. 4A) has an approximate impedance of 75 ohms thus the two-conductor folded dipole has an impedance of 300 ohms. In a three-conductor folded dipole (Fig. 4C) the current is reduced to one-third at the feed point and thus the impedance is raised nine times or to approximately 600 ohms.

In the folded dipole using conductors of different diameters (Fig. 4D) if the driven conductor is the smaller of the two, a larger percentage of the current flows in the conductor having the greatest diameter. The current at the feed point is reduced by factors relating to the ratio of the diameters and the spacing between them.

In any parasitic array the addition of reflectors or directors lowers the

Fig. 4. Types of dipole antennas. See text.

Fig. 5. Method of choosing correct quarter-wave transformer to match 600 ohm line to the commonly-used 300 ohm line.

Fig. 6. Common method of stacking two yagis at a half wave. See text for details.

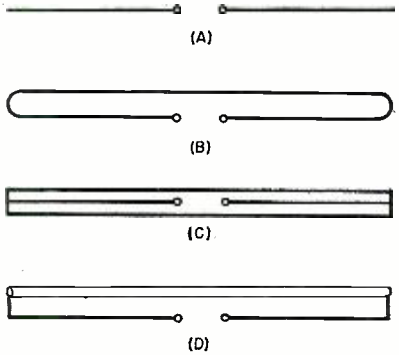


Fig. 4

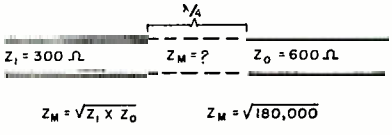


Fig. 5

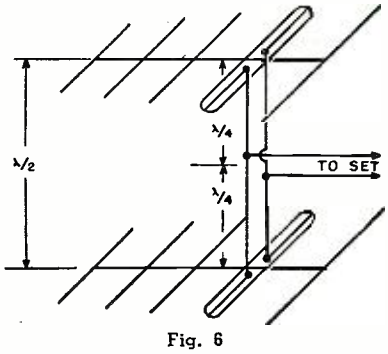


Fig. 6

antenna input impedance. In general, each additional parasitic element reduces the impedance still further. The amount of the reduction depends chiefly on the spacing between the added element and the fed dipole. It will thus be seen that the use of a straight dipole in a yagi array consisting of three or more close-spaced elements is not practical in television receiving applications since in this instance the impedance might drop to as low as 25 ohms. In most yagi arrays the addition of more than three directors no longer affects the impedance adversely since the distance between the additional director and the driven element is too great for coupling. There is an advantage to be realized in the form of increased directivity.

The use of a 300 ohm folded dipole in a television receiving yagi is preferred over a straight dipole because the higher input impedance comes close to matching the popular 300 ohm transmission line.

It must be emphasized that the reduction in antenna impedance depends equally on spacing and the number of parasitic elements. As a matter of fact, a wide-spaced, five-element yagi can have a higher impedance than a close-spaced, three-element yagi.

From a practical standpoint and for mechanical considerations, the cross arm on television receiving yagis is usually restricted to a half wavelength, particularly on the low band. This, in turn, means close coupling between the elements and, therefore, a low impedance results. In most commercial yagis a dipole having an impedance of approximately 600 ohms is required. This value is usually obtained in a five-element television receiving yagi by using one of two types of dipoles. One type is the three-conductor folded dipole (Fig. 4C) which has an impedance of approximately 600 ohms. The second arrangement utilizes the two diameter folded dipole (Fig. 4D) which should have a ratio of 3 to 1 in order to provide the desired 600 ohm impedance.

Up to now we have considered some of the problems involved in the design of a television receiving yagi. In many cases, however, the gain realized by the five-element yagi is insufficient for fringe areas. The small amount of gain obtained by adding more directors is not worthwhile. The most common procedure, then, is to stack these five-element yagis. It is the specific purpose of this article to point out why, in most cases, this is an unprofitable and an inefficient procedure. A yagi that matches a 300 ohm line as a single bay cannot be stacked and still match a 300 ohm line unless certain changes are made.

In pursuing this topic, it is first necessary to discuss the characteristics of the linear quarter-wave transformer. The characteristics of this quarter-wave section of parallel wire transmission line are such that it has the property of matching unlike impedances so that there is no electrical

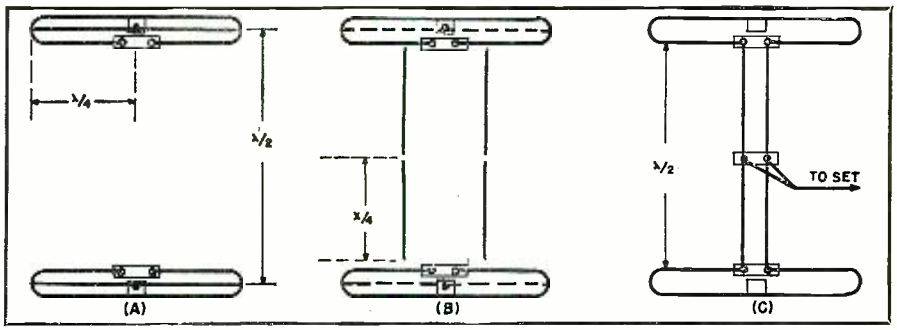


Fig. 7. (A) Two 3-conductor folds spaced a one-half wave. (B) The two folds with center conductor removed preliminary to using conductors as stacking rods. (C) The two folds used as conventional folded dipoles with the center conductors used as connecting rods.

discontinuity in the system in which it is incorporated. This characteristic is effective only for the frequency at which the transformer equals one quarter wavelength. The formula for determining the desired impedance for the quarter-wave matching transformer is:

$$Z_M = \sqrt{Z_i \times Z_o}$$

where: Z_M is the unknown matching impedance
Z_i is the input impedance, and
Z_o is the output impedance.

As an example, let's determine what impedance is necessary to match 300 ohms to 600 ohms in the problem of Fig. 5.

These particular values were chosen for this problem because they are the ones involved when stacking two yagis each having an impedance of 300

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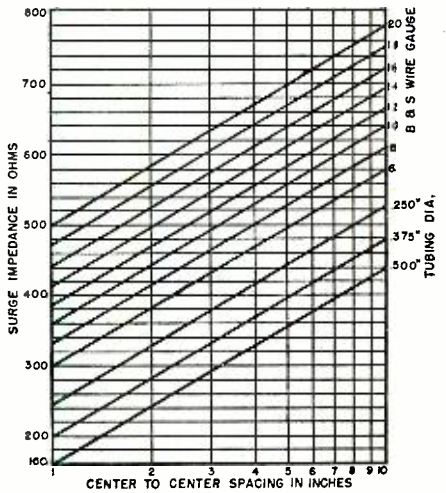
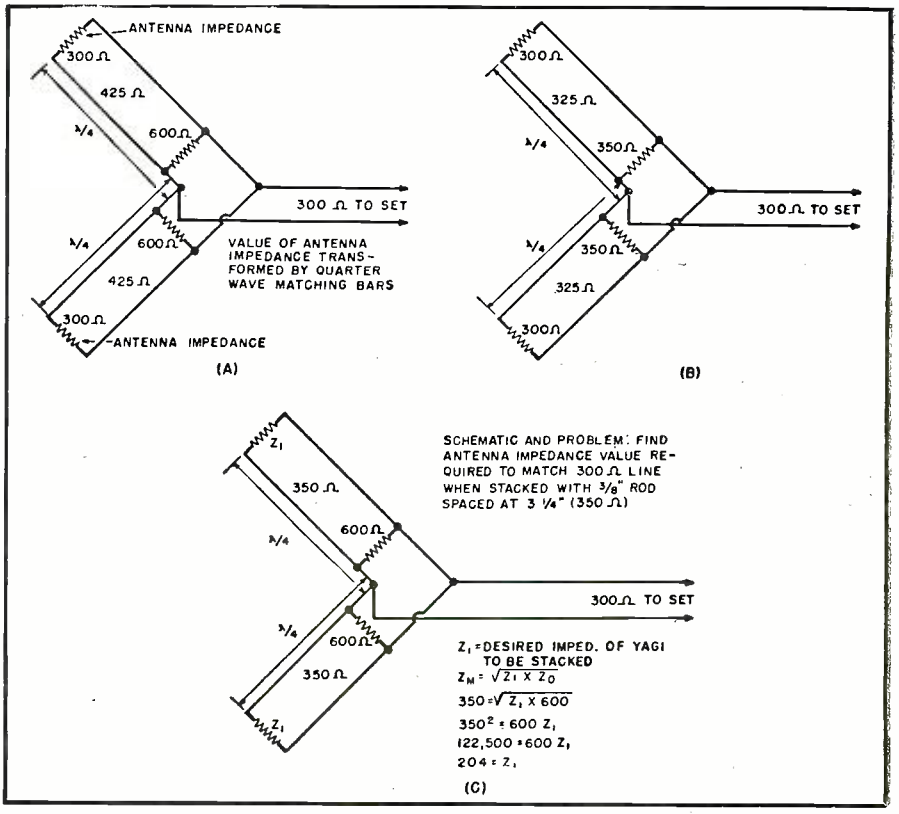


Fig. 8. Characteristic impedance versus spacing of commonly-used conductors.

Fig. 9. (A) Schematic of Fig. 6 with impedance values included. (B) Schematic showing resultant impedance of two 300 ohm yagis stacked using ⅜ inch rods spaced at 3 inches (325 ohms). (C) Schematic and problem: Find antenna impedance value required to match 300 ohm line when stacked with ⅜ inch rod spaced at 3¼ inches (350 ohms).



Sales Aids

By
HAROLD BECKER
Eastern Editor
RADIO & TELEVISION NEWS

Manufacturers spend literally millions each year to help you sell their products. It is to your advantage to use such material.

WHAT the consumer thinks of the television technician is just as important to the parts manufacturer as it is to the technician himself. The manufacturer has long recognized that the backbone of his replacement business is the technician and anything that discredits the technician will, in the final analysis, affect his (the manufacturer's) business.

To offset the indignities heaped upon television technicians by national magazines, local citizens' groups, and other media of propaganda, the leading tube manufacturers have taken up the technician's battle through positive advertising and promotion propaganda. The theme serves to place the technician on the same level as other business folk and emphasizes the importance of the service he renders to his community.

In a dynamic campaign that reaches magazine readers, television viewers, and radio listeners, *Sylvania* makes the average consumer conscious of what the radio-television technician means to the community. For the first time the local technician as a medium of "service" will be featured in national magazine campaigns, spot radio announcements, and a national weekly television show. Specifically, *Sylvania* is running a national advertising campaign in *Life, Look, Saturday Evening Post,* and *Colliers* and a weekly television show, "Beat The Clock" over the *CBS* network at 7:30 p.m. every Saturday night in all major television markets. The September and October magazine insertions feature Paulette Goddard while the November-December ads spotlight Patrice Munsel.

To allow the service dealer to tie in with its national campaign on a local level, *Sylvania* has made a dealer kit available through its local distributors. The kit contains:

1. Streamers and pasteboard displays for both window and counter use coordinated with the national magazine campaign to give continuity of recognition at the dealer level.

2. A series of direct mail cards promoting the theme of the national magazine campaign. Room for dealer imprint allows for local association with the national pitch.

3. A 60-page book of radio spot announcements aimed at those service dealers who use the "extra" in sales promotion.

For maximum impact you should coordinate your local promotions with those carried out on national level. Tim-

ing in this case could be an important adjunct to the success of your promotion. This service dealer campaign has been in progress since March and time has proven that, when correctly executed, it can promote new business.

Utilizing the theme, "Serving the Community—Your Neighborhood Radio-Television Technician," the *RCA* Tube Department's campaign focuses the spotlight squarely on the service dealer. It promotes the idea that the local radio-television servicing technician is a merchant ready and able to fulfill his role in servicing the radio and television sets in the community. It places the service dealer

These sales aids represent only a few of the thousands that manufacturers make available to their dealers and distributors. Prepared by merchandising and advertising experts, these counter cards, window streamers, service aids, and product identification campaign materials, can mean dollars to you if you will take advantage of this promotion service.

in that group of businessmen who have long been accorded "professional" status. In short, it is aimed at combating the often repeated phrase, "screwdriver mechanic," and the voluminous amount of bad publicity recently heaped upon the television service technician.

Highlighting the campaign is a large size window display (21"x30") which depicts the service dealer as a member of his community offering his radio and television service ability in its interest. The banner headline tells the story, "Serving the Community—Your Neighborhood Radio-Television Technician." A smaller reproduction (10"x14") of this display is available for counter use.

A series of direct mail cards carries out the same theme, emphasizing the service dealer's place in the community and the nature of his business. The entire campaign is intended primarily to add greater prestige to the local service dealer.

The *Raytheon Manufacturing Company* continues to promote its "Bonded Electronic Technician" program in the latest service-dealer window displays. The handsome 5-color display (17"x24") boldly proclaims the *Raytheon* "Code of Ethics" for the protection of the consumer. This theme is unquestionably more timely today than ever before in the service industry. Consumer respect for the technician is at its lowest ebb and any promotional counterbalance such as this will tend to raise the stature of the local technician in the eyes of his community.

Probably the most revolutionary promotion to be undertaken in the radio-television service industry in recent years is the "Easy Budget Plan" recently introduced by the *Hytron Radio and Electronics Corporation.* It places servicing costs on a par with equipment costs and thus insures a better business standing for the local television technician.

Since the television technician is principally a dealer in services, this new *Hytron* plan allows him to sell his service on the same installment basis available to set dealers. The plan comes at a time when many consumers are faced with

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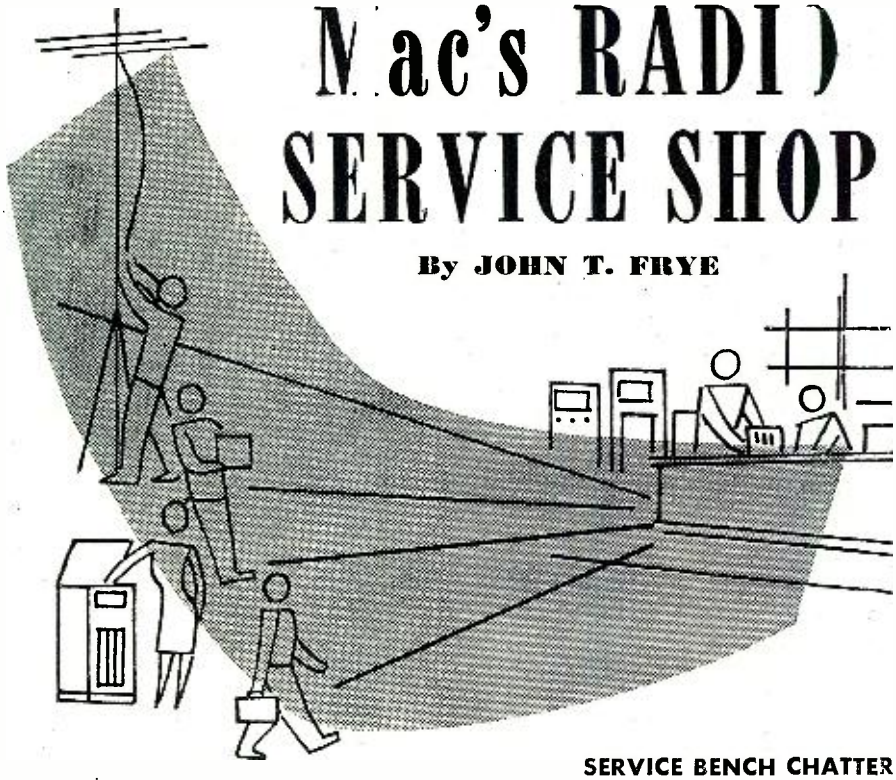
Mac's RADIO SERVICE SHOP

By JOHN T. FRYE



SERVICE BENCH CHATTER

A LOUD slam of the shop screen door announced that Barney was back from the service call he had started on only a few minutes before.

"Mission accomplished!" he said, making a sign of smug self-approval with circling thumb and forefinger. "It was the old story: they had moved the TV set across the room and, as a result, had more lead-in than they needed. Someone had told them that twin-lead could not be spliced; so, since they thought they might sometime want to return the set to its original position, they rolled the extra twin-line into a neat little coil and poked it into the back of the set. As you can guess, Channel 4 was very blizzardy, and 6, 7, and 9 could not be seen at all.

"As soon as I whacked off the extra lead-in, everything was hokey-dokey. I sold the man one of those little plastic twin-line splicers and showed him how he could use it to restore the chunk of line we had amputated if he ever wanted to move the set back to where it was. Then I checked the ion trap to make sure it had not been jarred out of adjustment when the set was moved. Sure enough, it was off quite a little; so I put it back where it belonged and at the same time touched up the focus. The guy was most happy to learn that nothing serious was wrong with his set, and he paid the service charge without a whimper, even though I had only been in the house about ten minutes."

"Good boy!" Mac applauded. "I especially like the fact that you checked that ion trap. Often when a technician locates a simple trouble, it seems to the customer that he is being charged an awful lot just to be told that his set was not plugged into the wall socket, and so forth. What he can't always understand is that if the technician had not been called away from his bench, he could have made that five dollar service charge and more without stepping outside the shop. In such a case, the service charge is really not for what the technician does at the customer's home; instead, it is to compensate him for the income he lost by being called away from his bench.

"However, an alert technician can invariably make some little adjustment on a set, such as touching up the linearity or centering controls, that will produce an easily-seen improvement in reception. This minor service usually takes only a few seconds to accomplish, and it leaves the customer with the happy feeling that he has received a good return for his money. In this case, he really did, too. If that ion trap had been left out of adjustment, it could easily have ruined the picture tube in a short time."

"Oh yeah," Barney interrupted, "there's one other thing. After the set was turned off, the tube continued to emit flashes of light like heat lightning every few seconds all the time I was there. The man said it would continue to do this at a decreasing frequency rate for as long as two hours after the set had been shut off and even the plug pulled from the wall socket. I promised to ask you about it."

"That's a timely one!" Mac exclaimed with a chuckle. "Just last week I wrote a letter to the engineering department of a large kinescope manufacturing concern and asked about the same thing, for I had noticed it happening on a set we had in here for service. The engineers wrote back that quite often a tube will have what they call 'cold emission' and continue to emit electrons sporadically for some time after all heat has left the cathode. The filter condensers on the high voltage circuit retain a charge for a long time and maintain a potential on the tube electrodes after the power has been cut off. This potential directs the bursts of electrons to the screen and causes it to flash. The engineers said they did not know how to prevent it and did not think anyone else did either. However, they left the impression that it was nothing to worry about, outside of the rather spooky feeling it gives you to see a 'dead' set carrying on in that fashion."

"I had to do a little service on my own set last night," Barney said as he placed an a.c.-d.c. set on the bench and started removing a defective filter condenser. "Right in the middle of the wrestling matches, the whole screen went dark except for a streak right up and down the middle of the screen about a quarter of an inch wide. I was feeling mightly low when I saw that, for I figured something must be wrong with the horizontal portion of the deflection yoke. I reasoned that if anything was wrong with any other part of the horizontal deflection circuit, there would be no high voltage, for the set uses a horizontal flyback type of high voltage circuit; and that would mean there would be no illumination of the screen at all.

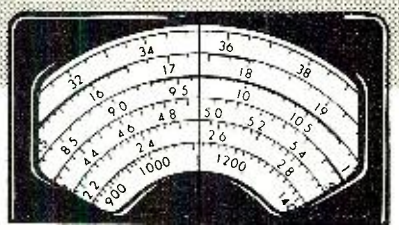
"However, with the same dopey impulse that makes a man who does not know from nothing about automobiles get out and lift the hood and peer beneath it when his car won't start, I pulled the set out from the wall and looked into the back of it. The first thing I saw was a tiny but very bright little spark on top of the 6BQ6G horizontal output tube inside the high-voltage cage. Right away I shut off the set and poked the tip of my solder gun through the louvres of the cage and reheated the solder on that plate cap; then I turned the set back on, and it took right off and played all right all the rest of the evening."

"That *was* a queer one," Mac mused. "Apparently the expansion and contraction of the tube broke the solder connection between the cap and the plate lead, but the separation was so tiny that the current arced across it; and, while this current was too low to sustain any appreciable amount of deflection, it was sufficient to produce enough voltage to illuminate that narrow streak on the screen."

For a little while there was silence in the shop as each of the men became engrossed in his work. Mac was installing a new quadrature coil in a gated-beam TV sound detector, and Barney was installing new filter condensers in the small set. Barney was through first, and after he had cleaned both cabinet and chassis and put the two together, he placed the receiver on the secondary bench and snapped it on for the thirty-minute check that

(*Continued on page* 159)

International SHORT-WAVE



Compiled by **KENNETH R. BOORD**

IT IS a pleasure this month to dedicate the *ISW DEPARTMENT* to *Radio Roma,* Rome, Italy. Through the courtesy of David Dary, Manhattan, Kansas, we present the following interesting data from officials of the *Italian Radio:*

"In September 1946, when it was decided to resume special broadcasts for listeners abroad from *Radio Roma,* many people thought it was an extremely difficult—if not impossible—undertaking. In fact, the only material which had been saved from the destruction of the once-so-outstanding Roman Short Wave Center, 'Prato Smeraldo,' consisted of two senders, miserable remains of a technical plant for which we were envied by the whole world and which was composed of eight powerful transmitters with 50 and 100 kw. aerials and with a dense system of directional and omnidirectional antennas.

"But in 1946, 'Prato Smeraldo' was nothing but a name and a heap of broken walls. Thus was it reduced by war and by pillage during the period of Armistice. And yet, the Italian Broadcasting System was not only appreciated everywhere in the world, but it also had true and faithful friends. With these old friends—scattered over the world—the Italian Broadcasting System had to re-establish former relationships, and the extent of this sole problem may give an idea of all the other difficulties which had to be overcome.

"First of all, the technical means we had at our disposal were not modern or efficient enough to facilitate our purposes. Nevertheless, in spite of all obstacles and impediments, by and by, persevering as we are, we succeeded in making our voice reach the four cardinal points. The beginning was difficult, indeed, but it was a matter of fact that Italy was still alive in her Sons in North and South America, in Africa, in Europe, and in Asia.

"In many directions our signals were almost overcome by the broadcasts of other countries equipped with more powerful technical means. Italy's voice was caught only by those who patiently tried to get it. And, in that first period of time, our musical programs necessarily had to be short, although their artistic value undeniably was superior to any other. As a matter of fact, we practically had to extend our service to the whole world with only two transmitters which were not even particularly powerful, and we also had to take into consideration which were the best hours for most listeners.

"Meanwhile, the Roman Short Wave Center was rebuilt. Now it is entirely completed through the help of the Italian Broadcasting System, and it has started its programs, taking the place of the old plants of 'Busto Arsizio.' Buildings for machinery and staff have been finished. The directional and omnidirectional aerials, with their supporting pillars, are working now. Already, five modern short-wave transmitting plants with 50 to 100 kw. aerials are functioning. We are—and may be justly—proud of the fact that new life was given to the Roman Short Wave Center through such Italian firms as Messrs. Marelli and Messrs. Marconi, and through Italian technicians and workers who equipped it with the most modern and, from the technical point of view, with the most perfect new transmitters.

"Unfortunately, since no international agreement has been reached for the use of frequencies in short-wave broadcasting, our position is a rather difficult one, especially because Italy is among the 'lastcomers' who do not have free or exclusive channels in the potent short-wave bands. But our technicians, no doubt, will overcome these temporary difficulties. They will avail themselves of any scientific progress in this field to make our voice—just as in the past—reach any part of the world with an always more perfect clearness.

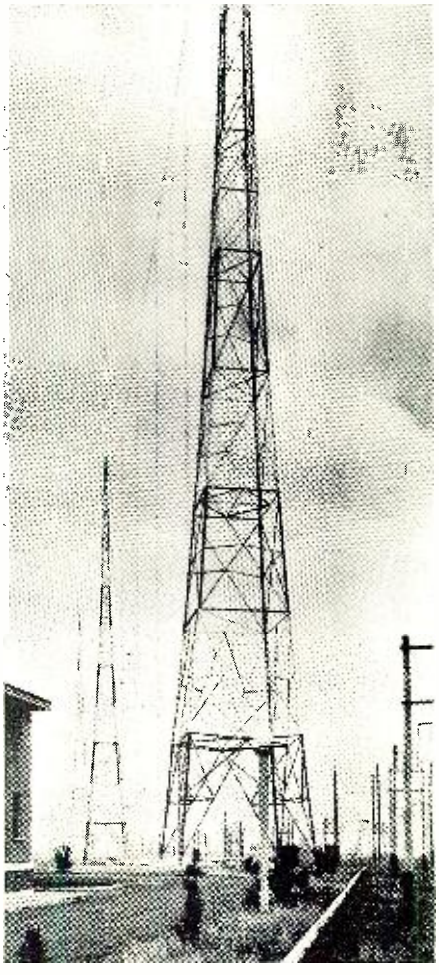
"The numerous letters and reports from our listeners abroad furnish the best proof of the results which have been achieved to date. These letters and reports are the expression of the most 'affectionate' feelings and they show with what interest our transmissions are followed. Of course, there also are listeners who complain that they can not hear us every day. We realize this regrettable position and we are very sorry for it. But for the time being, we cannot but assure them that we shall undertake every effort to avoid this inconvenience. In fact, it is our aim to assure the best possible reception anywhere as well as to always radiate 'top-class' programs. Day by day, we do our best to give to our news bulletins, to our musical programs, to our talks, and so on, that cheerful and attractive charm that may bring us the greatest number of 'affectionate' listeners.

"To prepare the best possible programs, we have engaged specialized collaborators who make up the texts of the bulletins and who translate and read them in foreign languages. Each day, 59 programs in 29 languages are radiated. Each of these programs consists of a news bulletin, a musical portion, and features.

"Thus, our sole aim is to make

(*Continued on page* 142)

This is the short-wave antenna installation of Radio Roma, Rome, Italy which employs both directional and omnidirectional antennas for its short-wave broadcasts.



(Note: Unless otherwise indicated, all time is expressed in American EST: add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.)

The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

Practical SOUND ENGINEERING

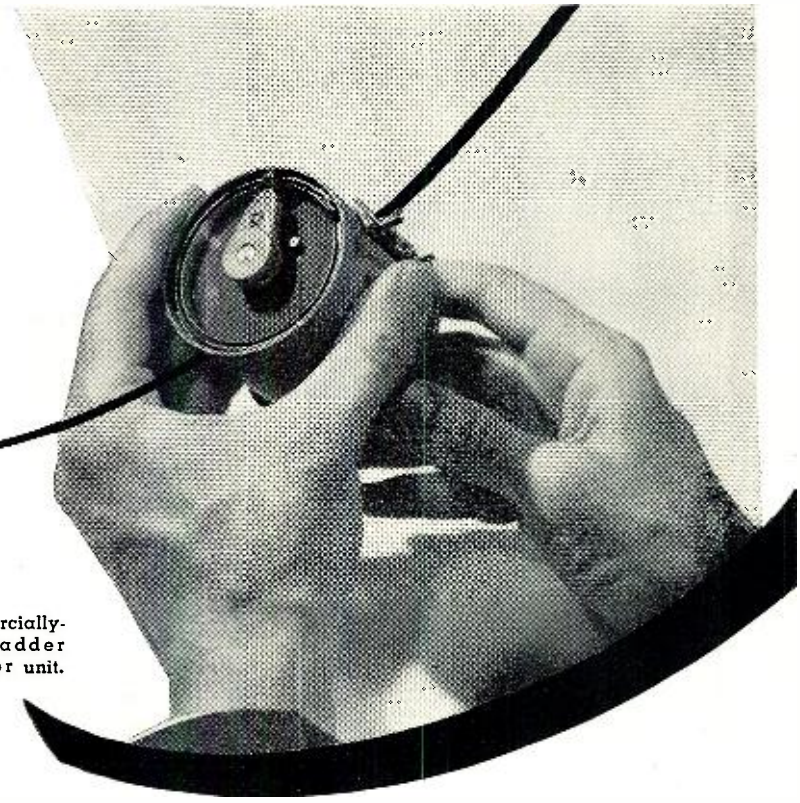


Fig. 1. A commercially-built, modern ladder type attenuator unit.

By H. M. TREMAINE, D.Sc.
Audio Consultant

Part 8. A discussion of sound mixers as used in present-day recording and reproducing systems.

SOUND mixers used in sound recording and reproducing systems are, as a rule, resistive combining networks designed to provide a means for combining several separate sources of sound signals or program material into one composite signal. Provision is also made whereby the levels of each input may be controlled individually without affecting the settings of other controls in the network. The network also provides an impedance match and isolation for each individual control.

A "master gain" control is generally included to allow the "fading" in and out of the several inputs simultaneously. The master control may be a part of the mixer network or it may be placed somewhere in the output circuit, controlling the over-all gain of the system. Mixer combining networks are constructed of non-inductive resistors similar to those employed in attenuators. Such networks must not affect the frequency response of the incoming program material. Therefore, the mixer network must have a uniform frequency characteristic over its entire operating range.

The mixer controls are generally placed in a cabinet or console which also houses a vu meter, master gain control, equalizers, talk-back system, and any other equipment essential to the mixing operations. In some instances, the console may house the microphone preamplifiers, equalizers, filters, line amplifier and "patch bay" (jack strips) for convenience of operation.

The network may be designed for either parallel or series connection of the loss pots. The circuit may be balanced or unbalanced with respect to the ground. The input impedance is generally one of the standard values, such as 150, 250, or 600 ohms. Standard output impedances are 250, 500, and 600 ohms.

Two losses are encountered in a mixer resistive network, a *fixed* loss caused by the mixer "building out" resistors, and a *variable* loss which is caused by the loss setting of the mixer pot. The first loss is fixed by the network design and is called the mixer "insertion loss"; the second loss will vary with the mixer pot setting and depends upon the levels required to properly mix the program material.

Two types of mixing are in use—"high level" and "low level." The first is the most commonly used, and requires a preamplifier before the signal is fed into the mixer console. In the second system, the signal is sent directly into the mixer pot without amplification. This latter method is practically *obsolete*, and is not used in professional systems.

The benefits derived from the use of high-level mixing are two-fold: (1) the signal-to-noise ratio is increased, and (2) the effect of mixer pot contact noise is greatly reduced. Also, amplifying the program material before mixing allows a greater latitude in the control of the signal levels.

Mixer pots should be selected with care, with particular attention to contact noise and wear. The average variable attenuator has a noise level of approximately minus 120 dbm, which is ample for all purposes. The electrical configuration may be a bridged, plain T, or ladder type.

Basically, an attenuator, or pad, is a resistive "network" consisting entirely of resistance elements, so designed that, when it is inserted in a circuit, a given amount of attenuation or control of the signal level may be obtained without the introduction of any frequency or phase modification. When attenuators are properly designed and terminated, it is possible to control the reduction in level, in the order of several thousand to one, without disturbing the impedance match or the frequency response of the circuit into which they have been inserted.

It will be noted throughout this discussion that the terms "impedance" and "resistance" are employed interchangeably, since attenuators are constructed of non-inductive resistors which offer no appreciable impedance and only d.c. resistance. Thus, the d.c. resistance is equal to the impedance.

Attenuators may be either fixed or variable. Both types are constructed of "non-inductive" wirewound or carbon resistors. If the pad is to be of the variable type, such as those used in mixer consoles, it is generally constructed on a frame having a series of contacts and one or more slider arms to control the amount of resistance in the circuit. The resistors are soldered directly to the inner ends of the contacts within the frame. The interior of the frame is then filled with a compound as a protection against moisture.

The variable type attenuator is usually constructed so as to have a total loss of 40 to 50 db in steps of not more than 1.5 db. When the slider engages two contacts, the loss is one-half or 0.75 db. Changes in level of this magnitude cannot be detected by the human ear, therefore the reduction in level appears gradual and smooth.

However, the last few steps near maximum attenuation are somewhat greater than 1.5 db to facilitate fast "fades" and "cut-off." A typical variable bridged-T attenuator is illustrated in Fig. 2, its electrical configuration in Fig. 3.

A bridged-T variable attenuator consists of two fixed resistors, R_1, and two variable resistors, R_2 and R_3. See Fig. 3. The fixed resistors, R_1, are equal to the line impedance while the variable arms are varied inversely in fixed steps. In a "T" type attenuator the contact noise remains constant, therefore the signal-to-noise ratio varies with the loss setting of the pot. The advantages in this pot are that its impedance remains constant at any point in its range and that it has no "minimum insertion" loss at its zero position.

In Fig. 1 is shown a "ladder" type attenuator which is also continuously variable and is similar in its construction to a slide-wire potentiometer. Its electrical configuration is given in Fig. 4.

Although ladder pots have not been looked upon with favor in the past because of their design, with modern improvements they are to be preferred over the plain or bridged-T types. In the ladder pot the contact noise is attenuated with the signal; therefore it has a lower noise level. Although the input and output impedance varies somewhat for a single pot, when connected into a mixer network containing several inputs, the impedance variation may be ignored.

Looking into the input of a ladder pot, the impedance remains constant up to about 45 db of loss; after that it drops to about one-half. However, as this is beyond a useful point, it makes little difference. The impedance variation will be reduced in proportion to the number of input positions in the network.

The output impedance of a ladder pot remains constant over its entire operating range down to about 5 db of loss. After that, the impedance increases about 20 per-cent. The advantages of the ladder pot are; lower initial cost, one slider arm, one row of contacts, and a good signal-to-noise ratio. Because of its configuration, the ladder pot has a 6 db minimum insertion loss at its zero position. For recording purposes, the slide-wire design is far superior to the contact type because it allows a continuously variable change in loss, in fractions of a db.

Fig. 5 shows the circuit of a simple four-position mixer network, employing an unbalanced parallel circuit grounded on one side. It will be observed that resistors R_{B1} to R_{B4} are placed in series with the output of each individual attenuator. Also, a resistor, R_{B5}, is connected in series with the output circuit. These resistors are called "building-out" resistors. Their purpose is two-fold: First, they are of such value that they maintain the correct impedance match between the various attenuators. Second, they isolate the action of the pots from each other, thus preventing *interaction* between circuits.

Although the circuit in Fig. 5 is shown using bridged-T attenuators, ladder pots or plain-T pots may be substituted if desired. If ladder pots are used, the *fixed* insertion loss of the mixer will be increased 6 db or the equivalent insertion loss of *one* ladder pot. It will be further noted that both the input and output impedance, Z_1, is the same for this particular circuit. If an output impedance different from that of the input is desired, an impedance-matching transformer may be used at the output, as shown.

As previously stated, this circuit is *unbalanced* and *grounded* on one side, therefore circuits *balanced* to ground *can not* be directly connected to the input unless an "isolation" or "repeat coil" is interposed between the incoming line and the input of the attenuator pot.

Mixer circuit diagrams are generally drawn with ground connections at various points in the circuit but in actual practice separate *insulated* ground wires are run from the several ground points to a central ground terminal, as indicated in Fig. 5. Grounding the circuit in this manner reduces the possibility of accidentally grounding the circuit at some other point, thus creating a "ground loop" which may pick up hum and noise from surrounding equipment.

Mixer consoles are generally made of steel since this not only provides protection for the mixer components but also provides a certain amount of "magnetic shielding."

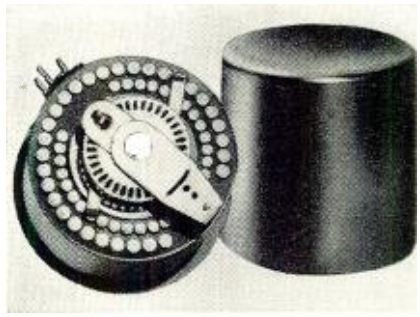


Fig. 2. Rear view of a bridged-T attenuator.

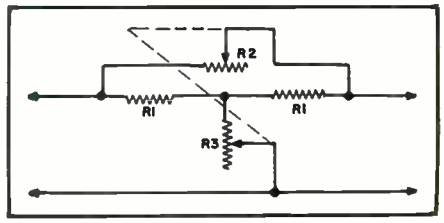


Fig. 3. Wiring diagram of bridged-T attenuator. In the more expensive commercial units, R_2 and R_3 are multiple tapped resistors, as shown in the photo of Fig. 2.

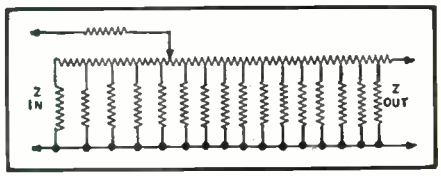
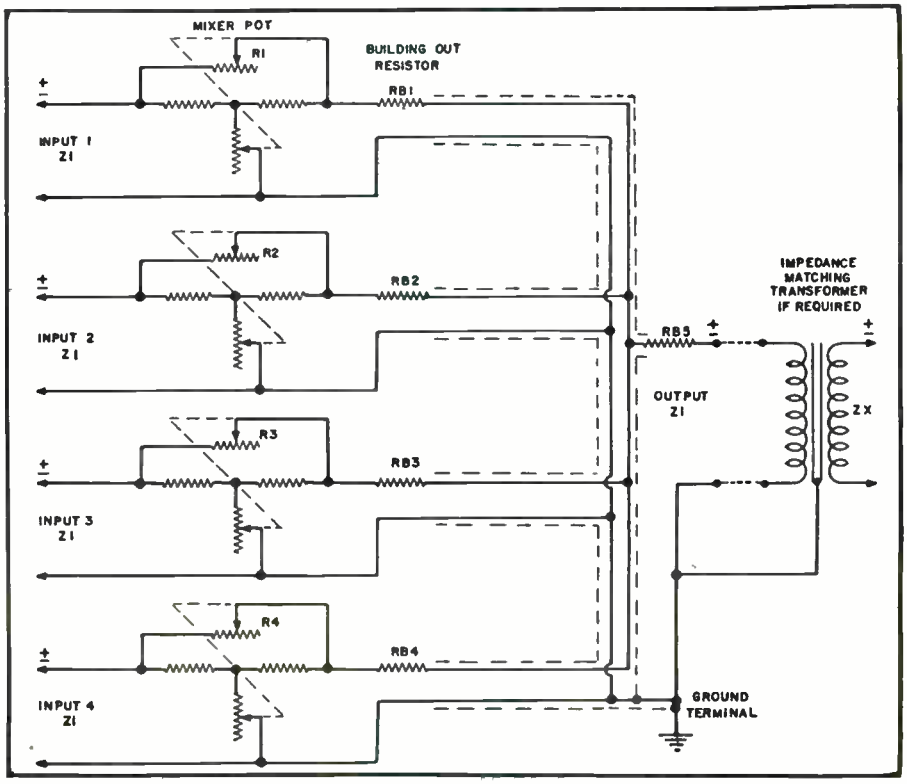


Fig. 4. Wiring diagram of the ladder type attenuator illustrated in the photo, Fig. 1.

The shields of the interconnecting wires must also be connected to ground at *one point*, if ground loops are to be avoided. The wire used for

Fig. 5. Circuit diagram of a simple, four-position mixer network which employs an unbalanced parallel circuit grounded at a single point.



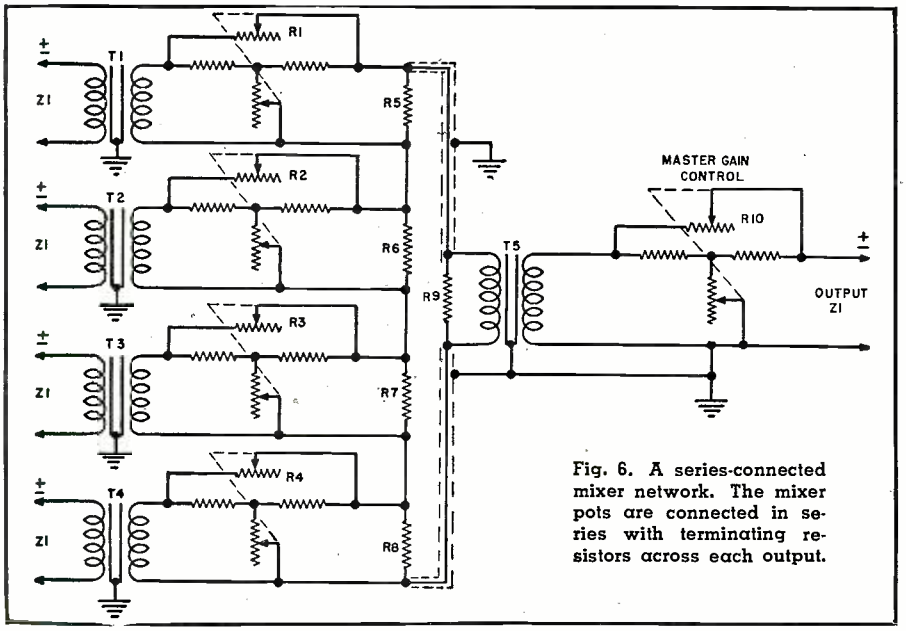


Fig. 6. A series-connected mixer network. The mixer pots are connected in series with terminating resistors across each output.

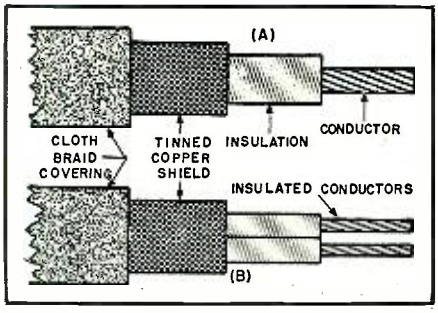


Fig. 7. Two types of suitable mixer cable.

this purpose consists of a twisted pair (tinned copper, enameled) covered with a flexible copper shield. A *cloth braid* over the outside of the shield insulates it from other pairs, and thus avoids the creation of ground loops.

Mixers may also be wired using unbraided, shielded pairs. In this type construction, the shields of all similar level pairs are tied together by soldering every few inches. This method is often employed in mixers designed to operate near radio transmitters where strong r.f. fields may be present. For sound installations the braided-type pair is more desirable, as the ground may be "lifted" at a particular piece of equipment or rack, and circuit difficulties traced. Illustrations of wire suitable for mixers are shown in Fig. 7.

Fig. 8. Wiring diagram of a split-mixer used to control two or more channels.

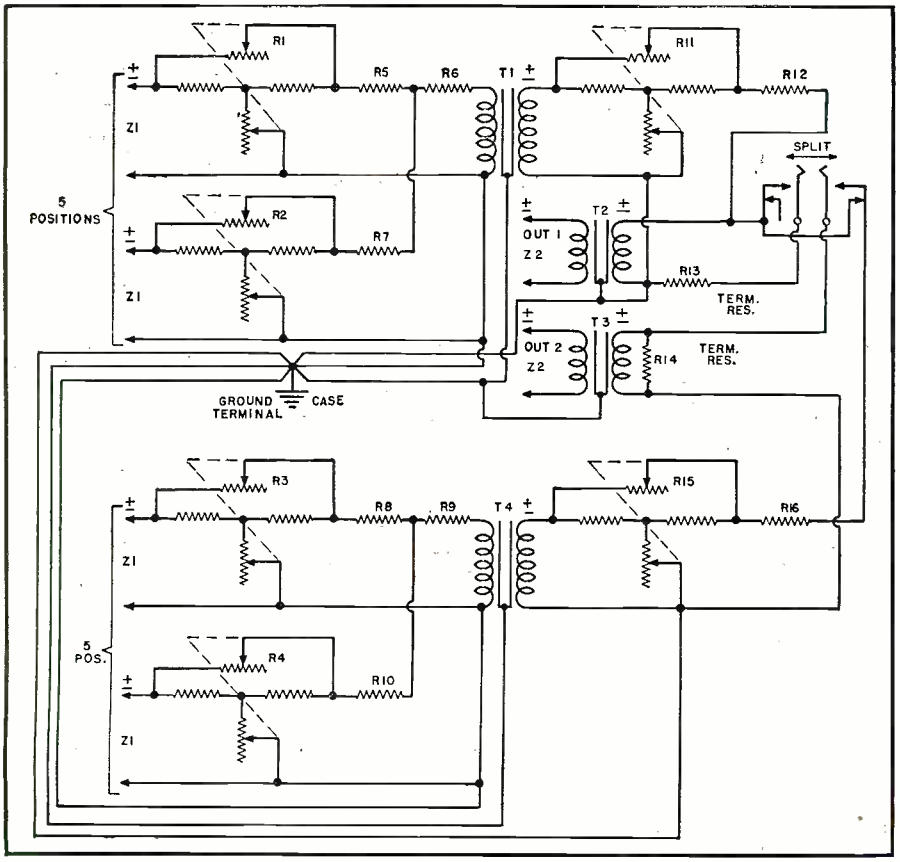


Fig. 8. Wiring diagram of a split-mixer used to control two or more channels.

Fig. 6 illustrates a "series-connected" mixer network. It will be observed the mixer pots are connected in series, with terminating resistors R_5, R_6, R_7, and R_8 connected across the output of each attenuator. The combined output is taken at the first and fourth controls and connected to the primary of an output transformer, T_5.

The principal objection to this circuit is that the pots cannot be grounded and are "floating" which may induce serious leakage at the high frequencies. Also the incoming lines or devices must be *isolated* from any physical connection to the mixer pots by a repeat coil. This circuit is *not* recommended for professional use.

A "split-mixer" is one that may be separated electrically into two or more sections for the purpose of controlling two or more recording channels from one mixer console. This method is often used when recording an orchestra and choir simultaneously. The circuit of a mixer network designed for this purpose is shown in Fig. 8. Although the circuit shows only four pots, any number of positions may be added, provided the proper value of building-out resistors are used and the correct impedance match is maintained between the various circuits.

When the key switch is in its normal position as shown, mixer pots R_1 and R_2 are in parallel with the lower group R_3 and R_4, through the transformers T_1 and T_4. Master gain controls are shown at R_{11} and R_{15}. With the key switch in this position the output signal appears at the secondary of transformer T_2.

When this circuit is used as a split-mixer, the upper group of attenuators is connected to transformer T_2 and T_3, thus providing two separate outputs. Two master controls, R_{11} and R_{15}, afford separate control of the levels from each section whether the mixer is split or not. When the key switch is in the split position, a terminating resistor, R_{13}, is connected across the primary of transformer T_2.

The value of the "building-out" resistors, R_{B1} to R_{B5}, Fig. 5 and R_5 to R_{10}, R_{12} and R_{16}, Fig. 8) may be computed by use of the equation:

$$R_B = \frac{N-1}{N+1} \times Z_1$$

where N equals the number of mixer positions and Z_1 the input impedance.

Thus, for a six-position mixer of 600-ohms impedance,

$$R_B = \frac{6-1}{6+1} \times 600 = 428.4 \text{ ohms}$$

As stated earlier, a fixed insertion loss is created by the building-out resistors R_B in the network. This loss may be calculated as follows:

$$db \text{ insertion loss} = 20 \log N$$

(*Continued on page* 114)

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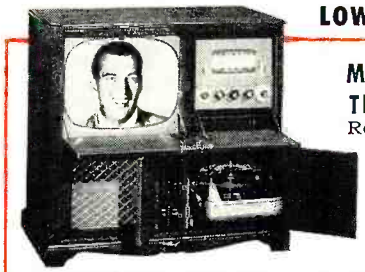

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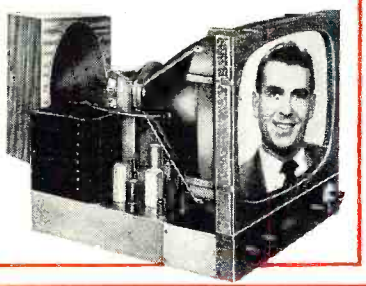

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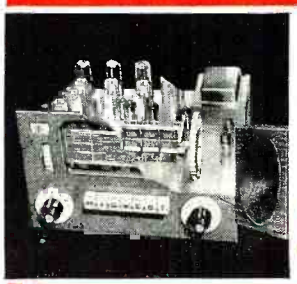

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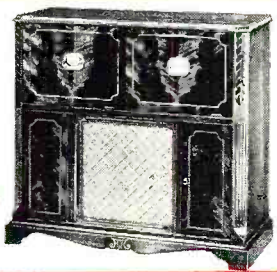

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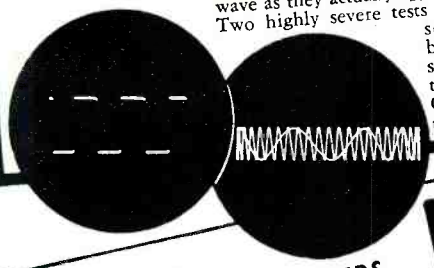

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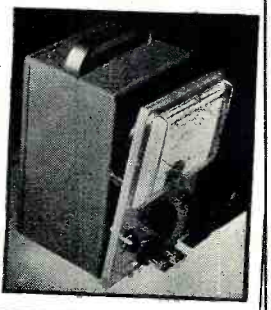
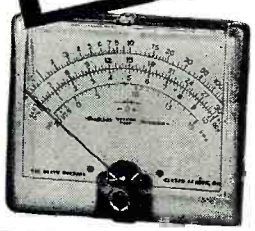
NEW STYLE AND BEAUTY

Style that's modern, yet functional — that's the trend of today — and Heathkits are right up to the minute. Note the cut showing the new V-5 and AV-1 cabinet and panel construction. The front panel and rear cover slide right over the recessed flange of the case thereby eliminating sharp edges and pointed corners. The voltmeter kits aren't "shelf" or "mounted" instruments — they're moved about on the bench a lot and thus the new compact size and specially designed cabiners — Another 1952 Heathkit feature.



A STATEMENT FROM SIMPSON ELECTRIC CO.



In choosing Simpson Meters for their Heathkit VTVM, the Heath Co. has set a new high standard of kit meter quality. The same high quality of material, workmanship and design that has given Simpson the reputation for building "Instruments That Stay Accurate" is found in the Heathkit Meter Movement.

SIGNED
SIMPSON ELECTRIC CO.

A STATEMENT FROM CHICAGO TRANSFORMER

It is indeed gratifying to note the outstanding sales records you are building with you Heathkits.

This sales success is readily understandable, since we are cognizant of the high quality standards you have established for your component suppliers.

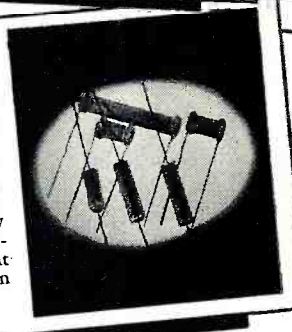
We at Chicago Transformer are proud that our product has contributed to the recognized quality and increasing popularity of Heathkits.

CHICAGO TRANSFORMER DIVISION
Essex Wire Corporation

L. S. RACINE
Vice-President and Sales Manager

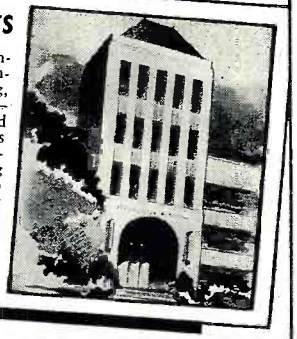
HEATHKIT PRECISION RESISTORS

Where exact resistance values are required for instrument accuracy, the Heath Co. has spared no effort in supplying the finest resistors available. Precision resistors as manufactured by Continental Carbon Inc., and Wilcor Corp., meet the rigorous JAN (Joint Army-Navy) specifications and are small in size, extremely non-inductive, highly stable, have a low temperature coefficient, and can be held to great accuracy. You'll find quality components in Heathkits.



COLLEGES USE HEATHKITS

Colleges and Universities throughout the country are using Heathkits in their electrical engineering, radio, and physics laboratories — Heathkits are the answer to good test equipment at low cost, plus being rugged, dependable, and accurate. Trade schools are having their students build Heathkits to obtain a first hand working knowledge of test equipment and to get the practical experience gained by construction. Heathkits fill school needs.



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The HEATH COMPANY
. . . BENTON HARBOR 15, MICHIGAN

New LABORATORY LINE HEATHKITS

NEW Heathkit A.C. VACUUM TUBE VOLTMETER KIT

Now — as a Heathkit — at a price anyone can afford, an AC VTVM.
A new kit to make possible those sensitive AC measurements required by audio enthusiasts, laboratories, and experimentors. Here is the kit that the audio men have been looking for. Its tremendous range of coverage makes possible measurements of audio amplifier frequency response — gain or loss of audio stages — characteristics of audio filters and attenuators — hum investigation — and literally a multitude of others. Ten ranges consisting of full scale .01, .03, .1, .3, 1, 3, 10, 30, 100, 300 volts RMS assure easy and more accurate readings. Ten ranges on DB provide for measurements from −52 to +52 DB. Frequency response within 1 DB from 20 cycles to 50 KC.

The ingenious circuitry incorporates precision multiplier resistors for accuracy, two amplifier stages using miniature tubes, a unique bridge rectifier meter circuit, quality Simpson meter with 200 microampere movement, and a clean layout of parts for easy wiring. A high degree of inverse feedback provides for stability and linearity.

Simple operation is accomplished by the use of only one control, a range switch which changes the voltage ranges in multiples of 1 and 3, and DB ranges in steps of 10.

The instrument is extremely compact, cabinet size — 4⅛" deep x 4-11/16" wide x 7⅜" high, and the newly designed cabinet makes this the companion piece to the VTVM. For audio work, this kit is a natural.

MODEL AV-1
Shipping weight 5 lbs.

$29.50

NEW Heathkit AUDIO FREQUENCY METER KIT

MODEL AF-1
Shipping weight 12 lbs.

$34.50

A NEW Heathkit Audio Frequency Meter — the ideal instrument for determining frequencies from 20 cycles to 100 KC. Set the selector switch to the proper range — feed the signal into the input terminals — and read the frequency from the meter — completely simple to operate, and yet dependable results.

Quality Simpson 200 microampere meter has two plainly marked scales (0-100 0-300. These scales, read in conjunction with the seven position selector switch, give full scale readings of 100, 300, 1000, 3000, 10,000, 30,000, and 100,000 cycles. Convenient ranges for fast and easy readings.

For greatest accuracy, the 1-3-10 ratio of ranges is maintained and each range has individual calibrating control.

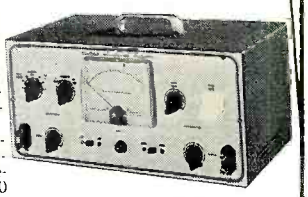
Input impedance is high (1 megohm) for negligible circuit loading. A signal voltage anywhere between 2 and 300V can be fed directly into the instrument and a change in signal voltage between these limits will not affect the meter reading. In addition, input wave shape is not critical (the unit will read the frequency of either sine wave or square wave input).

The tube complement consists of a 6SJ7 amplifier and clipper, 6V6 amplifier and clipper, 6H6 meter pulse rectifier, 6X5 power supply rectifier, and OD3/VR150 voltage regulator.

Construction is simple, and quality components are used throughout.

NEW Heathkit INTERMODULATION ANALYZER KIT

Intermodulation testing of audio equipment is rapidly being accepted by more and more engineers and audio experts as the best way to determine the characteristics of audio amplifiers, recording systems, networks, etc. — shows up those undesirable characteristics which contribute to listening fatigue when all other methods fail.



MODEL IM-1
Shipping wt. 18 lbs.

$39.50

The Heathkit Intermodulation Analyzer supplies a choice of two high frequencies (3000 cycles and a higher frequency) and one low frequency (60 cycles). Both 1:1 or 4:1 ratios of low to high frequencies can be set up for IM testing, and the ratios are easily set by means of a panel control and the instrument's own VTVM. An output level control supplies the mixed signal at the desired level with an output impedance of two thousand ohms. The Analyzer section has input level control and proper filter circuits feeding the instrument's VTVM to read intermodulation directly on full scale ranges of 30%, 10% and 3%. Built-in power supply furnishes all necessary voltages for operating the instrument.

You won't want to be without this new and efficient means of testing

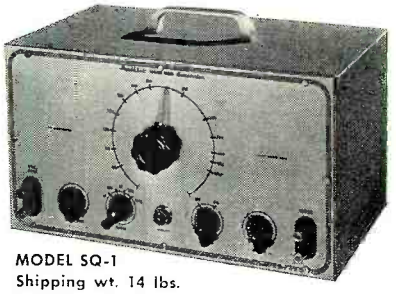
NEW Heathkit SQUARE WAVE GENERATOR KIT

The new Heathkit Square Wave Generator Kit with its 100 KC square wave opens an entirely new field of audio testing. Square wave testing over this wide range will quickly show high and low frequency response characteristics of circuits — permit easy adjustment of high frequency compensating networks used in vidio amplifiers — identify ringing in circuits — demonstrate transformer characteristics, etc.

The circuitry consists of a multivibrator stage, a clipping and squaring stage, and a cathode follower output stage. The power supply is transformer operated and utilizes a full wave rectifier tube with 2 sections of LC filtering.

As a multivibrator cannot be accurately calibrated, a provision is provided to allow the instrument to be accurately synchronized with an accurate external source when extreme accuracy is required.

The low impedance output is continuously variable between 0 and 25 volts and operation is simple. You'll really appreciate the wide range of this instrument, 10 cycles to 100 kilocycles — continuously variable. Kit is complete with all parts and instruction manual, and is easy to build.



MODEL SQ-1
Shipping wt. 14 lbs.

$29.50

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THE *New* 1952

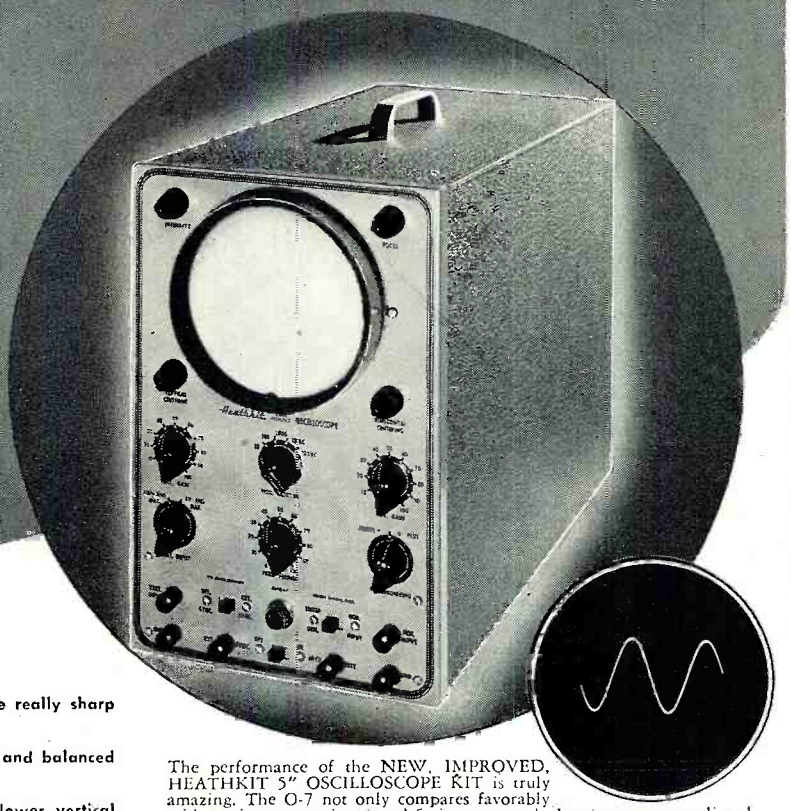
Heathkit

OSCILLOSCOPE KIT

MODEL O-7

SHIPPING WEIGHT 24 LBS.

$43.50



Features

- New "spot shape" control for spot adjustment — to give really sharp focusing.
- A total of ten tubes including CR tube and five miniatures.
- Cascaded vertical amplifiers followed by phase splitter and balanced push-pull deflection amplifiers.
- Greatly reduced retrace time.
- Step attenuated — frequency compensated — cathode follower vertical input.
- Low impedance vertical gain control for minimum distortion.
- New mounting of phase splitter and deflection amplifier tubes near CR tube base.
- Greatly simplified wiring layout.
- Increased frequency response — useful to 5 Mc.
- Tremendous sensitivity .03V RMS per inch Vertical — .6V RMS per inch Horizontal.
- Dual control in vernier sweep frequency circuit — smoother acting.
- Positive or negative peak internal synchronization.

The performance of the NEW, IMPROVED, HEATHKIT 5" OSCILLOSCOPE KIT is truly amazing. The O-7 not only compares favorably with equipment costing 4 and 5 times as much, but in many cases literally surpasses the really expensive equipment. The new, and carefully engineered circuit incorporates the best in electronic design — and a multitude of excellent features all contribute to the outstanding performance of the new scope.

The VERTICAL CHANNEL has a step attenuated, frequency compensated vertical input which feeds a cathode follower stage — this accomplishes improved frequency response, presents a high impedance input, and places the vertical gain control in a low impedance circuit for minimum distortion. Following the cathode follower stage is a twin triode — cascaded amplifiers to contribute to the scope's extremely high sensitivity. Next comes a phase splitter stage which properly drives the push-pull, hi-gain, deflection amplifiers (whose plates are directly coupled to the vertical deflection plates). This fine tube lineup and circuitry give a sensitivity of .03V per inch RMS vertical and useful frequency response to 5 Mc.

The HORIZONTAL CHANNEL consists of a triode phase splitter with a dual potentiometer (horizontal gain control) in its plate and cathode circuits for smooth, proper driving of the push-pull horizontal deflection amplifiers. As in the vertical channel, horizontal deflection amplifier plates are direct coupled to the CR tube horizontal deflection plates (for improved frequency response).

The WIDE-RANGE SWEEP GENERATOR circuit incorporates a twin triode multivibrator stage for producing a good saw-tooth sweep frequency (with faster retrace time). Has both coarse and vernier sweep frequency controls.

And the scope has internal synchronization which operates on either positive or negative peaks of the input signal — both high and low voltage rectifiers — Z axis modulation (intensity modulation) — new spot shape (astigmatism) control for spot adjustment — provisions for external synchronization — vertical centering and horizontal centering controls, wide range focus control — and an intensity control for giving plenty of trace brilliance.

The Model O-7 EVEN HAS GREAT NEW MECHANICAL FEATURES — A special extra-wide CR tube mounting bracket is provided so that the vertical cascade amplifier, vertical phase splitter, vertical deflection amplifier, and horizontal deflection amplifier can mount near the base of the CR tube. This permits close connection between the above stages and to the deflection plates; distributed wiring capacity is greatly reduced, thereby affording increased high frequency response.

The power transformer is specially designed so as to keep its electrostatic and electromagnetic fields to a minimum — also has an internal shield with external ground lead.

You'll like the complete instructions showing all details for easily building the kit — includes pictorials, step-by-step construction procedure, numerous sketches, schematic, circuit description. All necessary components included — transformer, cabinet, all tubes (including CR tube), completely punched and formed chassis—nothing else to buy.

NEW INEXPENSIVE *Heathkit*

ELECTRONIC SWITCH KIT

Model S-2
Shipping Wt. 11 lbs.

Only

$19.50

The companion piece to a scope — Feed two different signals into the switch, connect its output to a scope, and you can observe both signals — each as an individual trace. Gain of each input is easily set (gain A and gain B controls), the switching frequency is simple to adjust (coarse and fine frequency controls) and the traces can be superimposed for comparison or separated for individual study (position control).

Use the switch to see distortion, phase shift, clipping due to improper bias, both the input and output traces of an amplifier — as a square wave generator over limited range.

The kit is complete; all tubes, switches, cabinet, power transformer and all other parts, plus a clear detailed construction manual.

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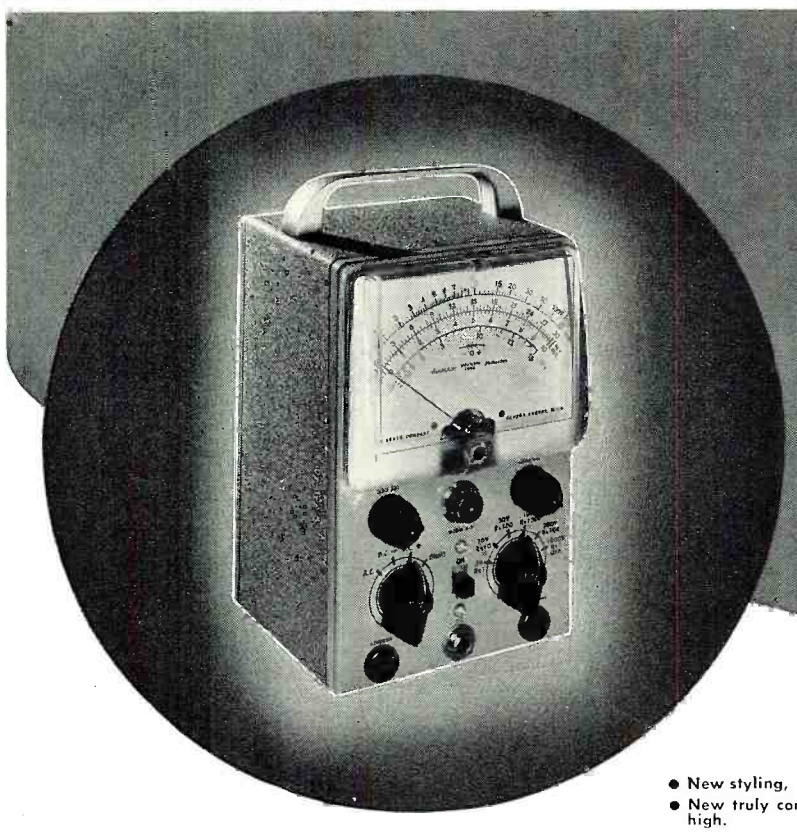


THE *New* 1952 *Heathkit* VTVM KIT

MODEL V-5
SHIPPING WT. 5 LBS.

$24.50

Features

- New styling, — formed case for beauty.
- New truly compact size. Cabinet 4⅛" deep by 4-11/16" wide by 7⅜" high.
- Quality 200 microamp meter.
- New ohms battery holding clamp and spring clip — assurance of good electrical contact.
- Highest quality precision resistors in multiplier circuit.
- Calibrates on both AC and DC for maximum accuracy.
- Terrific coverage — reads from ½V to 1000V AC, ½V to 1000V DC, and .1 to over 1 billion ohms resistance.
- Large, clearly marked meter scales indicate ohms, AC Volts, DC Volts, and DB — has zero set mark for FM alignment.
- New styling presents attractive and professional appearance.

A real beauty — you'll have only highest praise for this NEW MODEL VACUUM TUBE VOLTMETER. Truly a beautiful little instrument — and it's more compact than any of our previous models. Note the new rounded edges on the front panel and rear cover. The size is greatly reduced to occupy a minimum of space on your workbench — yet the meter remains the same large size with plainly marked scales.

A set of specially designed control mounting brackets permit calibration to be performed with greatest ease — also makes for ease in wiring. New battery mounting clamp holds ohms battery tightly into place, and base spring clip insures a good connection to the ohms string of resistors.

The circuitry employs two vacuum tubes — A duo diode operating when AC voltage measurements are taken, and a twin triode in the circuit at all times. The cathode balancing circuit of the twin triode assures sensitive measurements, and yet offers complete protection to the meter movement. Makes the meter burn-out proof in a properly constructed instrument.

Quality components are used throughout —1% precision resistors in the multiplier circuit—conservatively rated power transformer— Simpson meter movement — excellent positive detent, smooth acting switches — sturdy cabinet, etc.

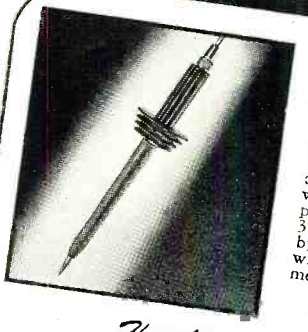
And you can make a tremendous range of measurements — ½V to 1000V AC, ½V to 1000V DC, .1 to over 1 billion ohms, and DB. Has mid-scale zero level marking for quick FM alignment. DB scale in red for easy identification — all other scales a sharp, crisp black for for easy reading.

A four position selector switch allows operator to rapidly set the instrument for type or reading desired—positions include ACV, DC+V, DC—V, and Ohms. DC— position allows negative voltage to be rapidly taken. Zero adjust and ohms adjust controls are conveniently located on front panel.

Enjoy the numerous advantages of using a VTVM. Its high input impedance doesn't "load" circuits under test — therefore, assures more accurate and dependable readings in high impedance circuits such as resistance coupled amplifiers, AVC circuits, etc. Note the 30,000 VDC probe kit and the RF probe kit — available at low extra cost and specially designed for use with this instrument. With these two probes, you can make DC voltage measurements up to 30,000V, or make RF measurements — added usefulness to an already highly useful instrument.

The instruction manual is absolutely complete — contains a host of figures, pictorials, schematic, detailed step-by-step instructions, and circuit description. These clear, detailed instructions make assembly a cinch.

And every part is included — meter, all controls, pilot light, switches, test leads, cabinet, instruction manual, etc.



Heathkit 30,000V DC
PROBE KIT

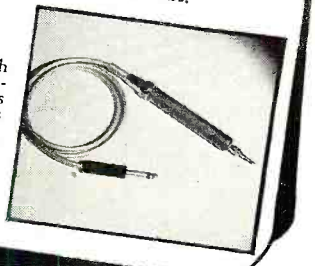
A new 30,000 V DC Probe Kit to handle high voltages with safety. For TV service work and all other high voltage applications. Sleek looking — Two color molded plastic — Red body and guard — jet black handle. Comes with connector, cable, and PL55 type plug. Plugs into Heathkit VTVM so that 300V scale is conveniently multiplied by 100. Can be used with any standard 11 megohm VTVM. **$5.50**

No. 336 High Voltage Probe Kit
Shipping Wt. 2 lbs.

Heathkit
RF PROBE KIT

This RF Probe Kit comes complete with probe housing, crystal diode detector, connector, lead and plug and all other parts plus clear assembly instructions. Extends range of Heathkit VTVM to 250 Mc. ± 10%. Works on any 11 megohm input VTVM. Specify No. 309 RF Probe Kit. **$5.50**

Ship. Wt. 1 lb.



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Heathkit SIGNAL GENERATOR KIT

Model SG-6
Shipping Wt. 7 lbs.

$19.50

The new Heathkit Signal Generator Kit has dozens of improvements. Covers the extended range of 160 Kc to 50 megacycles on fundamentals and up to 150 megacycles on useful calibrated harmonics; makes this Heathkit ideal as a marker oscillator for TV. Output level can be conveniently set by means of both step attenuator and continuously variable output controls. Instrument has new miniature HF tubes to easily handle the high frequencies covered.

Uses 6C4 master oscillator and 6C4 sine wave audio oscillator. The kit is transformer operated and a husky selenium rectifier is used in the power supply. All 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. 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.

Heathkit CONDENSER CHECKER KIT

Only

$19.50

Model C-2
Shipping Wt. 6 lbs.

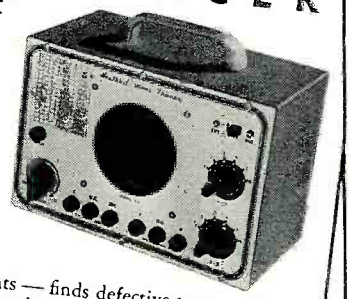
Checks all types of condensers — paper — mica — ceramic — electrolytic. All condenser scales are direct reading and require no charts or multipliers. Covers range of .00001 MFD to 1000 MFD. A Condenser Checker that anyone can read. A leakage test and polarizing voltage for 20 to 500 V provided. Measures power factor of electrolytics between 0% and 50% and reads resistance from 100 ohms to 5 megohms. The magic eye indicator makes testing easy.

The kit is 110V 60 cycle transformer operated and comes complete with rectifier tube, magic eye tube, cabinet, calibrated panel and all other parts. Has clear detailed instructions for assembly and use.

NEW Heathkit SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

$19.50

Model T-2
Shipping Wt. 7 lbs.



The popular Heathkit Signal Tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker — locates intermittents — finds defective parts quicker — saves valuable service time — gives greater income per service hour. Works equally well on broadcast, FM, or TV receivers. The test speaker has an assortment of switching ranges to match either push-pull or single output impedances. Also tests microphones, pickups and PA systems. Comes complete: cabinet, 110V 60 cycle power transformer, tubes, test probe, all necessary parts, and detailed instructions for assembly and use.

Model TC-1
Shipping Wt. 12 lbs.

$29.50

Heathkit TUBE CHECKER KIT

The Tube Checker is a MUST for radio repair men. Often customers want to SEE tubes checked, and a checker like this builds customer confidence. In your repairing, you will have a multitude of tubes to check — quickly. The Heathkit tube checker will serve all these functions — it's good looking (with a polished birch cabinet and an attractive two color panel) — checks 4, 5, 6, 7 prong Octals, Loctals, 7 prong miniatures, 9 prong miniatures, pilot lights, and the Hytron 5 prong types. AND IT'S FAST TO OPERATE — the gear driven, free-running roll chart lists hundreds of tubes, and the smooth acting, simplified switching arrangement gives really rapid set-ups.

The testing arrangement is designed so that you will be able to test new tubes of the future — without even waiting for factory data — protection against obsolescence.

You can give tubes a thorough testing — checks for opens, shorts, each element individually, emission, and for filament continuity. A large BAD-?-GOOD meter scale is in three colors for easy reading and also has a "line-set" mark.

You'll find this tube checker kit a good investment — and it's only $29.50.

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NEW *Heathkit* T.V.

ALIGNMENT GENERATOR KIT

Model TS-2
Shipping Wt. 20 lbs.

Here is an excellent TV Alignment Generator designed to do TV service work quickly, easily, and properly. The Model TS-2 when used in conjunction with an oscilloscope provides a means of correctly aligning television receivers.

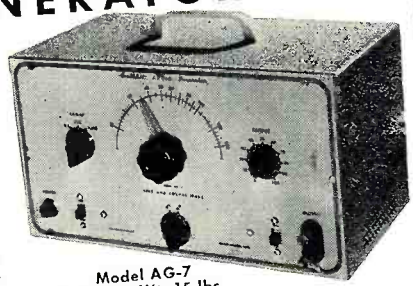
The instrument provides a frequency modulated signal covering, in two bands, the range of 10 to 90 Mc. and 150 to 230 Mc. — thus, ALL ALLOCATED TV CHANNELS AS WELL AS IF FREQUENCIES ARE COVERED.

An absorption type frequency marker covers from 20 to 75 Mc. in two ranges — therefore, you have a simple, convenient means of frequency checking of IF's, independent of oscillator calibration.

Sweep width is controlled from the front panel and covers a sweep deviation of 0-12 Mc. — all the sweep you could possibly need or want.

And still other excellent features are: Horizontal sweep voltage available at the front panel (and controlled with a phasing control) — both step and continuously variable attenuation for setting the output signal to the desired level — a convenient instrument stand-by position — vernier drive of both oscillator and marker tuning condensers — and blanking for establishing a single trace with base reference level. Make your work easier, save time, and repair with confidence — order your Heathkit TV Alignment Generator now!

NEW *Heathkit*
SINE AND SQUARE WAVE
AUDIO GENERATOR KIT



Model AG-7
Shipping Wt. 15 lbs

$34.50

Designed with versatility, usefulness, and dependability in mind, the AG-7 gives you the two most needed wave shapes right at your fingertips — the sine wave and the square wave.

The range switch and plainly calibrated frequency scale give rapid and easy frequency selection, and the output control permits setting the output to any desired level.

A high-low impedance switch sets the instrument for either high or low impedance output — on high to connect a high impedance load, and on low to work into a low impedance transformer with negligible DC resistance.

Coverage is from 20 to 20,000 cycles, and distortion is at a minimum — you can really trust the output wave shape.

Six tubes, quality 4 gang tuning condenser, power transformer, metal cased filter condenser, 1% precision resistors in the frequency determining circuit, and all other parts come with the kit — plus, a complete construction manual — A tremendous kit, and the price is truly low.

THE NEW *Heathkit*
HANDITESTER KIT

$13.50

Model M-1
Shipping Wt. 3 lbs.

A precision portable volt-ohm milliammeter. Uses only high quality parts — All precision 1% resistors, three deck switch for trouble-free mounting of parts, specially designed battery mounting bracket, smooth acting ohm adjust control, beautiful molded bakelite case, 400 micro-amp meter movement, etc.

DC and AC voltage ranges 10-30-300-1000-5000V. Ohms range 0-3000 and 0-300,000. Range Milliamperes 0-10 Ma, 0-100 Ma. Easily assembled from complete instructions and pictorial diagrams.

NEW *Heathkit*
BATTERY ELIMINATOR KIT

A few auto radio repair jobs will pay for the Heathkit Battery Eliminator Kit. 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 7½ Volts at 10 Amps. continuous or 15 Amps. intermittent.

Also serves as storage battery charger. A well filtered, rugged power supply uses heavy duty selenium rectifier, a husky choke, and a 4000 MFD electrolytic condenser for clean DC. 0 - 15V voltmeter indicates output which is variable in eight steps. Better be equipped for all types of service — it means more income.

$22.50

Model BE-2
Shipping Wt. 19 lbs.

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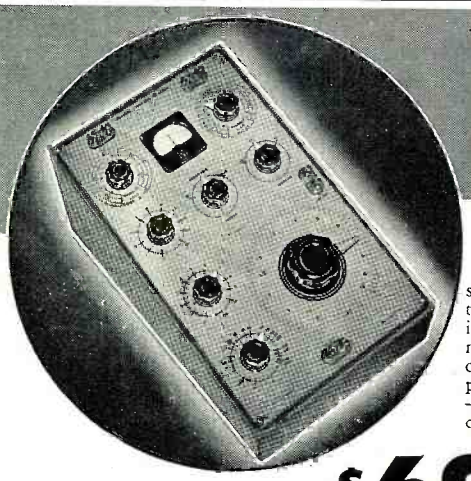
Heathkit IMPEDANCE BRIDGE KIT



Model 1B-1B
Shipping Wt. 15 lbs.

$69.50

This Impedance Bridge Kit is really a favorite with schools, industrial laboratories, and serious experimenters. An invaluable instrument for those doing electrical measurements work. Reads resistance from .01 Ohms to 10 meg., capacitance from .00001 to 100 MFD, inductance from 10 microhenries to 100 henries, dissipation factor from .002 to 1, and storage factor from 1 to 1000. And you don't have to worry about selecting the proper bridge circuit for the various measurements — the instrument automatically makes the correct circuit when you set up for taking the measurement you want. Bridge utilizes Wheatstone, Hay, Maxwell, and capacitance comparison circuits for the wide range and types of measurements possible. And it's self powered — has internal battery and 1000 cycle hummer. No external generator required — has provisions for external generator if measurements at other than 1000 cycles are desired. Kit utilizes only highest quality parts, General Radio main calibrated control. Mallory ceramic switches, excellent 200 microamp zero center galvanometer, laboratory type binding posts with standard ¾ inch centers, 1% precision ceramic-body type multiplier resistors, beautiful birch cabinet and ready calibrated panel. (Headphones not included.)

Take the guesswork out of electrical measurements — order your Heathkit Impedance Bridge kit today — you'll like it.

Heathkit LABORATORY RESISTANCE DECADE KIT

$19.50

Shipping Wt. 4 lbs.

An indispensable piece of laboratory equipment — the Heathkit Resistance Decade Kit gives you resistance settings from 1 to 99,999 ohms IN ONE OHM STEPS. For greatest accuracy, 1% precision ceramic-body type resistors and highest quality ceramic wafer switches are used.

Designed to match the Impedance Bridge above, the Resistance Decade Kit has a beautiful birch cabinet and attractive panel. It's easy to build, and comes complete with all parts and construction manual.

Heathkit LABORATORY POWER SUPPLY KITS

Limits:

No load	Variable 150-400V DC
25 MA	Variable 30-310V DC
50 MA	Variable 25-250V DC

Higher loads: Voltage drops off proportionally

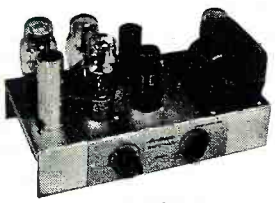
$29.50

Model PS-1.....Ship. Wt. 20 lbs.

Every experimenter needs a good power supply for electronic setups of all kinds. This unit has been expressly designed to act as a HV supply and a 6.3 V filament voltage source. Voltage control allows selection of HV output desired (continuously variable within limits outlined), and a Volts-Ma switch provides choice of output metering. A large plainly marked and direct reading meter scale indicates either DC voltage output in Volts or DC current output in Ma. (Range of meter 0-500V D.C., 0-200 Ma. D.C.). Instrument has convenient stand-by position and pilot light.

Comes with power transformer, filament transformer, meter, 5Y3 rectifier, two 1619 control tubes, completely punched and formed chassis, panel, cabinet, detailed construction manual, and all other parts to make the kit complete.

Heathkit ECONOMY . . . 6 WATT AMPLIFIER KIT



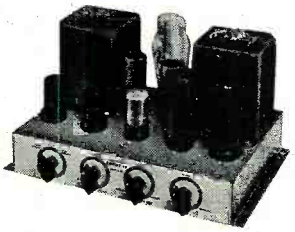
Model A-4
Ship. Wt. 8 lbs.

$12.50

No. 304 12 inch speaker . . . **$6.95**

This fine Heathkit Amplifier was designed to give quality reproduction and yet remain low in price. Has two preamp stages, phase inverter stage, and push-pull beam power output. Comes complete with six tubes, quality output transformer (to 3-4 ohm voice coil), husky cased power transformer and all other parts. Has tone and volume controls. Instruction manual has pictorial for easy assembly. Six watts output with response flat ± 1½ db from 50 to 15,000 cycles. A quality amplifier kit at a low price. Better build one.

Heathkit HIGH FIDELITY . . . 20 WATT AMPLIFIER KIT



$33.50

Shipping Wt. 18 lbs.

Our latest and finest amplifier — the model A-6 (or A-6A) is capable of a full 20 Watts of high fidelity output — good faithful reproduction made possible through careful circuit design and the use of only highest quality components. Frequency response within ± 1 db from 20-20,000 cycles. Distortion at 3 db below maximum power output (at 1000 cycles) is only .8%. The power transformer is rugged and conservatively rated and will deliver full plate and filament supply with ease. The output transformer was selected because of its exceptionally good frequency response and wide range of output impedances (4-8-16-150-600 ohms). Both are Chicago Transformers in drawn steel case for shielding and maximum protection to windings. The unit has dual tone controls to set the output for the tonal quality desired — treble control attentuates up to 15 db at 10,000 cycles — bass control gives bass boost up to 10 db at 50 cycles.

Tube complement consists of 5U4G rectifier, 6SJ7 voltage amplifier, 6SN7 amplifier and phase splitter, and two 6L6's in push-pull output. Comes complete with all parts and detailed construction manual. (Speaker not included.)

MODEL A-6: For tuner and crystal phono inputs. Has two position selector switch for convenient switching to type of input desired.

MODEL A-6A: Features an added 6SJ7 stage (preamplifier) for operating from variable reluctance cartridge phono pickup, mike input, and either tuner or standard crystal phono pickup. A three position selector switch provides flexible switching. **$35.50**

Shipping Wt. 18 lbs.

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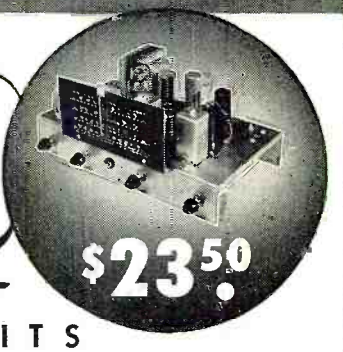
. . . BENTON HARBOR 15, MICHIGAN

Heathkit RECEIVER & TUNER KITS for AM and FM

$19.50

Model BR-1 Broadcast Model Kit covers 550 to 1600 Kc. Shipping Wt. 10 lbs.

Model AR-1 3 Band Receiver Kit covers 550 Kc. to over 20 Mc. continuous. Extremely high sensitivity. Shipping Wt. 10 lbs.

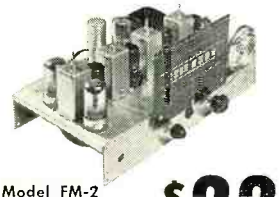


$23.50

TWO HIGH QUALITY Heathkit SUPERHETERODYNE RECEIVER KITS

Two excellent Heathkits. Ideal for schools, replacement of worn out receivers, amateur and custom installations.

Both are transformer operated quality units. The best of materials used throughout — six inch calibrated slide rule dial — quality power output transformers — dual iron core shielded. I.F. coils — metal cased filter condenser. The chassis has phono input jacks, 110 Volt output for phono motor and there is a phono-radio switch on panel. A large metal panel simplifying installation in used console cabinets is included. Comes complete with tubes and instruction manual incorporating pictorials and step-by-step instructions (less speaker and cabinet). The three band model has simple coil turret which is assembled separately for ease of construction.



Model FM-2
Ship. Wt. 9 lbs.

$22.50

TRUE FM FROM Heathkit FM TUNER KIT

The Heathkit FM Tuner Model FM-2 was designed for best tonal reproduction. The circuit incorporates the most desirable FM features — true FM.

Utilizes 8 tubes: 7E5 Oscillator, 6SH7 mixer, two 6SH7 IF amplifiers, 6SH7 limiter, two 7C4 diodes as discriminator, and 6X5 rectifier.

The instrument is transformer operated making it safe for connection to any type receiver or amplifier. Has ready wound and adjusted RF coils, and 2 stages of 10.7 Mc IF (including limiter). A calibrated six inch slide rule dial has vernier drive for easy tuning. All parts and complete construction manual furnished.

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HEATH COMPANY
BENTON HARBOR 15,
MICHIGAN

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- ☐ Freight
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Quantity	Item	Price	Quantity	Item	Price
	Heathkit Oscilloscope Kit — Model O-7			Heathkit H.V. Probe Kit — No. 336	
	Heathkit VTVM Kit — Model V-5			Heathkit R.F. Signal Gen. Kit — Model SG-6	
	Heathkit FM Tuner Kit — FM-2			Heathkit Condenser Checker Kit — Model C-2	
	Heathkit Broadcast Receiver Kit — Model BR-1			Heathkit Handitester Kit — Model M-1	
	Heathkit Three Band Receiver Kit—Model AR-1			Heathkit Power Supply Kit — Model PS-1	
	Heathkit Amplifier Kit — Model A-4			Heathkit Resistance Decade Kit — Model RD-1	
	Heathkit Amplifier Kit — Model A-6 (or A-6A)			Heathkit Impedance Bridge Kit — Model IB-1B	
	Heathkit Tube Checker Kit — Model TC-1			Heathkit A.C. VTVM-KIT — Model AV-1	
	Heathkit Audio Generator Kit — Model AG-7			Heathkit Intermodul. Analyzer Kit—Model IM-1	
	Heathkit Battery Eliminator Kit — Model BE-2			Heathkit Audio Freq. Meter Kit — Model AF-1	
	Heathkit Electronic Switch Kit — Model S-2			Heathkit Square Wave Gen. Kit — Model SQ-1	
	Heathkit T.V. Alignment Gen. Kit — TS-2				
	Heathkit Signal Tracer Kit — Model T-2				
	Heathkit R.F. Probe Kit — No. 309				

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.

Enclosed find ☐ Check ☐ Money Order for_____

Please ship C.O.D. ☐ Postage enclosed for_____lbs.

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WHAT'S *New in Radio*

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page, and the issue number, delay will be avoided.

DELUXE AM-FM TUNER

Collins Audio Products Co., Inc., P. O. Box 368, Westfield, N. J. is currently

marketing a custom deluxe AM-FM tuner, the 45-S.

The new tuner uses 21 tubes and has all of the necessary controls located on the tuner panel. In addition, the tuner has a meter to aid in FM tuning. This meter indicates the relative signal strength of FM stations received and permits the accurate orientation of the antenna for maximum reception.

The user may select either 500 ohms or high output impedance by means of a toggle switch located on the rear apron of the chassis. The tuner also has automatic FM squelch which is available by switch control.

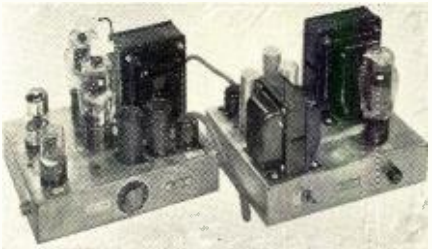
The tuner is mounted on a 10" x 17" x 3" chassis and is supplied with an 8¾" x 19" panel for rack or cabinet mounting. The over-all depth of the unit, including knobs, is 13" and it weighs 30 pounds.

AMPLIFIER COMPONENTS

Standard Transformer Corporation, 3580 Elston Avenue, Chicago 18, Illinois is introducing a line of components designed especially for use in Williamson amplifiers.

The new *Stancor* components include a high fidelity output transformer (A-9054), a power transformer (PC8412), and a filter choke (C-1411).

Tests on amplifiers constructed from these parts show a flat frequency response at the 8 watt level remaining unchanged at the low level of .5 watt.



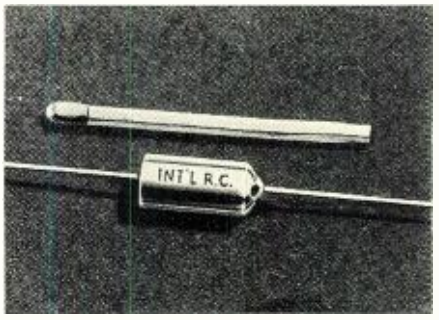
Intermodulation distortion measures 3% at 8 watts' output. Total harmonic distortion at 1000 cycles is extremely low and may be considered non-existent below the 10 watt power level.

A bulletin describing these new components and giving complete construction details on the amplifier is available from the company. Ask for the *Stancor* "Williamson Amplifier Bulletin No. 382."

SELENIUM RECTIFIERS

International Rectifier Corporation of 6809 S. Victoria Ave., Los Angeles 43, California has recently introduced a new line of hermetically-sealed selenium cartridges.

The rectifiers are assembled in half-wave cartridges with current ratings from 300 microamperes up to 60 milliamperes. The individual units accommodate up to 400 cell elements with d.c. voltage ratings up to 8000 volts per cartridge. The units are capable of withstanding 100 G's accelera-



tion and can be operated at ambient temperatures up to 100 degrees C.

Outside diameters vary from 3/16" to 1¼" depending on the current rating. The rectifiers have been designed for such applications as airborne radar components, guided missiles, bias supplies, inverse peak clippers, oscilloscope power supplies, modulators, etc.

NEW VIBRATOR LINE

A new line of communications equipment vibrators designated as the "Red Ball" series, has been introduced by the *James Vibrapowr Company* of 4036 N. Rockwell Street, Chicago 18, Illinois.

These new vibrators include many new design and production features which are said to provide greater efficiency, dependability, and longer life in all types of mobile communications applications.

Full information and details on the test results on this line may be obtained from local distributors or from the company direct.

GRID DIP METER

Of interest to hams and engineers alike is the new grid dip meter recently introduced by *Sylvan Electronic Laboratories* of Broadalbin, New York.

The Model GDO-1 features a probe

130,000 qualified TV servicemen needed

Here is how you can be one of them

INDUSTRY EXPERTS HAVE ESTIMATED over 130,000 qualified TV technicians will be needed for the installation, trouble-shooting and repairing of the television receivers in use by 1955.

There are far fewer than 50,000 fully trained TV technicians available today. This means more jobs, unrivaled future for security, greater earning power for thousands and thousands of additional TRAINED and EXPERIENCED TV Servicemen. Will you be one of them?

OUTSTANDING FUTURE FOR QUALIFIED TV SERVICEMEN

Men now in radio servicing as well as men in the radio-electronics industry with no experience in TV servicing . . . here is your opportunity. The RCA Institutes Home Study Course in Television Servicing makes it possible for you to convert your skill in radio servicing, or interest in radio-electronics, to the important money-making field of TV servicing.

The RCA Institutes Course gives you a sound knowledge of television fundamentals . . . intensive practical instruction in the proper maintenance and servicing of complex TV receiver circuits—*including color TV and UHF* . . . teaches you the "short cuts" on TV installation and trouble-shooting, saving you many hours of on-the-job labor.

TRAINING MEETS MODERN REQUIREMENTS

This course is in step with the progress of the television industry. It is backed by RCA—pioneer in television development. It is based on the actual experience of the RCA Service Company in servicing thousands of home television receivers. The course is constantly being revised, improved and kept up-to-the-minute. It will help you to a more profitable and productive future in these ways:

PREPARE YOU to take the required technical examination with confidence, in those areas that require a license or permit to engage in TV servicing.

TRAIN YOU, if you are a serviceman in a non-TV area, to become a qualified TV technician by the time TV comes to your area. In TV areas, TV servicing has substantially replaced radio servicing as the chief source of income.

IF YOU ARE A QUALIFIED TV SERVICEMAN, it will keep you in step with the latest industry developments including color TV and UHF.

IT DEVELOPS the latent talents of installers into skilled trouble-shooting TV technicians.

TRAINS MEN in radio-electronics with no previous servicing experience to fill jobs as TV technicians, to win promotions and better pay.

RCA INSTITUTES HOME STUDY COURSE PLANNED TO YOUR NEEDS

You keep your present job in radio—television—electronics. In your spare time, you study at home. You learn "How-to-do-it" techniques with "How-it-works" information in easy-to-study lessons prepared in ten units. Cost of RCA Home Study Course in Television Servicing has been cut to a minimum—as a service to the industry. You pay for the course on a "pay-as-you-learn" unit lesson basis. You receive an RCA Institutes certificate upon completion of the course. The RCA Institutes Home Study Course in Television Servicing is approved by leading servicemen's associations.

RCA Institutes conducts a resident school in New York City offering day and evening courses in Radio and TV Servicing, Radio Code and Radio Operating, Radio Broadcasting, Advanced Technology. *Write for free catalog on resident courses.*

Send for FREE BOOKLET

Mail the coupon—today. Get complete information on the RCA INSTITUTES Home Study Course in Television Servicing. Booklet gives you a general outline of the course by units. See how this practical home study course trains you quickly, easily. Mail coupon in envelope or paste on postal card.

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Home Study Department, RN-1051
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Without obligation on my part, please send me copy of booklet "RCA INSTITUTES Home Study Course in TELEVISION SERVICING." (No salesman will call.)

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RCA INSTITUTES, INC.
A SERVICE OF RADIO CORPORATION of AMERICA
350 WEST FOURTH STREET, NEW YORK 14, N.Y.

type oscillator unit which facilitates its use in restricted spaces, a voltage regulated transformer type power supply, an easily-read 4½" meter with a 0-200 microampere movement, internal

modulation and provision for external modulation, a frequency range of from 1.5 to 300 mc. in 7 coil ranges, a built-in coil storage drawer, and rugged mechanical construction.

CONTROL KNOBS

The Equipment Sales Division of the *Raytheon Manufacturing Company,* Waltham 54, Massachusetts has announced the availability of a comprehensive line of standard control knobs designed especially for the electronics industry.

Made of black injection molded cellulose acetate butyrate and incorporating anodized aluminum inserts with two plated hex socket set screws, the knobs are compatible with current government specifications.

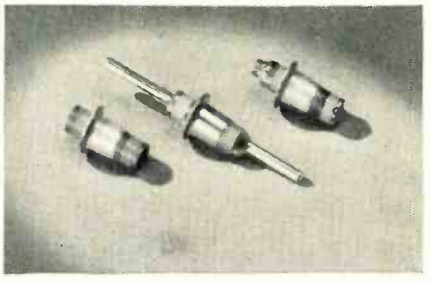
The knobs are available in five basic sizes, six functional styles, and in two surface finishes. The forty-four varieties of knobs comprising this series range from 7/10" diameter for subminiature applications to 2¼" diameter for larger types of equipment. Matched sets of round, pointer, dial, and crank knobs will be available in the various size ranges.

MINIATURE FEEDTHROUGHS

Centralab, Division of *Globe-Union Inc.,* 900 E. Keefe Avenue, Milwaukee 1, Wisconsin has announced the availability of two new miniature feedthrough condensers, the Types FT-20 and the FT-25.

Both units are .135" maximum diameter but the Type FT-20 is .400" long and the Type FT-25 has a maximum length of .690". Each is equipped with a ¼" diameter eyelet which can be soldered to the chassis.

These units are rated at 500 volts,

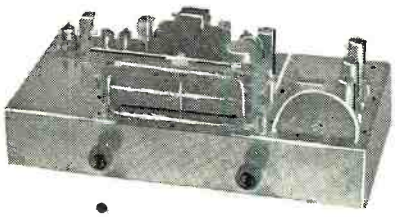


1000 volts d.c. flash test. The FT-20 is available in any standard capacitance tolerance from 25 to 250 $\mu\mu$fd. up to 650 $\mu\mu$fd. with ±20% tolerance and up to 1000 $\mu\mu$fd. with a GMV tolerance. The Type FT-25 ranges from 50 to 700

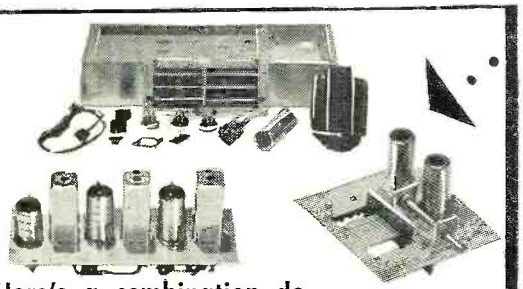
(*Continued on page* 138)

A New Idea in Radio Tuners—
COLLINS "PRE-FABS" SAVES YOU MONEY

Now you can have a high quality Collins FM Tuner at about half the cost. You buy the basic units which have all been prewired, aligned and factory tested. All you do is assemble these into the punched chassis and wire up the power supply. Yes, it's that easy the Pre-Fab way.



The Collins "Pre-Fab" Tuner Assembled.



Here's a combination designed for the pocket as well as the ear... High in quality—low in cost. **$33.75**

There's no finer tuner available than this Collins Deluxe Combination. Engineered for high quality and yet priced right. **$46.50**

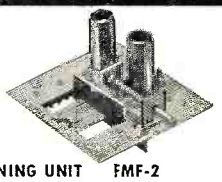
Each Collins "Pre-Fab" combination meets the high standards of the famous Collins FM Tuner—very low distortion and full frequency audio response from 20 cycles to over 20,000 cycles per second. High gain and sensitivity.

All Prices Shown Include Tubes

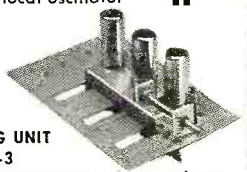
Choose Any Combination

They are priced for your pocketbook from $33.75 to $46.50

ALL YOU BUY IS
a tuning unit, an IF Amplifier and the universal chassis kit, which is standard for all combinations. Check the "Pre-Fabs" listed below and make your selection.



TUNING UNIT FMF-2
Permability Tuned . . . has two tuned stages using a 6AK5 converter and 6C4 local oscillator **$11.50**



TUNING UNIT FMF-3
Permability Tuned...has three tuned stages including a 6J6 RF. amplifier, 6AK5 converter, and 6C4 oscillator **$14.50**

IF AMPLIFIER IF-3
Employs three tubes terminating in a new type ratio detector circuit **$8.75**

IF AMPLIFIER IF-4
Also employs a ratio detector ...extra IF stage gives it added gain **$12.25**

IF AMPLIFIER IF-6
Deluxe model . . . has three IF stages, two limiters, and a discriminator type of detector. Superior to any such amplifier on the market in gain and sensitivity. **$18.50**

UNIVERSAL CHASSIS KIT UC-1
Includes a punched chassis, handsome slide rule tuning dial, oversize power transformer, filter condenser, rectifier tube and socket, hardware, volume control and switch, knobs, terminal strips, AC line cord and plug. **$13.50**

Mail—Order Coupon TODAY!

Collins Audio Products Company, Inc.
P. O. Box 368, Westfield, N. J.

Enclosed find ☐ check ☐ money order for_____

Send me the following "Pre-Fab" Units:

☐ Tuning Unit FMF-2
☐ Tuning Unit FMF-3
☐ IF Amplifier IF-3
☐ IF Amplifier IF-4
☐ IF Amplifier IF-6
☐ Universal Chassis Kit UC-1

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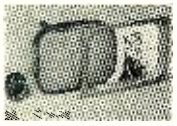
City & State_____

17″ T.V. CONVERSION KIT $29.95

McGee's Main Store and its Warehouses Were not in the Kansas City Flood Area—Business as Usual—Prompt Shipments.



CONVERT TO A RECTANGULAR PICTURE

With each conversion kit you get a plastic mask, 70 degree deflection yoke, 90 day guaranteed black face picture tube, plus our new 77J1-X 14,000 Volt Universal fly-back and horizontal output transformer that works on any output tube and any single rectifier (1B3 or 1X2). A suggested diagram is furnished for use of the transformer with several different output tubes and rectifiers. We think this is the finest and best priced conversion kit in the country. Shipped Truck or Express, only.

Kit No. TCK-14, with 14BP4A 14″ rectangular tube, Net price..... **$27.95**
Kit No. TCK-16, with 16RP4A 16″ rectangular tube, Net price..... **34.95**
Kit No. TCK-17, with 17BP4A 17″ rectangular tube, Net price..... **29.95**
Kit No. TCK-20, with 20CP4A 20″ rectangular tube, Net price..... **49.95**

PICTURE TUBE SALE

Values like this 12LP4, $17.95

Look over these picture tube prices and you will see, that for set replacement and conversion use, McGee offers you more for your money. Every picture tube guaranteed full replacement for 90 days. Every tube is a tremendous value. These tubes are not seconds, but 1st quality.

NOTE: 10MP4 Replaces a 10BP4 Without Any Circuit Changes.

Tube No.	Diameter	Defl. Angle	Overall Length	Neck Length	Envelope	Face Type	Ion Trap	Net Price
10M P4	10″	54	17″	7-9/16″	Glass	Clear	Single	**$16.95**
12L P4	12″	50	18¾″	8¼″	Glass	Clear	Double	**17.95**
12Q P4	12″	55	17½″	7″	Glass	Clear	Single	**17.95**
14B P4A	14″ (R)	70	16-13/16″	7½″	Glass	Filter	Double	**19.95**
15D P4	15″	60	20¾″	7⅞″	Glass	Clear	Double	**29.95**
16A P4	16″	53	22-5/16″	7-9/16″	Glass	Clear	Double	**29.95**
16J P4	16″	60	20¾″	7½″	Glass	Clear	Double	**22.95**
16G P4A	16″	70	17-11/16″	6⅞″	Metal	Filter	Single	**24.95**
16L P4	16″	52	22¼″	7⅜″	Glass	Clear	Double	**29.95**
16R P4A	16″ (R)	70	18¾″	7½″	Glass	Filter	Single	**24.95**
17B P4A	17″ (R)	70	18⅝″	7½″	Glass	Filter	Single	**22.95**
19D P4A	19″	60	20¾″	5½″	Glass	Filter	Double	**39.95**
20C P4A	20″ (R)	70	21¾″	7″	Glass	Filter	Double	**39.95**

Note: (R) Designates a rectangular type tube. 10M P4 perfect for 10B P4.

TV MASKS AT BARGAIN PRICES

Tube Size	Mask Size	1st Quality	2nd Quality
14″ Rectangular	10½ x 13″	$3.49	$1.95
16″ Round	13¾ x 17¼″	4.95	2.95
16″ Rectangular	12½ x 15¾″	4.95	2.95
17″ Rectangular	13 x 16½″	5.49	2.95
19″ Round	16 x 20″	6.95	None
20″ Rectangular	16¾ x 20¾″	6.95	4.95

Masks look like one pictured with conversion kits listed at top of page. A special purchase makes this offer possible. Safety masks with gold colored trim. Formed to fit the face of the picture tube. The 2nd quality B grade masks are perfect except for slightly uneven edges, which can be trimmed off. We guarantee you a good value whether you buy the 1st quality A grade, or the 2nd quality B grade.

TELEVISION KIT $59.95—Less All Tubes

FOR 17 OR 20-INCH TUBE

A complete kit of parts to build an AC transformer operated television chassis for use with a 16, 17 or 20 inch rectangular picture tube. The 12 channel Sarkes Tarzian tuner is ready wired. The 4 tube video IF strip is also wired. Circuit is of the conventional accepted design, with latest ceramic type flyback high voltage supply. Chassis is ready punched. Warning: Do not buy this kit unless you understand Television and electronics. It is difficult to wire. We furnish schematic and photos. Kit model WH 20 ship weight 40 lbs., less all tubes **$59.95**, less picture tube **$16.95** extra. 17 inch 17BP4A **$22.95** extra. 20 inch tube **$39.95** extra.

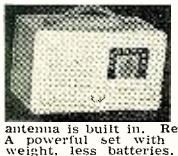
Kit of 19 tubes but 20CP4 20 inch rect.

NEW VERSATILE 12-TUBE FM-AM CHASSIS $69.95

- ★ BUILT IN PRE-AMPLIFIER FOR G.E. VARIABLE RELUCTANCE PICKUP
- ★ WIDE RANGE AUDIO
- ★ MAY BE USED WITH A CRYSTAL MIKE AS A HOME P.A. SYSTEM

McGee's new 1950 model 12 tube FM/AM chassis. Latest design with phono inputs for all types of record players, crystal or G.E. variable reluctance. Receives standard broadcast 550 to 1700 kc. FM 88 to 108 MC. Wide range audio response (push-pull 7C5) and bass boost tone control. Loop antenna for broadcast and 300 ohm line type antenna, may be stapled in cabinet. Attractive lighted slide rule dial. Chassis size, 13½x9″ high and 9″ deep. Shipping weight 20 lbs. **Stock No. 7-CX.** Made to sell at a much higher price. McGee's sale price is **$69.95**, less speaker output matches 8 ohms). **7-CX** chassis with our 12″ coaxial PM. CU-14X, both **$79.95.**

LOOK AT THESE BARGAINS!



TRAV-LER 3-WAY PORTABLE — $18.95

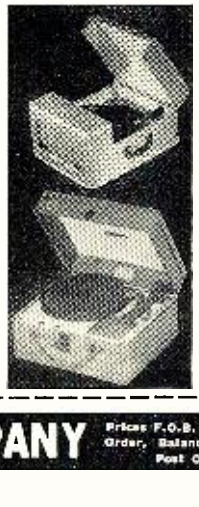
A lucky purchase makes this value possible. Model 5022 Trav-Ler 3 way portable. Operates on 105 to 125 volts AC or DC, or self-contained batteries. A full 2 gang superhet with Alnico V dynamic speaker. Tube component: 1R5, 1U4, 1U5, 3V4, plus rectifier. Has vernier airplane dial. A smartly styled two-tone portable with ivory plastic front panel and Tan or Red leatherette covered case. Compact size 9 x 5¼ x 5¼″. Loop antenna is built in. Receives broadcast 550 to 1600 kc. A powerful set with 6 tube performance. Shipping weight, less batteries, 6 lbs. (17 lbs. with batteries). Trav-Ler Model 5022, portable less batteries **$18.95** ea. Lots of 3 **$18.50** ea. Battery kit for Model 5022 **$1.75** extra. (consists of one 67½ volt 'B' and 2 No. 2 flashlight cells.)

VM 3-SPEED AUTOMATIC—$44.95

Another special purchase offer! VM-975, 3 speed portable automatic record changer. Housed in a deluxe browni leatherette case 14½ x 17¼ x 8¾″ high. Famous VM Tri-O-Matic changer, plays all 3 speed and all 3 sizes automatically. 10 and 12″ records of the same speed can be inter-mixed. Flip-over crystal cartridge provides the correct needle size for the record you are playing. Has good quality 3 tube amplifier, a tone and volume control and heavy magnet PM speaker. Regular dealer net is $51.60. Now, a limited number are available at the special sale price of only **$44.95** each. Shipping weight 22 lbs.

TRAV-LER 3-SPEED PORTABLE—$18.95

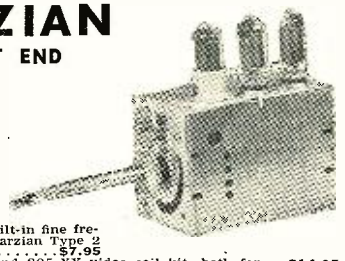
Trav-Ler Model 7033, deluxe 3-speed electric portable record player. Powerful 3 tube amplifier, (12SQ7, 50L6, and 35Z5 rectifier). Full size Alnico V magnet, dynamic speaker. Plays all records; 7″, 10″ and 12″, 33⅓, 45 and 78 RPM. Crystal pickup, with all purpose truncated permanent needle. Luggage style case. 12½ x 10½ x 6¼″, expertly covered with simulated Tan, Green, or Red leatherette. Shipping weight 11½ lbs. Trav-Ler Model 7033, 3-speed portable electric record player. Net price only **$18.95.** Lots of 3. **$18.50** each.



SARKES-TARZIAN

13-CHANNEL T.V. FRONT END

WITH TUBES AND DIAGRAM $79.95



This popular Sarkes-Tarzian television front end is widely used today. The 13 channel rotary switch type with individually tuned coils. Price includes a schematic diagram and 3 tubes, 6C4 osc. 6BH6 RF and 6AG5 mixer. Regular factory cost is twice our price. Each tuner and its own tube sockets are wired, ready to hook up to a video and sound IF strip. May be used with either intercarrier or separate sound IF circuits. Built-in fine frequency control. Ship. weight 3 lbs. Sarkes-Tarzian Type 2 TV tuner with tubes net..... **$7.95**

Combination deal. Sarkes-Tarzian TV tuner and 205-XX video coil kit, both for... **$14.95**

Sarkes-Tarzian Type 3—Same as Type 2 only has input IF coil built-on. Tapped for sound IF channel. Net..... **$9.95**

Sarkes-Tarzian Type 3 tuner and 205-XX coil kit both for..... **$16.95**

BRAND NEW GENERAL INST. TELEVISION FRONT END-TUNERS

Sale Price $7.95

All completely wired, brand new and prealigned. 13 channel selector incorporating fixed inductance and variable capacitance. Converter output transformer is attached to be coupled direct to separate sound and video. I.F.'s. 3 6J6 tubes are required. Shaft length 2¼″. Built in fine frequency control. Original factory cost over **$20.00.** Weight 4 lbs. Stock No. GI-13P, less tubes. Net price **$7.95.**

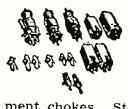
Stock #G1-13PX Same as above only not in new condition. Have been in sets, but guaranteed a good value—less tubes. G. Inst. Tuner—G1-13PX, net **$2.95.**

BRAND NEW R. C. A. TELEVISION FRONT END-TUNERS

Sale Price $14.95

A fortunate purchase from a T.V. set manufacturer makes this value possible. RCA 13 channel completely wired, tested and aligned T.V. tuner. A 13 channel selector switch with outer sleeve fine frequency control. Converter output transformer is attached for direct coupling to video and sound I.F. stages. Shaft length, 3⅜″. Original dealer's cost on this item was over **$30.00.** McGee offers them to you brand new (they have never been soldered to or in sets) for only **$14.95,** less tubes. (3 6J6 tubes required). Shipping weight 2 lbs. Stock No. RCA-13P, less 3 6J6 tubes. Net **$14.95,** two for **$27.95.**

Video Coil Kit $7.95



20 matched TV video and sound I.F. coils. Intended for use with the RCA circuit. You get 6 peaking coils, 4—25.75 mc picture I.F.'s, 2—21.25 mc sound I.F.'s, discriminator and converter coil and 5 filament chokes. Stock No. 205-XX, weight 3 lbs. Net price, **$7.95. $6.95** if purchased with ANY TV tuner: all coils identified.

T.V. BOOSTER REGENCY $19.10

Regency DB-410 television booster. A real engineered unit, small and compact. Slug tuned, using 1—6J6 tube as neutralized push-pull amplifier. Dollar for dollar, your best booster buy. 5¾x 4¾″. For 110 volt AC operation. Weight 6 lbs. Net price **$19.10.**

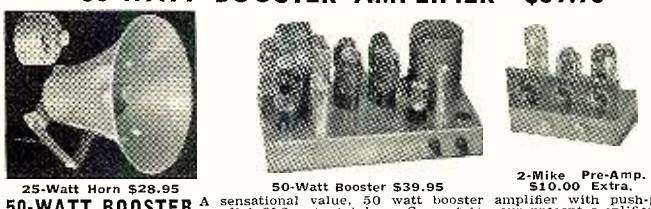
TUBES

These very low tube prices are made possible by our purchasing from set makers in bulk quantities and boxing tubes in plain white cartons. Each tube has brand and type stamped on carton. Nationally advertised brands shipped you: Sylvania, National Union, RCA, Crosley, Tung-Sol, Jewel, etc.. 6 months' guarantee.

All firsts, no throw-outs or seconds. You must be satisfied.

Popular TV Rectifiers		3S4	$0.79	2A7	$1.29	6SR7	$0.88
1X2A	$ .99	3V4	.89	3A4	.98	6ST7	1.29
1B3	1.19	5Z4	.59	3LF4	1.29	6SV7	1.42
5U4G	.69	**Misc. Receiving Types**		3Q4	1.08	6T8	1.57
6W4	.74	6SA7	$ .82	5AZ4	.66	6W6	1.08
Popular TV Receiving Types		6SH7	.79	5W4	.81	6Y7G	1.57
5Y3GT	$ .59	6SK7	.82	5X4	.88	7A5	1.08
6AG5	.89	6SL7	.79	5Y4	.73	7A6	.88
6AL5	.69	6X4	.64	5Z4	1.29	7A8	.88
6AU6	.79	7B6	.89	6AB4	.98	7AF7	.88
6BG6G	2.10	7H7	.89	6AC7	1.42	7AH7	1.08
6BQ6gt	1.29	7Y4	.81	6AG5	1.91	7B4	.88
6J6	1.19	12SH7	.85	6AH6	1.91	7C4	1.57
6K6gt	.69	12SJ7	.79	6AK5	1.91	7E6	1.08
6S4	.79	117L7	1.49	6AQ5	.98	7E7	1.29
6SN7gt	.99	**Loctal 1½ Volt Types**		6AT6	.73	7K7	1.29
6V6gt	.85	1LA6	$1.17	6BA6	.90	7L7	1.29
12AU7	.99	1LB4	1.17	6BA7	1.18	7N7	1.08
12SN7gt	.89	1LC5	1.17	6BC5	.98	7Q7	.98
Popular Receiving Types		1LC6	1.17	6BC8	.98	7R7	1.08
12SA7gt	$ .79	1LD5	1.17	6CB6	.98	7S7	1.08
12SK7gt	.79	1LE3	1.17	6CD6G	2.94	7V7	1.29
12SQ7gt	.73	1LG5	1.17	6CF5	.81	7Y4	.88
35C5	.89	1LH4	1.17	6CF7	1.57	10Y	1.29
35Z5	.59	1LN5	1.17	6K5gt	1.18	12A8gt	1.08
50C5	.89	1LA4	1.17	6K7	.98	12AL5	.98
50L6gt	.87	1C6	1.57	6K8G	1.57	12BA6	.88
14A7	.99	1H5	.88	6L7	1.57	12BA7	1.18
14B6	.99	1L4	.98	6Q7gt	.88	12BE6	.88
14Q7	.99	1N5	.98	6S8	1.29	12BD6	.98
35Y4	.89	1Q5	1.29	6SD7	1.42	12J5gt	.73
50A5	1.09	1T5	1.29	6SF5	.81	12J7	1.08
1R5	.89	1U4	.98	6SF7	1.08	12K8	1.29
1S5	.89	1V2	.73	6SQ7	.73	12Q7	.88
1T4	.89	2A5	1.08	6SS7	.98	12SF7	.98
						12SJ7	.88
						12SL7	1.18
						12SR7	$1.08
						14A4	1.29
						14B8	1.10
						14C5	1.29
						14E6	1.08
						14E7	1.29
						14H7	1.18
						14N7	1.29
						14R7	1.29
						14W7	1.29
						14Y4	1.18
						14Z7	1.29
						19BG6	2.94
						25BQ6	1.57
						25L6gt	.88
						25W4gt	.98
						25Z5	.81
						25Z6gt	.81
						26	.98
						27	.88
						35/51	1.18
						38	1.08
						39/44	1.29
						41	.98
						42	.98
						43	.98
						47	1.42
						50Y6	.88
						56	.88
						57	.88
						58	.98
						76	.81
						77	.98
						78	.98
						80	.66
						89	1.08
						117N7	1.91
						117Z6	1.18
						9003	.98

50-WATT BOOSTER AMPLIFIER—$39.95



25-Watt Horn $28.95 — 50-Watt Booster $39.95 — 2-Mike Pre-Amp. $10.00 Extra.

50-WATT BOOSTER A sensational value, 50 watt booster amplifier with push-pull parallel 6L6 output tubes. Connect to your present amplifier as a booster or use with the PR-2X Pre-amp to add the use of 2 mikes and one low level input. The booster amplifier has one input jack and with 1 volt input gives 50 watts of audio. Booster has a 9 lb. potted case high fidelity output transformer, matches speaker with 4-8-16 ohm voice coil, also 60 ohm and 250 ohm line. Booster has a 225 mill power supply with 5U4 rectifier. Price includes tubes: 4 6L6, 7N7 and 5U4. The two variable controls are for master volume control and base boost tone control. Size 8 x 6½ x 14½. Stock No. PA-55X. Shipping weight 26 lbs. Sale price **$39.95** ea.

30-WATT BOOSTER 30 watt Booster Amplifier. Identical in appearance to the PA-55X above, only with 175 mill power transformer and push-pull parallel 6V6 tubes instead of 6L6's. The same wide range output is incorporated. Use this where 30 watts of ADDED audio power is required. If mike input gain is required order our PR-2X Pre-amp. Stock No. PA-30X. Ship. wt. 22 lbs. Price **$32.95** ea.

2-MIKE PRE-AMP. Pre-amplifier plugs in directly to the PA-55X and PA-30X Booster amplifier. It enables use of 2 Crystal or Dynamic Mikes plus one low level input. Furnished with 4 foot cables and plugs for remote control of the 55 or 30 watt Booster Amplifier. Small chassis size 5 x 3¼ x 4″. Stock No. PR-2X, with tubes 7F7 and 7N7. Net price **$10.00** ea.

25-WATT HORN 25-Watt Driver and 3½-foot air column re-entrant Trumpet. The standard type trumpet and driver you see the most. Drivers are 100% weatherproof, horn is spun aluminum, offered to you at a considerable savings. Stock No. MA-33. Shipping weight 20 lbs. Net price **$28.95.**

McGEE RADIO COMPANY Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER 1422 GRAND AVE., KANSAS CITY, MISSOURI

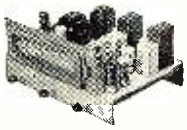
SENSATIONAL NEW 2-BAND RADIO KIT ONLY $14.95

7-TUBE FM-AM TUNER

MODEL RAL-8

★ AC SELF POWERED **$29.95**

★ 3 GANG TUNING ★ A COMPLETE KIT



McGee has ready for delivery, this self powered AC, 7 tube FM and AM superhet tuner kit. Build yourself a professional looking tuner that may be connected to any audio amplifier. Receives broadcast 550 to 1650 kc and FM 88 to 108 mc. A 3 gang tuning condenser is used on both FM and AM. This extra stage of TRF makes a smoother working tuner. 2 IF stages on FM and one IF stage on AM (I.F. frequency 456 and 10.7 mc). Lighted slide rule dial with metal escutchon plate. Our own lab designed and wired an original tuner using these parts. Chassis is ready punched and painted. Everything furnished including tubes and diagrams. Shipping weight 12 lbs. Stock No. RAL-8, net price $29.95.

MODEL ME6-2 $14.95

NEW MODEL 6-TUBE, 2-BAND RADIO KIT

A FULL 2-GANG SUPERHET KIT

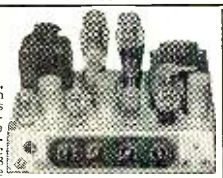
RECEIVES 550-1600 KC PLUS 6-18 M.C.

McGee's new 1951, 6 tube; AC-DC 2 band radio kit. Receives broadcast, 550 to 1600 kc and short wave, 6 to 18 mc. A straight forward superhet circuit with 2 gang tuning condenser, 456 kc I.F. transformers, etc. 5" speaker illuminated slide rule dial. Everything furnished, including tubes, diagram and a photo showing view of underside of completely wired chassis. The chassis pan and dial parts are factory production. With this kit, you can build a commercial looking and factory quality 2 band radio, housed in a streamlined plastic cabinet. Size: 13 x 6¾ x 6¼". Stock No. ME6-2, shipping weight 10 lbs. Net $14.95.

SELF POWERED AC Broadcast Tuner Kit. 3-Gang Tuning Complete Kit, $12.95

A self-powered, 3-gang superhet tuner kit with R.F. stage. When wired according to our diagram will make a top quality broadcast tuner (550 to 1650 kc), for use with any amplifier. Don't class this with ordinary tuners; this has its own power transformer. This complete kit is furnished with a diagram, photos and tubes: 6SH7 R.F., 2—7E5 converter-mixer oscillator, 6SF7 I.F. detector, and 6X4 rectifier. Connect to any audio amplifier. Ideal for use with our S-2030, TM-16 or 7X5 amplifier kits. Chassis size, 9½x8x4½" high. Shipping weight, 7 lbs. Broadcast tuner kit Model BT-38X. Net price, **$12.95.**

8-TUBE 22 WATT Wide Range Amp. Model 7x5 Kit Only $37.95



A complete kit, including tubes (3-7E5, 2-7F7, 2-6A3, plus rectifier), diagram and photos. All triode circuit makes for minimum harmonic distortion. Inputs for radio tuner any kind of phono pickup (crystal or G.E. variable reluctance) and either crystal or dynamic mike. Output transformer matches 8 ohm voice coil. Twin electronic tone controls, bass and treble with range selector switch for either juke box quality with heavy bass response or brilliant symphonic range. The best quality amplifier kit we know how to make. Has a very wide range output and heavy power transformer. Response 18 to 20,000 CPS. 8 tube all triode amplifier kit, complete with tubes. Weight 25 lbs. Net **$37.95.**

10-TUBE RADIO KIT $29.95

3-GANG TUNING
MIKE INPUT
12 WATT
HI-FI AUDIO
BASE-TREBLE BOOST

A NEW 1951 ALL-PURPOSE RADIO KIT

10-Tube Broadcast (550 to 1700 kc) Radio Kit for custom builders. Features 3-gang superhet circuit with A.V.C., high gain IF circuit, 8" slide rule dial. Chassis size 12½" long, 10" front to back, 6½" high. Audio inputs for a crystal or dynamic mike, and record changer or player. Tone compensation for standard crystal pick-up or General Electric variable reluctance. Push-pull 6V6 output tubes, shielded high fidelity output transformer matches 8 ohm PM speaker, husky power transformer, 2 tone controls for separate base and treble boost. A complete kit, including tubes (3—7E5, 6SH7, 6SF7, 2—7F7, 2—6V6, plus rectifier), diagram and instructions. Shipping weight 18 lbs. Stock No. BK-R10, Net price **$29.95.** 10" PM speaker, **$6.95** extra. Crystal mike and desk stand, **$4.95** extra. 12" coaxial speaker **$12.95** extra.

5-Tube Broadcast SUPERHET RADIO KIT $12.95

Model RS-5 tube AC-DC superheterodyne radio kit. Has loop antenna and 2 gang condenser, with lighted slide rule dial and attractive plastic cabinet. Receives broadcast, 550 to 1650 kc. Full size dynamic speaker, matched 456 I.F.'s, automatic volume control. This is a complete radio kit. Everything furnished, including diagram, photos and tubes: 12K8, 12SH7, 2—7E5 and 70L7. Shipping weight 7 lbs. Stock No. RS-5. Net price **$12.95.**

Build Your Own Phono-Mike Broadcaster $7.95

Kit Model DE-6R. With this simple kit, you can build a 3-tube phono oscillator that also has a mike input. Will broadcast over any radio, within your home, (about 75 feet) from crystal or crystal phono pickup. Fader control fades from mike to record. Ideal for a home P.A. system, baby listener and home entertainment. A complete kit of parts including tubes. Kit Model DE-6R. Net price, **$7.95.** DE-6RWT, wired and tested. Net price, **$9.95.** Crystal mike and desk stand, **$4.95** extra. Concealed microphone unit, only 1" in diameter and ¼" thick. Specify hidden mike when ordering. Stock No. T-001. Net, **$3.95** extra.

6-TUBE AC-2-BAND KIT $16.65

A New 2-band radio chassis kit, features 3-gang tuning, full AC circuit with power transformer, complete with diagram, all parts and tubes, 6SA7, 2 7A7, 7H6, 6K6, and 5Y3. Chassis size, 7" deep, 6" high, 12¼" long. 7½" slide rule dial. Very ideal for schools, etc. A straight forward superhet circuit complete except for speaker and cabinet. Output transformer is part of radio kit. Stock No. AA-61. Shipping weight 9½ lbs. Net price **$16.95.** 6" PM speaker **$2.79** extra, 8" PM **$3.49** extra.

5-STATION INTERCOM MASTERS $16.95

SUB-STATIONS $3.95

Model 2700 5-station intercom master, in an attractive walnut cabinet 10x5½x8", Push-button for each sub and talk-listen switch and volume control. AC-DC amplifier with lots of power and full size Alnico V PM speaker. 1950 production of a famous factory. Only 300 left, weight 7 lbs. Model 2700, net, **$16.95.**

Model MG-300 molded walnut plastic substation with call-back switch and heavy PM speaker. 5½x8½x3½", for wall or desk. Weight 2 lbs. Net, **$3.95** each; 5 for **$18.95.**

3 wire intercom cable, plastic, **$1.95** per 100 ft.; 500 ft., **$9.50.**

4-PRONG VIBRATORS $1.29

IN ALUMINUM SERRATED CANS

10 FOR $11.90

4 MILLION AUTO RADIOS BUILT IN 1950 AND HERE IS THE PERFECT REPLACEMENT VIBRATOR FOR MOST OF THEM.

Latest 1951 production by a top quality manufacturer. Fully guaranteed six months. Quiet running. A result of modern vibrator engineering and research. Replaces Motorola, Chrysler and any standard 4 prong non-sync Vibrator. McGee contracts for a tremendous quantity to take care of your 1951 needs. Stock #V-53 Standard 4 Prong Vibrator **$1.29** each. 10 for **$11.90**; 50 for **$55.00.**

NEW HEAVY DUTY 4-PRONG VIBRATOR $1.95

For 7-8 Tube Auto Sets $1.95

A standard 4 prong vibrator that lists for $4.90 costs service men $2.94. But you can buy this 8 point heavy duty vibrator at McGee for only $1.95 each, or 10 for $17.50. If you have had trouble with vibrators that don't hold up in the 7 and 8 tube original equipment auto radios, this is the vibrator that you should buy. Vibrator can is standard diameter and length. Fits Mopar, Chrysler, etc. Unit is a heavy duty, 8 point, non-sync type; especially designed for auto sets that draw more than 10 mils "B", such as 7 and 8 tube sets with push-pull 6V6's, 6K6's, etc. A long life vibrator offered to you at a saving. Fully guaranteed for 6 months. Stock No. V-90, **$1.95** each, 10 for **$17.50.**

WEBSTER CHICAGO

3-Speed Changer

$24.95

A Regular $47.50 List

Webster Chicago Model 100-16 3 speed automatic record changer with crystal cartridge and all speed Sapphire needle. (1 needle plays all records). Base size 12x12¾". Shipping weight 14 lbs. This offer good only as long as our stock lasts. A special purchase makes this offer possible. Webster Chicago 3 speed changer, Model 100-16, Sale price **$24.95.**

50-W. OUTPUT TRANS. ONLY $7.50 WHY PAY MORE

50-watt super quality high fidelity output transformer. Matches push-pull parallel or push-pull 6L6 tubes to 4/8/16-ohm voice coil, also 60 and 250 ohm line. Very efficient winding construction only 140 ohms, total resistance in primary, and 8-ohm voice coil tap only .2 of an ohm. This output transformer wastes a minimum amount of audio power due to heat loss within the transformer. Very ideal for public address amps. Stock No. 50-JB, net weight 5½ lbs. Bargain price **$7.50** ea., 2 for **$13.95.**

McGee's Super High Fidelity *Best Value in U.S.A.* OUTPUT TRANS. 20-20,000 CPS. $7.95

Model A-403 High fidelity output transformer. Why pay $20 or $30 for an output, when our A-403 is available at $7.95? Impedance, 6600 ohms plate to plate, (for PP 6L6 or 6V6), 10% feedback winding, 4-8-15-250 and 500 ohm secondary. Housed in a potted case. Net weight 6 lbs. Recommended for all amplifiers up to 34 watts.

TREMENDOUS SPEAKER AND BAFFLE SALE

ORDER 3 OR MORE TAKE 5% OFF

8" LEATHERETTE WALL BAFFLE AND PM $4.95

Stock No. 818—Tan Leatherette Covered Plywood Slanting Wall Baffle and 8-inch Alnico V Oxford PM Speaker with 3.2 Ohm Voice Coil. #818X same as 818 but with Heavier Oxford 8 PM with 8 Ohm Voice Coil, **$5.95.**

10" BAFFLE AND SPEAKER $6.95

Stock No. CA-10 10"—Tan Leatherette Wall Baffle with 10" Permaflux Alnico V PM Speaker, **$6.95.**

12" BAFFLE AND SPEAKER $9.95

Stock No. 1218X 12" Tan Leatherette Wall Baffle and 12" Heavy 6.8 oz. Alnico V Magnet 8 Ohm Voice Coil Oxford PM, **$9.95.**

TREMENDOUS SALE ON AUTOMATIC CHANGERS

GENERAL INSTRUMENT 78 R.P.M. Record Changer SCOOP PRICE $10.95

TWO FOR $21.00

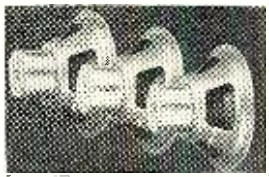
General Instrument 78 RPM automatic record changer. Plays 10- or 12-inch records automatically. One of the latest models made. Beautiful golden brown hammertone finished base, 12⅜x12⅞". Equipped with an Astatic L-70 crystal cartridge. Heavily flocked turntable and plastic fittings are deep maroon colored. This may be our last chance to offer a 78 RPM changer at this price. Comes packed two to a master carton, just like they would be shipped to a set manufacturer. Order 2 changers for an additional saving. Shipping weight for 2 changers, 20 lbs. Stock No. IT-SGI. Net price, **$10.95** each; two for only **$21.00.**

V.M. 3 SPEED Record Changers $22.95

VM Model 406 deluxe 3 speed automatic record changer—plays them all—intermixes records of the same speed—equipped with a flip over crystal pickup with twin needles—base size 12¼x13. Ship. weight 12 lbs. VM-406. Net, **$22.95.**

Buy the VM-950 changer with or without base. Choice of G.E. VR or crystal cartridge. We think the VM-950 record changer is the finest in America. It automatically plays all records all speeds and all sizes; 12 10-in., 33⅓ or 78 rpm. 10 12-in., 33⅓ or 78 rpm and 12 and 10-in. records of the same speed intermixed. 12 7-in. 33⅓ or 12 7-in. 45 rpm. Automatically shuts off after the last record. Size 13 13/16x17⅛x7¼ in. high. Offered with crystal cartridge, G.E. VR cartridge, or either with a base. VM-950. 3 speed changer with standard crystal cartridge and needles for 1 and 3 mil. (78 rpm, 33⅓, 45 rpm.) Net **$29.62.** VM-950GE. 3 speed changer with the new RPX-050 magic, all-in-one variable reluctance cartridge with stylus. Net **$32.80.** VM-955. 3 speed changer with crystal cartridge on a base. Net **$32.01.** VM-955GE. 3 speed changer with RPX-050 VR cartridge with base. Net **$35.19.**

SUPER HEAVY DUTY 10" PM $6.95



We made a special purchase on several hundred 20 watt, 10", 32 oz. Alnico 3 magnet PM speakers. Deep throat and easy moving cone. Ideal for all high fidelity sound systems and radio replacement. The magnet on this speaker is usually used on a 15" size. Very efficient, good high and bass response. You'll appreciate it when you get your hands on this speaker. Attractive copper finish. 8 ohm voice coil. Stock No. 1025PS. Weight 7 lbs. Net price **$6.95** each.

Order three of these and use them in a cluster of three. They will take 60 watts of audio and have more cone area than any 15" speaker. For high power, top quality P.A. work. Think this over. 3 No. 1025PS speakers for only **$19.95.**

BUY YOUR WIDE RANGE COAXIAL SPEAKER AT McGEE

12" COAXIAL PM $12.95

A $32.50 retail value. 20 watt 12" coaxial PM speaker of quality used on radios of the $300 to $500 bracket. Hook up like any PM speaker. High pass filter is built on speaker. Matches 8 ohm output of radio or amplifier. Wide range response. 20 to 17,500 CPS. Model **No. CU-14X.** Ship. wt. 9 lbs. Special sale price, **$12.95.**

15" COAXIAL PM $19.95

Only $19.95 buys a full 15", 20 watt coaxial PM speaker, with built-in high pass filter. Hook to any 8 ohm output on radio or amplifier. Response below 20 to above 17,500 CPS. Good bass response. A lucky purchase makes this price possible. Full 32 oz. magnet in the woofer. 5" tweeter. Model **P15-9.** Ship. wt. 11 lbs. Sale price, **$19.95.**

McGEE RADIO COMPANY Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER
1422 GRAND AVE., KANSAS CITY, MISSOURI

The Yagi Antenna

(*Continued from page 67*)

ohms. The problem involves the antennas shown in Fig. 6 and its schematic representation with the values superimposed in Fig. 9A.

Each antenna must have its impedance stepped up to 600 ohms at the junction point where the 300 ohm line to the set is connected. The two transformed impedances of 600 ohms each are in parallel. Paralleling these impedances gives an impedance of 300 ohms at the junction point, the exact impedance required to match the 300 ohm transmission line.

At first glance the problem appears simple. It would seem that all that is necessary is to use two sets of 425 ohm quarter-wave matching transformers to stack the two 300 ohm yagis. However, let us first consider how the characteristic impedance of parallel wire transmission is determined. The formula is:

$$Z = 276 \log 10 (2S/d)$$

where: S is the spacing between conductors, and
d is the diameter.

In other words, the impedance depends on the diameter and spacing. Bear in mind that practically every commercial stacked yagi is claimed to match 300 ohm line and uses ⅜" or ½" tubing for matching bars. These bars are usually spaced 3" apart. The chart of Fig. 8 shows the characteristics or surge impedances of the most commonly-used transmission line conductor sizes at various spacings.

In order to stack 300 ohm yagis it is necessary to use 425 ohm transmission line. In order to obtain a 425 ohm impedance using ⅜" line, the spacing should be approximately 6½". In order to get 425 ohms using ½" tubing, the spacing should be approximately 10".

Since most commercial television receiving yagis use ⅜" tubing spaced at 3", let's check the chart to determine the surge impedance of this line. The chart shows that the impedance is approximately 325 ohms. The schematic diagram of Fig. 9B shows that a 325 ohm transformer is tied to each 300 ohm yagi, resulting in two parallel impedances of 350 ohms or a net impedance of 175 ohms at the junction point.

Thus, the two single bay yagis which match the 300 ohm line present a 2 to 1 mismatch under ordinary methods of stacking. Two solutions to this problem are possible. First, it is possible to use 425 ohm stacking harnesses constructed of wire. Referring to the chart of Fig. 8, it will be seen that for a 425 ohm line at 3" spacing #6 wire must be used. Second, the impedance of each yagi can be lowered so that the ⅜" matching bars, with their characteristic impedance of 350 ohms, can be used to present two parallel impedances of 600 ohms. Schematically, Fig. 9C, the problem is as follows:

If we can lower the impedance of the yagi to approximately 200 ohms when stacking, this 200 ohm impedance will be transformed to 600 ohms by the ⅜" tubing matching bars. The two 600 ohm impedances in parallel result in a perfect 300 ohm match to the transmission line.

The *Channel Master Corp.* has achieved these results by means of a mechanical arrangement. To obtain a total impedance of 300 ohms in a single bay yagi, a three-conductor folded dipole is used. The 600 ohm impedance of the element is reduced to 300 ohms by the proper choice of spacing of the parasitic elements. See Fig. 1.

The bottom section of the fold contains the feed points, for the following reasons. In stacking this yagi the impedance is dropped to 200 ohms by removing the center conductor of the folded element, making it a conventional folded dipole. Since the tip-to-tip distance of the fold is one half-wave, the removal of the center conductor yields a pair of ⅜" quarter wave connecting bars. The same process is repeated on the other yagi and a full set of connecting rods is obtained. (Fig. 2) These are then used to connect the two yagis as shown in Fig. 3. The result is a yagi which provides a perfect match to 300 ohm line either in its single or stacked version. In this way the full value of stacking is realized and an additional gain of 3 db is obtained.

—30—

V.H.F.-DX EXPEDITION

OF interest to hams is the announcement of a 2-meter DX expedition which has been scheduled to take place during a 24-hour period, beginning Saturday, October 6th.

W5VWU is leading the expedition to Sandia Crest, 10,600 feet above sea level and 5000 feet above the surrounding terrain. Sandia Crest is approximately 9 miles northeast of Albuquerque, New Mexico.

Equipment for the expedition will include a 100 watt transmitter on a frequency of 144.14 mc., c.w. only, a multi-element beam (horizontal polarization), and a converter with two 6J4 grounded-grid r.f. stages. A low-powered transmitter will be used on a frequency of 7155 kc. to aid in coordinating the 2-meter schedules. Operation will begin at 4 p.m. (MST) on October 6th and continue for 24 hours.

All interested amateurs are urged to arrange a 2-meter sked with W5VWU by writing him at Sandia Park, New Mexico. A 40-meter schedule with interested stations will aid in establishing contact on 2 meters.

During periods for which no definite schedules have been set, the following arrangement will be used: The first fifteen minutes of each hour the beam will be oriented to the north; second period to the east; third period to the south; and the last fifteen minutes to the west.

Operators participating in the expedition include W5CA, W5LHF, W5VWU, and W5LZD.

—30—

EDW. H. GUILFORD
Vice President

I can train you to pass your FCC License Exams in a minimum of time if you've had any practical radio experience — amateur, Army, Navy, radio servicing, or other. My time-proven plan can help put you, too, on the road to success.

Let me send you FREE the entire story

Just fill out the coupon and mail it. I will send you, free of charge, a copy of "How to Pass FCC License Exams," plus a sample FCC-type Exam, and the amazing new booklet, "Money-Making FCC License Information."

How to Pass FCC License Exams

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Tells where to apply and take FCC examinations, location of examining offices, scope of knowledge required, approved way to prepare for FCC examinations, positive method of checking your knowledge before taking the examination.

Get Your FCC Ticket in a Minimum of Time

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TELLS HOW—

WE GUARANTEE

TO TRAIN AND COACH YOU AT HOME IN SPARE TIME UNTIL YOU GET

YOUR FCC LICENSE

If you have had any practical experience—Amateur, Army, Navy, radio repair, or experimenting

TELLS HOW—

Employers make JOB OFFERS Like These to Our Graduates Every Month

Telegram, August 9, 1950, from Chief Engineer, Broadcast Station, Pennsylvania: "Have job opening for one transmitter operator to start immediately, contact me at once."

Letter, August 12, 1950, from Dir. Radio Div. State Highway Patrol: "We have two vacancies in our Radio Communication Division. Starting pay $200; $250 after six months' satisfactory service. Will you recommend graduates of your school?"

These are just a few examples of the job offers that come to our office periodically. Some licensed radioman filled each of these jobs . . . it might have been you!

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY WITH OUR COACHING AT HOME IN SPARE TIME

Name and Address	License	Lessons
Lee Worthy 2210½ Wilshire St., Bakersfield, Cal.	2nd Phone	16
Clifford E. Vogt Box 1016, Dania, Fla.	1st Phone	20
Francis X. Foerch 38 Beucler Pl., Bergenfield, N. J.	1st Phone	38
S/Sgt. Ben H. Davis 317 North Roosevelt, Lebanon, Ill.	1st Phone	28
Albert Schoell 110 West 11th St., Escondido, Cal.	2nd Phone	23

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RN-34, 4900 Euclid Bldg., Cleveland 3, Ohio

TELLS HOW—

Our Amazingly Effective JOB-FINDING SERVICE Helps CIRE Students Get Better Jobs

Here are a few recent examples of Job-Finding results

GETS FIVE JOB-OFFERS FROM BROADCAST STATIONS

"Your 'Chief Engineer's Bulletin' is a grand way of obtaining employment for your graduates who have obtained their 1st class license. Since my name has been on the list I have received calls or letters from five stations in the southern states, and am now employed as Transmitting Engineer at WMMT."

Elmer Powell, Box 274, Sparta, Tenn.

GETS CIVIL SERVICE JOB

"I have obtained a position at Wright-Patterson Air Force Base, Dayton, Ohio, as Junior Electronic Equipment Repairman. The Employment Application you prepared for me had a lot to do with my landing this desirable position."

Charles E. Loomis, 4516 Genessee Ave., Dayton 6, Ohio.

OURS IS THE ONLY HOME STUDY COURSE WHICH SUPPLIES FCC-TYPE EXAMINATIONS WITH ALL LESSONS AND FINAL TESTS.

GETS JOB WITH CAA

"I have had half a dozen or so offers since I mailed some fifty of the two hundred employment applications your school forwarded me. I accepted a position with the Civil Aeronautics Administration as Maintenance Technician. Thank you very much for the fine cooperation and help your organization has given me in finding a job in the radio field."

Date E. Young, 122 Robbins St., Owosso, Mich.

Your FCC Ticket is always recognized in all radio fields as proof of your technical ability.

Get All 3 FREE

MAIL COUPON NOW

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RN-34—4900 Euclid Bldg.
Cleveland 3, Ohio
(Address to Desk No. to avoid delay)

I want to know how I can get my FCC ticket in a minimum of time. Send me your FREE booklet, "How to Pass FCC License Examinations" (does not cover exams for Amateur License), as well as a sample FCC-type exam and the amazing new booklet, "Money-Making FCC License Information."

NAME .....
ADDRESS .....
CITY ..... ZONE ..... STATE .....
Paste on penny post card or send air mail

TUBES LESS THAN DEALER COST

We won't get rich on these tubes. Olson bought some tremendous tube inventories from THREE BIG DEALERS who were overstocked. This is a beautiful deal. Every tube is brand new, individually boxed. Brands include Ken-Rad, Tung-Sol, Raytheon, Philco, Sylvania, etc.

Now is your chance to get the most popular tubes at prices that are unbelievably low. You can't lose. STOCK UP NOW.

5Y3GT, 6J5, 6N7GT, 35W4 — **59¢**

0Z4, 6AR5, 6AV6, 35Z5 — **69¢**

1U5, 6AL5, 6AU6, 6BA6, 6K6GT, 6S4, 6W4GT, 12SA7, 12SK7, 12SQ7, 50L6 — **79¢**

5U4G	$0.74
6BG6G	2.19
6BQ6GT	1.49
6CD6	2.79
6J6	1.39
6K7GT	.99c
6SN7	.99c
7N7	.99c

6CB6, 6V6GT, 25W4GT — **89¢**

1B3GT, 1X2, 6AG5, 12AU7 — **$1.19**

ALL AMERICAN TUBE KIT

Kit contains one each of the following:
12SA7—12SK7—12SQ7—35Z5—50L6
Buy popular tubes this easy way and save loads of money. Tubes are brand new fresh stock, famous brands. Packed in handy carton.
Order No. AS-11, per kit..... **$3.85**

MICROPHONE

High output crystal mike for PA systems and recorders. Equipped with handle base and 7' shielded cable. Shpg. wt. 5 lbs.
M-67, each..... **$5.95**
M-66, same but with on-off switch built into handle..... **$6.95**

BY-PASS COND. KIT

Giant Olson Value. Contains only genuine Cornell-Dubilier and Solar condensers all 600V and 1600V in capacities from .0001 mfd to .1 mfd. Attractively boxed. Contains 24 condensers. Reg. List Price $6.50.

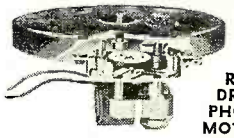
AS-40 **$1.99**

BUILD YOUR OWN RECORD PLAYER

PHONO AMPLIFIER

RA-19. **$3.98** LESS TUBES

A real high efficiency 3-tube amplifier of modern design. Connect to any crystal phono arm and speaker. Has volume and tone controls 7"x3¼"x2". Shpg. wt. 2 lbs.
SET OF TUBES FOR AMPLIFIER 12SQ7 50L6 35Z5
No. AS-22..... **$2.64**



RIM DRIVE PHONO MOTORS

Nationally famous brand. Self starting, complete with turntable. Operates on 115 volt AC 60 cy. Shpg. wt. 5 lbs.

SINGLE SPEED 78 RPM Stock No. M-52 **$3.79**

3 SPEED 33⅓ 45 78 RPM Stock No. M-63 **$5.99**

PICKUP ARMS

For 78 RPM discs. With Astatic cartridge. Shpg. wt. 2 lbs. M-58 **$2.99**

3 SPEED PICK-UP ARM

Cartridge flips by means of a lever. Equipped with dual cartridge, one side plays 33⅓ and 45 and other 78 RPM. Double needle included. M-64. Each..... **$4.95**

PHONO CARTRIDGE

Universal replacement for Astatic L-70, L-72, L-82, etc. 3 volts. Fresh Stock.
XC-30 single each.... $1.79 **$1.59**
Lots of 10, each.....

HIGH OUTPUT CARTRIDGE

Similar to above but delivers 9 volts. Can be used on 33⅓, 45, and 78 RPM discs.
XC-47 single each..... $2.19 **$1.99**
Lots of 10, each.....

10 WATT RESISTOR KIT

We mean to move 80,000 fine 10 watt wire wound resistors during this sale. REGULAR LIST PRICE OF THIS KIT IS $15.00. Each kit contains 20 popular insulated resistors, with tinned copper leads. Shpg. wt. 2 lbs.
AS-46. Kit of 20..... **$2.49**

HOOKUP WIRE KIT

$4.95 AS-19 500 ft.

500 ft. of high grade wire, various insulations: plastic, rubber, cotton, etc. Contains 5 rolls, each 100 ft., solid and stranded. Shpg. wt. 5 lbs.

VOLUME CONTROL KIT

10 ASSORTED SINGLE AND DUAL CONTROLS **$2.99** AS-44

List value $18.50. Contains 10 popular single and dual controls, with and without switch. All 10 cost you less than the normal price of just two if bought regularly.

FP CONDENSER KIT

Assortment of 15 popular FP condensers, double and triple sections. Capacities from 10 mfd to 50 mfd; from 25 to 450 volts. Shpg. wt. 3 lbs.
$3.98 AS-24, each

GENUINE UNIVERSITY REFLEX SPEAKERS

25 WATT DRIVER UNIT No. S-165 **$14.70** each

Unit is breakdown proof, will handle 25 watts continuously and is guaranteed for 1 year. Hermetically sealed, complete protection from outdoor exposure. Has dural 16 ohm voice coil and genuine bakelite diaphragm. Fits trumpet shown below or any other standard trumpet. Brand new factory sealed cartons. Shpg. wt. 6 lbs.

REFLEX TRUMPET No. S-164 **$14.41** each

Trumpet is heavy gauge metal finished with corrosion resistant paint. Equipped with famous adjustable UNIVERSITY "U" BRACKET. Mounts in any position. 16½" diameter. Has heavy rubber rim for improved tone. Brand new factory sealed cartons. Shpg. wt. 15 lbs.

Get both Driver Unit and Reflex Trumpet. Genuine University matched set..... **$29.11**

WILCOX-GAY TAPE RECORDER

PRICE SLASHED
Reg. Price $149.95
WHILE THEY LAST **$79.95** Ea.
Model 1B10

READ WHAT THIS WILCOX-GAY RECORDER WILL DO!

IT'S A RECORDER . . . a precision tape recorder without equal in the recording field. Makes a full hour of continuous recording on a five-inch reel of tape; 2 hours using both channels. (This is double the time of conventional recorders. The fidelity, clarity and low-noise reproduction of this fine instrument is remarkable. Makes tape recordings from microphone, built in 78 RPM turntable or from any external radio or phonograph. IT'S A PUBLIC ADDRESS . . . jack provided for plugging in any PM speaker permitting use as a PA system. IT'S A PLAY-BACK . . . plays tape back through built-in speaker, and rewinds at high speed. Also will play records if a PM speaker is plugged into external speaker jack. OTHER FEATURES . . . two-tone maroon leatherette case, complete with crystal mike, cord and plug and built-in speaker. Neon recording level indicator, tone and volume controls. Jack for monitoring. Size 18⅜x13x8". Shpg. wt. 25 lb. Operates on 105-120 V 60 cy AC.

OUTPUT TRANSFORMERS

Matches 50L6, 35L6, 25L6, etc. to any 3.2 ohm V.C. Size 1⅝" x 1¼". Shpg. wt. 1 lb.
No. T-92 Single each . . . 69c
Lot of 10, ea. **49¢**

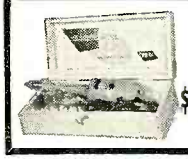
10 WATT WIRE-WOUND RESISTORS

R-16 **20¢ EA.** WHILE THEY LAST

Olson bought over $64,000 worth of these fine wire wound resistors (a famous manufacturer's entire stock). You can have them at 80% discount off list price. Stock up. Order whether you need them now or not. Regular list prices run from 75c to $1.10 each. These resistors are unaffected by heat, cold, or fumes. Winding is rigidly held in place on asbestos core by special formula. Stands terrific overloads. Accuracy 10%. FULLY GUARANTEED. Equipped with tinned leads.

TAKE YOUR CHOICE WHILE THEY LAST

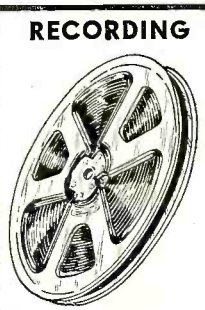
OHMS	OHMS	OHMS	OHMS	OHMS	OHMS
5	100	400	1200	3500	10,000
20	125	450	1250	4000	11,000
25	150	500	1500	5000	12,000
30	200	700	1750	6000	12,500
33	225	750	1800	7000	13,500
35	250	800	2000	7500	15,000
40	300	900	2250	8000	16,000
50	330	1000	2500	8500	
75	350	1200	3000		



FAIRCHILD GRINDER

TL-3 each **$9.98**

Every service shop needs one of these handy tools made by Fairchild, famous manufacturer of precision electric grinders. Regular nationally advertised price is $19.75. The set consists of 1—115 volt high speed, air cooled grinder, 6 assorted grinding wheels, 1 circular saw blade, 1 hardened steel reamer, 1 buffing brush, 1 abrasion stone and a natural finish wood case size 10"x5"x 3" to house the grinder. Shipped in original factory sealed cartons.

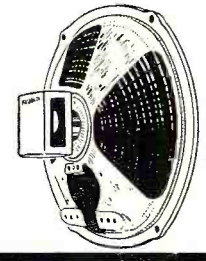


RECORDING TAPE—Famous Mfr's Close-Out!

Get the buy of your life. Save up to 64% on high quality RECORDING TAPE. A large manufacturer had to sell his inventory and he unloaded the whole deal. Olson now offers you this high grade recording tape at prices which defy competition. Standard ¼" wide, 1200 ft. long. Frequency response 50 to 8,000 cy. Plastic Reel included with each.

PAPER BASE— 1200 ft. Stock No. X-248 Single, each $1.69 Lots of 10, each **$1.49**

PLASTIC BASE 1200 ft. Stock No. X-249 Single, each $2.19 Lots of 10, each **$1.99**



MAGNAVOX & RCA SPEAKERS

12" and 8" Sizes

Think of it! Genuine Magnavox and RCA Speakers at a fraction of their real value. Yes—Olson really made a deal—a good deal—and you can cash in. These speakers are brand new, equipped with Alnico 5 magnets and dust-proofed 3.2 ohm voice coils.

STOCK UP NOW—THIS IS REAL VALUE

12" PM Speaker
Individually boxed
Stock No. S-140..... **$5.95**

8" PM Speaker
Individually boxed
Stock No. S-123..... **$2.99**

OLSON RADIO WAREHOUSE • 73 E. Mill St., Akron 8, Ohio

TV ANTENNAS

AU-62.

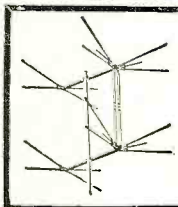
$3.83 Ea., in lots of 6

SOLD ONLY IN BOXES OF 6 ANTENNAS

$22.98

Carton of 6, wt. 25 lbs.

Here is a real bargain for TV installation men. Genuine Conical TV Antennas scientifically designed to give optimum reception. Highest grade aluminum tubing is used. Complete with antenna mmebers, reflector elements, cross arm and cross arm brackets. Less mast and 300 ohm twin-lead line. Take any size masts up to 1⅜" O.D. Packed in factory-sealed cartons of 6 Antennas to a box.



TV INSTALLATION MEN

If you install TV Antennas, Olson wants you to take advantage of this terrific Antenna Value. High gain Stacked Conical Array with high frequency stubs. Ideal for "Fringe" Area Reception. Sturdily constructed, elements are aluminum. Easily assembled.

THIS IS A TERRIFIC VALUE!

Each Antenna consists of two conical bays plus a pair of matching Q bars. Less mast. Packed—3 Antennas to a carton. This gives you six bays and 3 pairs of Q bars.

Sold Only in Boxes of 3 Antennas

AU-66. In lots of 3, each $8.66

Carton of 3..... Weight 25 lbs. $25.98

AMAZING RECORD PLAYER DEAL

$10 worth of RCA Discs Included

RA-60

$19.97

And best of all—this is not a kit. The phonograph comes to you completely assembled and factory tested. No troublesome wiring. No mistakes. Just plug in—put on the RCA non-breakable records which you get with the outfit and you have dependable entertainment. The amplifier employs 2 tubes, a 50L6 and a 35Z5. Motor is Alliance, the finest. The crystal tone arm is made by Astatic. Shure and Electro-Voice, in addition you get a complete set of RCA Victor non-breakable Children's Records which include such favorites as "Happy the Humburg," "The 500 Hats of Bathtolomew Cubbins," "Rapunzel," "Aladdin and His Lamp," etc. Discs are enclosed in beautifully colored albums giving each story so that the child can follow the recording. The cabinet is decorated with gay circus figures and the volume can be easily regulated by the full range volume control. Operates on 115 volts AC. Shpg. wt. 15 lbs. Don't delay, order several now. The price is low enough so it pays to order even for the parts contained.

Here is a once-a-year special. In this deal you get a nationally famous 78 RPM Record Player and $10.00 worth of genuine RCA Victor non-breakable children's records. You couldn't buy the parts alone at this price.

NO MORE WHEN THESE ARE GONE

*Look what the parts would cost if bought separately even at our SPECIAL SALE PRICE.

78 RPM Motor	$ 3.79
Phono arm and cartridge	2.99
Amplifier	3.98
Set of tubes for amplifier	1.89
PM Speaker	1.69
Output Transformer	.69
AC Cord	.29
Decorated Case	4.99
Set of RCA Victor Non-Breakable Records	10.00
	$30.31

PANEL LAMPS

Westinghouse, GE, and Tung-Sol bayonet panel lamps. 100 of a type to the box.

Stock No.	Type No.	Price per 100
X-161	47	$5.59
X-174	44	
PL-25	51	$3.99

Build a Receiver Set of Basic Components

Kit of 5 parts AS-38 $1.89

You get this kit of 5 basic parts to build an AC-DC set or portable:

Parts	Reg. List Price
Loop	$0.95
R. F. Coil	1.10
I.F. Transformer (456 KC) Input	1.60
Output	1.60
Oscillator Coil	.75
List Price of Set	6.00

Use any 365 mfd variable for tuning. Covers 535-1625 KC.

Reg. List Price $18.38. AS-36

OLSON'S NEW AKRAD KIT —WITH 4-DRAWER STEEL CABINET FREE

$6.95

We have a limited quantity of Olson Akrad "Super Sealed" by-pass condensers available in 4 drawer steel cabinets, size 6½x5¾x8⅛. Drawers have compartments. Condensers are designed to give long, dependable service even in the tropics. Kit Contains 42 Condensers. You get the 4 drawer steel cabinet and the following 42 Olson Akrad "Super Sealed" by-pass condensers.

Qty.	Cap.	Volts	Qty.	Cap.	Volts
2	.001	600	10	.05	600
2	.002	600	10	.1	600
2	.005	600	2	.005	1600
5	.01	600	2	.008	1600
5	.02	600	2	.01	1600

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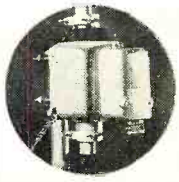

The Alliance Tenna-Rotor makes it possible for you to "beam" or turn your antenna in the direction best suited to pick up any TV station within range. When so turned the signal delivered by the antenna to the TV set is increased by giving you a better, clearer picture. The rotator unit is fully enclosed in a moisture-proof housing, factory lubricated for life. Bearings are stainless steel. Works in any weather. Guaranteed for a full year. Approved by Underwriters' Laboratories. Can be used on all masts up to 1¾" diameter. Takes up to a 20 lb. antenna. For heavier antennas also order the Thrust Bearing Bracket shown below. Operates on 115 V. 60 cy AC 30 watts. Rotates clockwise or counter-clockwise full 360° at 1 RPM. Available in 3 models. Shpg. wt. 15 lbs.

AU-15. MODEL ATR. Tenna-Rotor with control box which shows end of 360° rotation by means of an indicator lamp on control box. Does not show direction of antenna. Each $20.53

AU-12. MODEL DIR. Tenna-Rotor with control box which employs an indicator dial showing direction antenna is beamed. Each $26.43

AU-21. MODEL HIR. Tenna-Rotor with automatic control box. You set the pointer for direction desired and antenna turns to that direction and stops automatically. Each $26.43

4 CONDUCTOR CABLE

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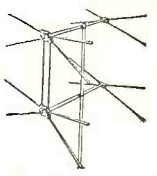
AU-13. each $2.91



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OLSON AKRAD

OLSON RADIO WAREHOUSE • 73 E. Mill St., Akron 8, Ohio

Vacuum Tube Keying

(*Continued from page* 51)

the keyed stage will only drop 12 or 15 volts which normally may be disregarded. In other words, you can add this simple keyer to your existing rig without a major rebuilding job. One 6AS7G will handle 100 mils or so, so several tubes in parallel are not needed as, for example, when type 45's are used.

Referring to the diagram, there is no advantage in making R_2 variable and any value from 5 to 6 megohms will be satisfactory. Shaping of the waveform is accomplished by varying R_3 and selecting the proper condenser by means of S_1.

C_2 is necessary, in most applications, to prevent a click on the "break," and does no harm in circuits where its use is not essential. The filter condenser, C_1, may be any value from 2 μfd. up, of adequate voltage rating. High voltage, high capacity electrolytics are cheap and available. The bleeder resistor R_1 serves only to keep C_1 discharged. It may be omitted if desired as it contributes nothing to the operation of the keyer.

The key, of course, plugs into J_1, using an ordinary phone plug, and the output to the cathode of the keyed circuit terminates in a cord and phone plug which is plugged into the keyed stage. Be sure the lead to the barrel of the plug goes to ground. The a.c. input terminates in a standard a.c. plug. No switch is provided since the unit is switched on at a master switch along with the transmitter. A single-pole, single-throw toggle switch may be inserted in the a.c. lead if desired.

The unit can be installed in a spare corner of the transmitter or may be built on a small separate chassis. Approximate cost of all parts at today's "sale prices" is close to $15.00. The keyer tube (6AS7G, figured in above cost at $6.50) is expensive if purchased at the regular price but they are occasionally available at "bargain prices" and it will pay to shop around.

Five of the fixed condensers, the rotary switch, and the switch plate may be omitted with a certain loss of flexibility for use in various circuits. The author has found that a .004 μfd. condenser in the keyer tube grid circuit will satisfy 90% of the requirements.

Operation and adjustment is easy and foolproof. Plug the unit into the a.c. line and the transmitter key jack. Plug the key into the unit. With an oscilloscope, the waveform may be adjusted by R_3 and S_1 to give the exact shape desired. As an oscilloscope is generally not standard ham equipment, the desired keying characteristics may be determined by listening to the note on your own receiver. For click elimination, check with the receiver's b.f.o. turned off. Clicks, when present, show up better with the receiver in the "phone" position than when the b.f.o.

is operating. When checking, adjust your receiver to its broadest position and do not use the limiter.

After checking on your own receiver, get comments on your keying during actual contacts over the air. With only two controls, testing with another station is made easy. Be careful not to get your keying too "soft" or characters will tend to run together when received at a distance or during periods of QSB. Avoid a chirp or tail at the end of characters of course. The best characteristics, both to avoid clicks and for average reception, are a soft "break" and a fairly heavy "make." —30—

Clipper-Amplifier

(*Continued from page* 65)

The rise of the output pulse obtained is approximately .13 microsecond, while minimum pulse width (70% of peak) is approximately .16 microsecond. The output signal remains constant at about 7 volts peak irrespective of pulse width, PPS, or pulse polarity.

Application

General applications of the pulse generator have been adequately covered in previous articles. However, the special clipper circuit described may be used in many other applications. One such application is as a clipper in a square-wave generator (*El-Tronics* Model SG-5). Other applications include its use as a noise limiter, peak clipper, FM limiter, etc. In different applications it may be necessary to vary the circuit parameters for optimum operation. In some applications, it is found desirable to provide bias on the 6BN6 tube. This may be accomplished by using a conventional cathode resistor with suitable bypass condenser.

Additional applications will suggest themselves to the experimenter working with this circuit and with the gated-beam tube. —30—

SAW-TOOTH GENERATOR

By MILTON HERMAN

MOST television technicians have found a need for a variable frequency saw-tooth generator for checking troubles in the vertical and horizontal circuits of TV receivers without realizing that they actually have such a generator in their oscilloscopes.

The signals can be made readily available by adding a binding post and connecting to the plate of the horizontal amplifier tube through a 1 μfd., 600 v. condenser. The saw-tooth is then available between this terminal and any one of the ground binding posts. The coarse and fine frequency controls can then be used to vary the output frequency and the horizontal gain control regulates the output voltage.

The brightness control of the oscilloscope should be turned to the minimum position while the scope is being used as a saw-tooth generator so that burning of the cathode-ray tube will be avoided. —30—

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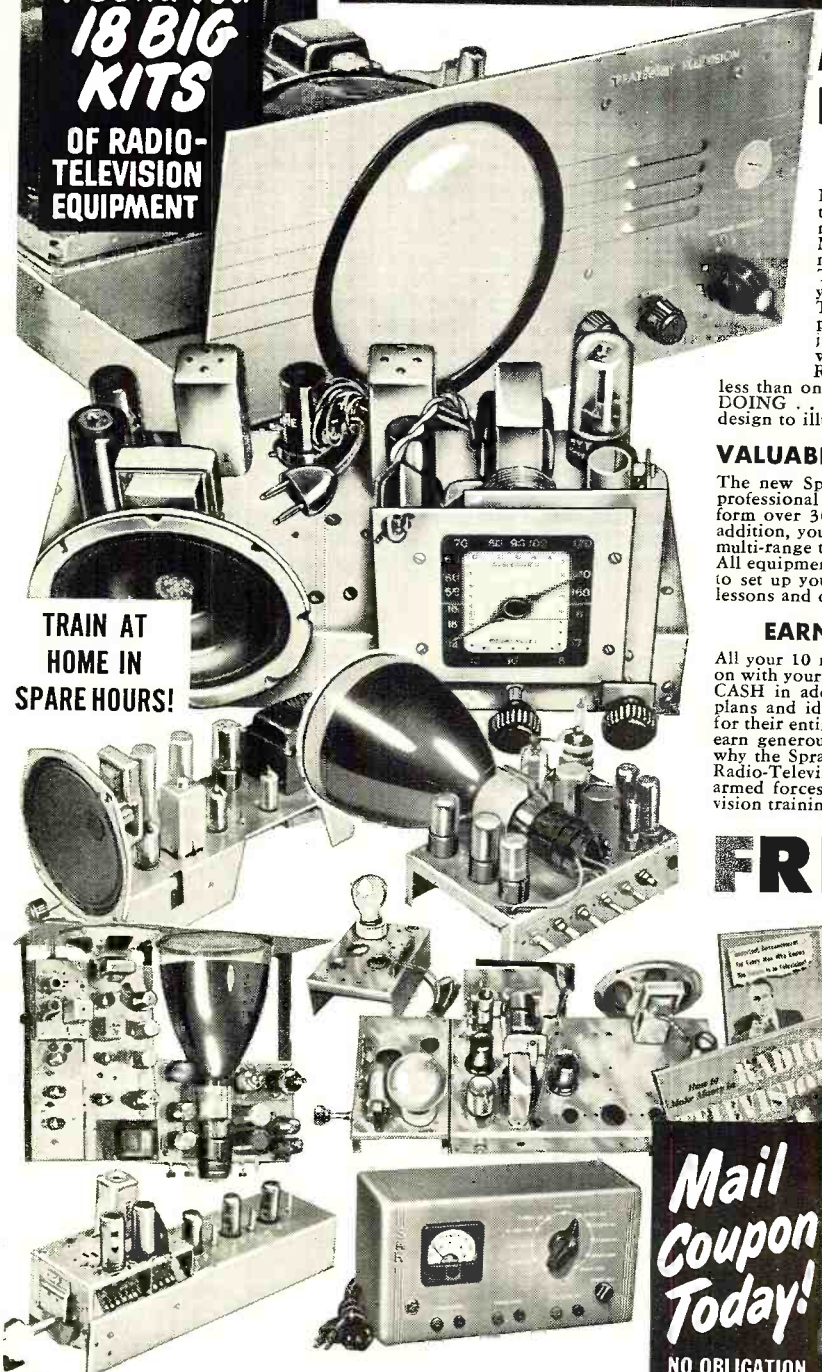

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2J46 ....39.50	12GP7 ....16.95	721A 2.59	1624 .... 2.39	RK62 .... .59	2B7 .... .75	6L5G .... .89	12AU7 .... 1.15	53 .... .98
2J48 ....29.50	12HP7 ....16.95	722A 2.95	1625 .... .45	RK73 .... .59	2V3G .... .79	6L6G 3.00	12AV6 .... .73	56 .... .65
2J49 ....39.50	12LP4 .... 22.50	723A/B ...14.95	1626 .... .45	RX21A 2.95	2X2 .... .65	6L6GA 1.75	12BA6 .... .85	57 .... .80
2J50 ....29.50	15E 1.19	724B 3.89	1629 .... .35	RX120 .... 8.95	2X2A 1.60	6L7 .... .98	12BE6 .... .87	58 .... .85
2J54B 39.50	15R .... .89	725A 7.95	1630 .... .98	V70D 6.95	3A4 .... .65	6L7G .... .95	12BH7 .... .79	59 .... .95
2J55 ....97.50	16AP4 ....42.50	726A 6.95	1631 .... 1.29	VR78 .... .69	3A5 .... .90	6N7 .... .89	12C8 .... .79	70L7 .... .95
2J61 ....49.50	16KP4 ....42.50	726B 29.50	1632 .... .79	VR91 .... 1.49	3B7/1291 .. .59	6Q7 .... .95	12F5GT ... .79	75 .... 1.25
2J62 ....49.50	19T8 .... 2.90	726C 49.50	1633 .... .75	VR92 .... .98	3D6/1299 .. .59	6R7 .... .85	12H6 .... .82	76 .... .55
2K25/	23D4 .... .45	730A 12.95	1634 .... .75	VT127A 3.95	3LF4 .... .95	6S7G .... .98	12J5GT ... .55	77 .... .60
723AB..29.50	28D7 .... .98	735/TTL ... 79.50	1635 .... 3.25	VT158 .... 14.95	3Q4 .... .79	6S8GT ... 1.05	12J7GT ... .82	78 .... .79
2K28 .... 36.25	30 Special. .59	800 .... 1.95	1638 .... .65	VU29 .... 2.95	3Q5GT ... .85	6SA7 .... .85	12K7GT ... .79	80 .... .73
2K29 ....24.50	35TG 4.95	801A .... .49	1641 .... .98	VU111 .... 1.49	3S4 .... .85	6SC7 .... 1.30	12K8 .... .89	82 .... .89
3AP1 .... 12.95	45 Special. .39	802 .... 4.49	1644 .... .98	WL468 ....12.95	3V4 .... .90	6SD7GT ... .98	12Q7 .... .69	83 .... 1.15
3B22/Elic. 2.95	53A 5.95	803 .... 4.49	1654 .... 2.39	WL530 .... 12.75	5R4GY 3.75	6SF5 .... .89	12SA7GT ... .93	83V 1.15
3B23/RK22 4.85	75TL 6.95	804 .... 9.95	1655 .... 1.49	WL531 .... 12.75	5T4 .... 1.95	6SF5GT ... .89	12SC7 .... .99	84/6Z4 .... .85
3B24 .... 5.95	100TH 9.95	805 .... 4.49	1851 .... 1.89	WL532 .... 2.95	5U4G .... .73	6SF7 .... .98	12SF5 .... .89	85 .... .89
3B24W 5.95	121A 2.98	806 ....29.95	1960 .... .79	WL578 .... 1.29	5V4G 1.12	6SG7 .... .98	12SF7 .... .89	89Y .... .45
3B25 .... 4.65	203A 8.95	807 .... 1.98	1961 .... 4.99	WL616 ....37.50	5W4 .... .81	6SH7 .... .73	12SG7 .... .79	1171.7/M7 . 1.35
3B26 .... 3.95	204A 69.50	808 .... 7.25	2050 .... 1.25	WL619 ....18.95	5X4G .... .89	6SJ7 .... .89	12SH7 .... .73	117N7 ... 1.35
3B27 .... 3.95	212 .... .89	809 .... 2.45	2051 .... .65	WL677 ....34.50	5Y3GT .... .63	6SK7 .... .89	12SJ7 .... .79	117P7 ... 1.35
3B28 .... 8.95	212E 49.50	810 .... 9.95	8005 .... 5.95	WL681 ....22.50	5Y4G .... .73	6SL7GT ... .98	12SK7 .... .98	117Z3 ... .89
3BP1 .... 8.95	215A .... .19	811 .... 3.25	8011 .... 1.75		5Z3 .... .89			117Z6 ... .90
3C22 ....64.50	217C 8.95	812 .... 2.95	8012 .... 3.95					
3C23 .... 9.95			8013 .... 2.95					

FULL-WAVE SELENIUM RECTIFIER STACKS

Max. A.C. Input Volts RMS	Max. D.C. Volts Output	Cell Size in Inches	Max. D.C. Amps. Output Continuous	Order by This Number	Price
SINGLE PHASE BRIDGE					
0-18	0-14.5	1¾″ x1¾″	1.3	18B4D1S1	$ 3.95
"	"	2-3/16″ x2-3/16″	2.4	18B4E1S1	4.95
"	"	3⅜″ x3⅜″	6.6	18B4F1S1	7.95
"	"	4½″ x5″	13.0	18B4K1S1	12.95
"	"	5″ x6″	17.5	18B4J1S1	15.45
"	"	4½″ x5″	26.0	18B4K1S2	22.50
"	"	4½″ x5″	39.0	18B4K1S3	37.50
"	"	4½″ x5″	52.0	18B4J1S3	47.50
"	"	4½″ x5″	70.0	18B4J1S4	54.50
0-40	0-34	1¾″ x1¾″	0.60	40B4D1S1	4.95
"	"	2-3/16″ x2-3/16″	1.2	40B4EW1S1	6.95
"	"	3⅜″ x3⅜″	3.2	40B4FW1S1	9.75
"	"	4½″ x5″	6.0	40B4K1S1	14.95
"	"	5″ x6″	9.0	40B4JW1S1	17.50
"	"	4½″ x5″	12.0	40B4K1S2	28.75
"	"	5″ x6″	18.0	40B4JW1S2	34.50
"	"	4½″ x5″	25.0	40B4J1S3	42.50
"	"	4½″ x5″	34.0	40B4J1S4	54.25
"	"	5″ x6″	36.0	40B4JW1S4	62.25
0-120	0-100	1¾″ x1¾″	0.60	40B4D3S1	12.45
"	"	2-3/16″ x2-3/16″	1.2	40B4EW3S1	14.95
"	"	3⅜″ x3⅜″	3.2	40B4FW3S1	24.50
"	"	4½″ x5″	6.0	40B4K3S1	32.50
"	"	5″ x6″	9.0	40B4JW3S1	42.50
CENTER-TAP					
10-0-10	0-8	1¾″ x1¾″	1.2	20C2D1S1	2.35
"	"	2-3/16″ x2-3/16″	2.4	20C2EW1S1	3.10
"	"	3⅜″ x3⅜″	6.4	20C2FW1S1	4.25
"	"	4½″ x5″	12.0	20C2K1S1	6.95
"	"	5″ x6″	16.0	20C2J1S1	8.95
"	"	4½″ x5″	24.0	20C2K1S2	14.75
"	"	4½″ x5″	36.0	20C2K1S3	19.65
"	"	4½″ x5″	48.0	20C2J1S3	27.50
"	"	4½″ x5″	64.0	20C2J1S4	34.50
"	"	4½″ x5″	80.0	20C2J1S8	42.50
"	"	4½″ x5″	84.0	20C2KW1S7	49.50
"	"	5″ x6″	96.0	20C2J1S6	55.50
"	"	4½″ x5″	128.0	20C2J1S8	67.50
3 PHASE BRIDGE					
0-120	0-150	1¾″ x1¾″	0.90	40B6D3S1	24.50
"	"	2-3/16″ x2-3/16″	1.8	40B6EW3S1	29.50
"	"	3⅜″ x3⅜″	4.75	40B6FW3S1	42.50
"	"	4½″ x5″	9.0	40B6K3S1	79.50
"	"	5″ x6″	12.5	40B6J3S1	86.75

SPECIAL RECTIFIERS ON REQUEST

TRANSFORMERS—115V 60 CY HI-VOLTAGE INSULATION

2700v @ 2 MA; 6.3v @ .6A; 2.5v @ 1.75A..$ 4.45
2500v @ 15 MA..... 3.49
2000-0-2000v @ 800 ma..... 24.95
1540v @ 5MA; 340-0-340 @ 300 MA..... 4.35
925v @ 10 MA; 525-0-525v @ 60 MA; 2X5v @ 3A; 6.3v @ 3.6A; 6.3v @ 2A; 6.3v @ 1A 4.85
415-0-415v @ 60 MA; 5v CT @ 2A; 115/230 Dual Pri..... 4.25
400-315-0-100-315v @ 200 MA; 2x6.3v @ 9A; 5v @ 3A; 2.5v @ 2A..... 5.35
325-0-325v @ 12 MA; 255-0-255v @ 240 MA. 4.25
300-0-300v @ 65 MA; 6.3v @ 2.5A; 6.3v @ 1A; 2x5v @ 2A..... 3.25
0-17.4/21.6/25.8v @ 400 MA; 6.4v @ .5A; 2.6v CT @ 2.5A Pri 115/230..... 3.85
12.6v CT @ 10A; 11v CT @ 6.5A..... 6.35
3x10v @ 7A..... 6.95
6.5v @ 12A; 6.3v @ 2A; 115v @ 1A..... 3.50
6.5v @ 8A; 6.5v @ 6A; 2.5v @ 1.75A..... 4.17
6.3v @ 1A; 2.5v @ 2A..$2.29 4-0-4v @ 1A .87
6.3v CT @ 1A..... 1.29
5v CT @ 20A; 10 KV INS..... 8.95
.6v @ 15A RMS..... 1.47

TRANSFORMERS—220v 60 Cyc

512.5-0-512.5 @ 427 MA.....$ 5.35
3x5v @ 6A; 4v @ 25A..... 2.95
3x6.3v CT @ 3A; 6.3v CT @ 1.6A..... 2.95
10v CT @ 6.5A; 6.3v CT @ 2.5A; 6.3v CT @ 1.8A 220/440 Pri..... 3.95
Step Up/Down 110/220. 500 watt..... 10.95

FILTER CHOKES HI V INS

.025 HY @ 1.36A.$1.98
3 HY @ 50 MA... .39
5 HY @70 MA/.2 HY @ 350 MA Dual 2.39
10 HY @ 55 MA.. .89
10 HY @ 250 MA.. 3.95
10 HY @ 100 MA.. 1.29
13 HY @ 130 MA.. 1.59
15 HY @ 70 MA.. 1.39
10/20 HY @ 85 MA. $1.49
15 HY @ 100 MA.. 1.69
15 hy @ 800 ma.. 6.95
5.3 HY @ 225 MA. 2.79
6.6 HY @ 175 MA. 2.10
8 HY @ 150 MA.. 1.79
200 HY @ 10 MA. 2.95
325 HY @ 2 MA.. 2.95
600 HY @ 1 MA.. 2.95

OIL CONDENSERS—DC RATINGS

3X.1 MFD	600v	$ .59	.1	MFD	2500v	$1.15
.25	"	" .35	.25	"	"	1.25
.5	"	" .45	.5	"	"	1.35
1	"	" .69	2	"	"	3.45
2	"	" .85	.01	"	3000v	1.25
2X2	"	" 1.15	.05	"	"	1.30
4	"	" 1.29	.1	"	"	1.35
6	"	" .98	.25	"	"	2.75
8	"	" 2.49	.5	"	"	2.85
10	"	" 2.79	1	"	"	2.95
3X.1	"	1000v .85	2	"	"	4.25
.5	"	" .89	4	"	"	6.95
1	"	" .67	1	"	3600v	3.98
2	"	" 1.75	.25	"	4000v	3.49
4	"	" 1.85	.5	"	"	3.75
8	"	" 3.55	1	"	"	3.95
14	"	" 3.85	2	"	"	5.75
20	"	" 4.25	3	"	"	5.89
.5	"	1500v 1.02	.1	"	5000v	2.75
1	"	" 1.19	.25	"	"	2.95
2	"	" 1.69	1	"	"	3.10
4	"	" 2.69	.1	"	7000v	3.75
.1	"	2000v 1.75	.02	"	7500v	2.25
.25	"	" 1.92	.03	"	"	2.35
.5	"	" 1.95	.05	"	"	2.35
1	"	" 2.09	.1	"	"	4.95
2	"	" 2.85	2X.1	"	"	7.95
4	"	" 4.45	.02	"	12000v	12.95
8	"	" 4.95				

HIGH CAPACITY CONDENSERS

2X3500 MFD	25v	$3.47	200	MFD	35v	$ .57
2500	"	3v .35	100	"	50v	.45
3000	"	25v 2.45	4000	"	30v	3.25
650	"	80v 1.29	2350	"	24v	2.25
2000	"	15v 1.69	10000	"	25v	4.57

PHONE DIGBY 9-0347
WRITE FOR QUANTITY PRICES

Prices subject to change without notice. F.O.B. NYC. minimum order $10.00. 20% deposit required. All merchandise guaranteed.

RADIO HAM SHACK Inc.
189 GREENWICH STREET . NEW YORK, N. Y.

WANTED! WANTED!

ATTENTION colleges, schools, hams, industrials!! Highest prices paid for surplus equipment, parts, and tubes. We are especially looking for test equipment TS-12, 13, 35, 14/AP, 15/AP, 146/UP, 173, 174, 175, 239, 259, 263. Any types with TS prefix. Write, wire or call.

R·H·S
SPECIALS OF THE MONTH

WANTED! WANTED!

APR-4, 5, 7 and tuning units. ARC-1, 3. ART-13, ATC. APS-10. microwave equipment in S, K, X-band. APS-15, APQ-13. APS-32, SCR-300, 284, 694, etc. BC-221, 342, 348. BC-1016 tape recorders. Write, wire or call.

RADAR—COMMUNICATIONS AND TEST EQUIPMENT

TS-35/AP X-band Signal Generator. Pulsed and C.W. freq. range. 8400-9600 mcs. This unit will measure power and frequency. 115v 60-2600 cyc.

TS-3/AP S-band Frequency and Power Meter. Portable. Battery operated. Complete with all cables.

TS-33/AP X-band Frequency Meter. 8500-9600 mcs. Contains crystal detector and indicating meter. Output to scope will indicate pulse wave shape.

TS-62/AP X-band Echo Box. 8400-9600 mcs. tuned and untuned input. Will indicate resonance on meter. Complete with pick up antenna and cable.

TS-268/UP Crystal Diode Test Set. Used to check 1N21, 1N22. 1N23, etc. Battery operated. Portable. Complete with spares.

TS-89/AP Voltage Divider. 1:10 and 1:100 ratios. Wide band for true pulse shape. Output to scope.

TS-10/APN Altimeter Test Set. Good condition. Complete with cables and dummy antenna **$35.00**

TS-12/AP V.S.W.R. Test Set for X-band. Complete with amplifier, slotted line, termination, adaptors, etc. In 2 carrying cases. Excellent.

TS-45/APM-3 X band signal generator. 8400-9600 mcs pulsed & CW output. Used to check APS4 and similar sets.

TS-36/AP X-band Power Meter. Consists of power measuring circuit. Horn antenna, co-ax to wave guide adaptor, connecting cable and probe. Will measure either absolute or relative power. Nominal band of usefulness is approx. 8.5-9.7 KMC. Excellent condition.

TS-125/AP S-band power meter. Sensitivity 2 M.W. full scale. Accuracy ±0.5 DB from 9-11 CM. powered by 1½v flashlight batteries. Excellent.

TS-174/U Freq. Meter. Freq. range is 50-250 mcs. High freq. version of BC-221. Excellent Condition **$385.00**

TS-16 Altimeter Test Set. Used to check various altimeters or as an accurate wavemeter. New **$29.95**

TS-61/AP S-band Echo Box. Using meter provided it is possible to maximize the XMTR adjustment and determine relative power output. Complete with probe and cable. Very good condition. **$140.00**

TS-13/AP Xa band signal generator, wave meter, wattmeter. Precision lab microwave. Test set. Will provide either pulsed or CW output in Xa band. Input 115v 60-800 cyc.

TS-226/AP used to measure peak power output of any xmitter in the range of 200-1000 mcs. Has provision for oscilloscopic signal observation and built in calibration. Part of AN/APM-29. Excellent.

TS-69/AP freq meter covering range of 400-1000 mcs. complete with calibration charts, antenna & crank. In metal carrying case. Excellent **$72.50**

TS-170/ARN-5 XTAL controlled test osc. with the following freq. ranges: 332.6, 333.8, 335.0 depending on XTAL in use. This set is used to align glide path receivers. Batteries and antenna are self contained. Excellent condition.

OTHER TEST SETS

TS-278/AP	TS-189/U	TS-92/AP
TS-102/AP	TS-110/AP	1E-36
TS-47/APR	TS-164/AR	TS-59/APN
TS-184/AP	TS-19/APQ-5	TS-23/APN

AN/APS-3 Airborne X-band Search and Homing radar. Complete. Contains RF head, modulator, synchronizer, control boxes, plugs, antenna, etc. 115v 400 cyc. Excellent condition **$875.00**

SQ 10 CM PORTABLE RADAR. This set is a very compact search radar. Complete installation available. Brand new in carrying cases with complete maintenance spares including extra trans. rec. ind. Tech. data as follows:

power input: 90-130v cy cyc.; pulse rate: 800 cyc.; range: 3, 15, 45 miles; pulse width: 1 microsec.: 300 yds. min. range, all ranges: I.F.F. synch. output available: accuracy ±5°: power output 1 KW: beam width: 8° horiz. 15° vert.; presentation: A.B. P.P.1.

AN/APS-15 R.F. Head and Modulator. X-band. Complete with all tubes. Good condition **$99.50**

SCR-504, lightweight portable direction finder covering the range of 100 KC to 65MC. built into a leather suitcase & was used to track down illegal transmitters. New & complete with spares.

DYNAMOTORS AND POWER UNITS

Type	Input Volts	Output Volts	Amps	Price
DM-19	12	500	.200	$ 6.95
PE-125	12v/24v	475	.200	14.50
DM-32	28	250	.060	3.75
DM-33	28	570	.160	2.95
DY-12	12	275	.110	
		500	.50	
PE-73	28	1000	.350	10.00
PE-94	28	300	.260	
		150	.010	
		115	.5	2.25
PE-97	Vibrator Power Supply			8.95
PE-98	12v	300v		35.00
800-1 inverter	28v	110v	800 cyc	40.00
PE-103	6 & 12	500	.160	35.00
PP-18-AR	Vibrapack			15.95
RA-42	(for BC-639 Receiver)			29.95
ATR	Inverter 12v	110v AC	125 watts	14.95

PHONE DIGBY 9-0347

WRITE FOR QUANTITY PRICES

Prices subject to change without notice. F.O.B., NYC minimum order $10.00. 20% deposit required. All merchandise guaranteed.

AN/CRT-3 Victory Girl. Dual frequency emergency lifeboat xmitter. Complete with xmitter, kite hydrogen generator, etc. New in knapsack. C.A.A. approved **$69.50**

AN/APR-5 Radar Search Receiver. Freq. range 1000-3100 mcs. Will detect signals up to 10,000 mcs. with reduced sensitivity. Contains oscillator and mixer cavity, IF strip, power supply. Input 60-2600 cyc. 115v. Excellent condition.. **$375.00**

T-50 Radiotelegraph Transmitter complete with power supply and all accessories with spares. Portable. New in cases **$275.00**

AN/APT-5 300-1500 mcs. xmitter cavity oscillator using 3C22 lighthouse tube. Power output 30 watts. Noise modulated. Excellent condition. Complete with all tubes **$149.50**

SK-1M Radar Receiver Indicators. Freq. 195 mcs. 2 R.F. stages, 3 IF stages. 1 video, etc. New condition **$125.00**

AN/TPS-1 SEARCH RADAR. This is a pack portable ground search radar for the detection of aircraft up to 100 miles. Range and azimuth data is displayed on a 7" P.P.1 and a 5" "A" scope. This set was called the G.I.'s radar because of its ruggedness, dependability and ease of servicing. Complete tech data is as follows:

Range Max. 100 Mi. Min. .25	P.R.R. 200 Per Sec.
Azimuth Mech. 360° Automatic 360° Accuracy ±3°	Pulse Width 2 Micro Sec.
Scanning Manual Automatic	Beam Width 3° Horiz. 13° Vert.
Presentation 7" P.P.I. 5" A Scope	
I.F.F. not provided but has provision for. Frequency 1074-1086 Mcs.	Power Input 1100 W at 115V 400 Cyc. and 180 W at 27V D.C.
Power output 150 K.W.	Weight: 1,518 Lbs.

AN/PPN-1 EUREKA! Ground portable, beacon responder. Unit will work into the AN/APN-2 transponder for purposes of homing. C.W. communication can also be carried on between plane and ground. Unit comes complete with xmitter, receiver, power pack, phones, etc. Brand new in knapsack. AN/APN-2 EQUIPMENT CAN BE SUPPLIED ON ORDER.

SCR-269/G Automatic Radio Compass. Freq. range 200-1750KC. Complete with BC-433-G receiver, BC-434, LP-21, 1-81. 1-82, BK22. etc. Very good condition **$129.95**

SCR-300 Frequency Modulated Transceiver. Freq. range 40-48 mcs. complete with 18 tubes, handset and antenna. Powered from self contained battery pack. Excellent condition. Weight approx. 35 lbs. with battery, each **$275.00**

TCS Marine Radio Telephone and Telegraph Xmitting and Receiving Equipment. Freq. range 1500-12000KC. Consists of xmitter, receiver, antenna loading coil, remote control box, power unit, cables, etc. Power input is 12 or 32v DC. We can supply an 110v AC power supply for stationary use at additional cost. Excellent condition.

SCR-536 Xmitter-Receiver (handy talkie). Freq. range 3885-5500KC. Complete with coils, tubes, crystals. Very good condition **$89.95**

AN/APA-10 Panoramic Adaptor for use with any receiver with following IF's: 455KC. 5 mcs, 30 mcs. Unit will give panoramic presentation (1 mc wide for 455KC input) (100KC for 5MC input) (2MC for 30 mcs input). Power input 115v 400 cyc. but can be changed with the addition of a proper power transformer. Excellent condition **$175.00**

10 CM R.F. package. 2700 mcs. Consists of BC-1007 modulator & BC-1091 RF head. Power output approx. 40 KW. Complete with tubes **$195.00**

RT-39/APG-5 10 CM LHTR R.F. head & modulator. Low power approx. 2 KW. Lighthouse tube rec & trans w/T.R. tunable. New **$135.00**

SCR-510 Freq. Modulated Portable Transceiver. Covering range of 20.0-27.9 mcs in 80 channels 100KC apart. Complete equipment consisting of BC-620 transceiver, power supply PE-97A, T-17 mike, handset, AN-45 antenna, battery operated or 6 or 12v input. Excellent condition.. **$69.95**

SCR-610 similar to SCR-510 except for freq. range which is 27.0-38.9 mcs. Excellent condition **$79.95**

AN/APA-11 Pulse Analyzer to work with Search Receiver for analysis of received pulsed signals. PPS, pulse width, wave shape, can be displayed on an CR tube. Unit can also be used as a standard oscilloscope for general servicing work. Input is 115v-400-2600 cyc. but can be changed with the addition of a 60 cyc. transformer. Very good condition.

SCR-694 Field Radio. Light weight version of SCR-284. Freq. range is 3.8-6.5 mcs. Power output is A1-20, A3-5; comes with transceiver BC-1306. GN-45 or 58 hand generator, antenna system, microphone, headset. etc. In excellent condition.

CY-30/TRC-1 antennas. Freq. range 70-100 mcs. Complete with antenna, poles, wires, etc., in carrying case.

COMMAND EQUIPMENT

ARC-5 274N OTHERS

RECEIVERS

ARA 500-1500KC. Good	$24.95
R-28/ARC-5	29.95
455B 6-9 mcs. Good	19.95
433 200-1750KC. Good	29.95
ARR-2 234-258 mcs. Good	19.95
BC-454 3-6 mcs w/tubes, new	16.95

TRANSMITTERS

T-23/ARC-5	$49.95
696-A 3-4 mcs. Good	29.95
TYPE O 5.3-7 mcs. New	9.95
AVT-23 3000-13,000KC complete w/control box, manual, etc. C.W. or phone. 14 or 28v input. Brand new. Original cases	79.50
BC-950A 100-156 mcs. New	59.95

ACCESSORIES

BC-456 Modulator. Good	$2.25
BC-450 Control Box (3 rec). Used	1.25
BC-451 Control Box (xmitter). Used	.98
BC-442 Relay Unit (ANT.). Used	1.95

Flexible Shafting Available

MISCELLANEOUS SPECIALS!

Sound Powered Chest and Headsets MI-2454-B type O, mfg. RCA. Brand new in original boxes. Pair	$ 29.95
Trailing Wire Antenna Feed Tube. New	5.95
Goniometer for SCR-277 Direction Finder. Excellent	39.95
HS-30 headsets, good	3.95
FT-154 BC-348 Shock Mounts	2.98
AN/CRW Receiver for Remote Control	5.95
BC-1206 Beacon Receiver 200-400KC. 28v in. Excellent	4.95
MN/26-Y Compass Receiver. Very good	24.95
BC-433G Compass Receiver. 200-1750KC in 3 bands. Excellent	39.95
HS-33 headsets, good	4.95
BC-1016 Tape Recorder. Complete. New	459.50
CFI Unit with 200KC Xtal. New	14.95
BC-733D receiver with tubes	29.95
BC-329 Transmitter. Excellent	89.95
QBG-1 Sonar complete with Hydrophone. Excellent	125.00
BC-608 automatic keyer for SCR522	5.95
AN/104A Antenna for SCR-522, ax handle. New	3.95
BC-1284 Lighthouse Tube Preamplifier. Excel.	69.95
ASB 500 mcs YAGI Antenna Dual 6 Element Single 5 Element	14.95 8.95
AN/APA-17 Radar Direction Finding Antenna, back to back parabola, freq. range 300-1000 mcs. Horizontally and vertically polarized. Excellent	59.00
BC-996 Interphone Amplifier. Good	9.95
ART-13 Loading Condenser. Excel	4.95
CW-3 less coil & crystals. New	29.50
CU-25 Loading Box for ART-13	49.95
AS-27/ARN5 Antennas. Very good	4.95
SA-1/ARN-1 Part of ARN-1. Very good	2.95
1D-80/APA-17 Indicator. Excel	129.95
AT-4 antenna, new	4.95
BC-639 receivers, new	285.00
RM-29 remote control, new	17.95
AVR-15 Aircraft Receiver. Very good	19.95
BC-923 Receiver. Very good	39.95
BC-800 Xmitter/Receiver. Very good	39.95
RA-300 FM Exciter (Mfg. Tempco). New	32.50
A-55 Dummy Antennas. Very good	2.25
BC-1365 Control Box. Good	3.95
FL-8 Filter	3.95
FL-5 Filter. Less cables. Fair	2.65
3C-16-D GSAP Gun Camera Computers with all access. In carrying case. Excel	19.95
AT-2A/APN-2 Antenna. Fair cond	4.95

Spares for ARC-5 and 274/N. APX-1, ASG-10. We have a large stock of TS-34A/AP Spares.

CORDS AND PLUGS

CG-(172/173) CPN-8 CM Coax Patch Cable. New	$4.95
CX-548/CRD-3 Cable. New	1.25
CX-546/CRD-3 Cable. New	1.25
CD-508A w/SW 14-U & 2 Cord Attachments with JK-48 Jack & PL-68 Plug. New	.75
CD-307A with PL-55 and JK. New	1.29
PL-55 Plug. New	.49
83-1SP Connector. New	.69
83-1R Coax Connector. New	.69
PL-68 plugs	.39
83-1J Feed Thru. New	1.10
83-1F Feed Thru. New	1.55

SCR-522 VHF Airborne Command Equipment. Freq. range 100-156 mcs. in 4 channels receiver and transmitter. Crystal controlled. Complete equipment. Consists of trans/rec, control box BC-602, dynamotor PE-94, AN104A antenna, plugs, etc. Power input with PE-94 is 28v. Excellent condition. We can supply PE-98 dynamotor for 12v input at additional cost.

RADIO HAM SHACK Inc.
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Manufacturers' Literature

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

C-D CATALOGUE

Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey has just released a comprehensive new catalogue covering mica and Faradon capacitors.

This 60-page publication, Catalogue #420-421, comprises a complete encyclopedia of data on a wide range of mica units manufactured by *C-D* for commercial, industrial, and military applications.

Manufacturer's type number and the corresponding JAN unit designation are shown together for each listing. In addition, all data such as characteristics, derating, dimensions, tolerances, extras or exceptions, are shown on the same page with the type in question.

Further inquiries on this catalogue should be addressed to the company.

TV COMPONENTS

In response to requests from dealers, the *RCA Tube Department* is making available to parts dealers and service technicians a revised and enlarged version of its book "Television Components."

Heretofore restricted to distributors, the new book includes the company's complete line of recently-introduced television components and contains vital statistics on more than 60 such components.

Compiled for quick reference, the book presents such vital information as electrical ratings and characteristics, terminal connection diagrams, outline drawings, typical circuits, associated components, and recommended installation procedures.

RCA distributors have copies of this publication which are available at 25 cents a copy.

PARABOLIC ANTENNAS

The Workshop Associates, Division of *The Gabriel Company,* Needham Heights 94, Massachusetts has recently issued a new catalogue covering its line of parabolic antennas.

Studio-transmitter link, police, pipeline, railroad, and utilities are only a few of the fields in which the antennas are applicable. Several photographs show the reflectors, feeds, and mounts, and specifications are given for heating and de-icing equipment. Complete electrical specifications are listed for each model.

LOOSE LEAF TUBE MANUAL

A revised and enlarged eighth edition of the *Sylvania* Technical Manual in a completely new "snap-open" loose-leaf format has recently been published by *Sylvania Electric Products Inc.*

The new manual contains comprehensive technical data on more than 500 receiving tube types, standard TV picture tubes, as well as 84 pages of general information on v.t. operation. New data sheets on future receiving tube types will be issued periodically, without charge, to holders of the manual.

The tube manual can be obtained either from the company's advertising department in Emporium, Pa. or through the company's authorized distributors. The price is $2.00 a copy.

MICRO SWITCH BULLETIN

Micro Switch, Freeport, Illinois has recently issued a new bulletin of interest to engineers, plant maintenance men, purchasing agents, and industrial executives.

Designated Bulletin No. 54, the new four-page brochure covers the company's entire line in a general way. This ultra-condensed circular is divided into sections, each of which deals with one clearly defined group of switches. It catalogues, describes, and illustrates a few representative switches in each classification.

Copies may be obtained from the company or from any of the firm's branch offices.

"SERVICE NEWS"

"The *Du Mont* Service News," a television service publication of the *Allen B. Du Mont Laboratories, Inc.* is now available to all technicians whether or not they handle *Du Mont* servicing.

Typical subjects covered in the monthly issues include interference, installation, fringe area problems, troubleshooting hints, and test equipment use.

A subscription form and a sample copy may be obtained by writing the Teleset Service Control Department of the company at 35 Market Street, East Paterson, N. J.

PRINTED CIRCUIT DATA

Centralab, Division of *Globe-Union Inc.,* 900 East Keefe Avenue, Milwaukee 1, Wisconsin has just published what is said to be the world's first printed electronic circuit replacement guide for service engineers.

The new guide lists 269 printed circuit plates used by 69 manufacturers. Replacements are easy to select from a cross-reference chart which designates the catalogue number for a given manufacturer's part number. Only 19 stock items are required to

BIGGER PAY CHECKS, INTERESTING JOBS and a SATISFYING CAREER – yours in RADIO—TV ELECTRONICS

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Prepare now to earn your secure, satisfying career in Radio, TV and Electronics—and the bigger jobs and fatter paychecks that come with it! These fields are expanding so rapidly that even the most expert of experts fall far short in their predictions. In the next 5 years, says the Chairman of the FCC, there will be 1,500 TV stations, and 5 years later there will be 2,500. 13,000,000 TV sets and 100,000,000 radios are now in use. (95% of the nation's homes have one or more sets.) Reams of similar statistics indicate thousands of good-paying jobs available now, and many more coming up. Qualified technicians are needed to fill them. One of these jobs can be yours, provided you have the technical training that CREI Home Study offers. CREI helps all levels, from novice to experienced engineer, because its specialized individual instruction brings out the best you have, and takes you as far as your own ability and effort will permit.

CREI is an accredited technical institute founded in 1927. CREI graduates today fill vital jobs throughout the radio, TV and electronics industries. Many leading firms pay CREI to train their own electronics personnel. Examples: RCA-Victor Division, Pan-American Airways, Bendix Products Division and United Air Lines.

Because CREI training is so thorough and so highly regarded, our graduates find a hearty welcome throughout the industry. At the service of our students and graduates is the CREI Placement Bureau, which right now has more requests for personnel than it can fill.

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cover these replacement requirements.

Free copies may be obtained either from local *Centralab* distributors or by writing the company direct.

"U.H.F. FUNDAMENTALS"

The Government Service Division of the *RCA Service Company* has recently published a new booklet in its electronic training series entitled "Ultra High Frequency Fundamentals."

A revised and expanded version of an earlier booklet, the new manual is designed as a technical aid for u.h.f. training and the installation, operation, and maintenance of u.h.f. electronic equipment. It may also be used as an introductory text in the study of radio and radar principles applicable to the service and repair of u.h.f. military equipment.

The booklet is available from the Government Service Division of *RCA Service Company,* Gloucester, N. J. at a cost of 75 cents a copy.

AMPLIFIER DATA

A data sheet covering the remote control Model 10C3, 30-watt amplifier is now available from *Brook Electronics, Inc.,* 34 DeHart Place, Elizabeth, N. J.

In addition to illustrating the unit, the data sheet carries complete performance specifications and details as to size, weight, and power requirements.

Since this amplifier is designed for custom installation, the flyer also carries details and photographs of a typical custom unit.

WINDOW ANTENNAS

The JFD Manufacturing Company of 6101 16th Avenue, Brooklyn 4, N. Y. is making available copies of a new brochure covering two new types of television window antennas.

Designated brochure No. 92, this four-page folder describes and illustrates two all-channel units, the "Conical" Model No. C119 and the "Hi-Lo" Model No. C120.

The booklet gives installation data, prices, and complete specifications on each of the units.

MULTIPLE ANTENNAS

Industrial Television, Inc., has recently published a booklet which describes a new multiple antenna system which is especially adapted to fringe area installations.

The new "Multivision System" is described as being suitable for large or small installations, including community antenna systems. The booklet describes in detail the "building blocks" which comprise this system.

Copies of this bulletin, entitled "Multivision Antenna System," may be obtained from the company at 359 Lexington Avenue, Clifton, N. J.

DEFENSE COMMUNICATIONS

The Advertising Division of *General Electric Company,* Electronics Park, Syracuse, New York now has available copies of a new brochure on civil defense communications.

The booklet presents pictorially typical communications systems now in use which can be coordinated into a dependable emergency communications network in any community.

In addition, the booklet describes the company's technical advisory service for civil defense radio communications.

Copies of this booklet are available from Dept. N-5 of the Advertising Division.

SELF-TAPPING SCREWS

Parker-Kalon Corporation, 200 Varick Street, New York 14, New York has published a handy new booklet which contains all of the essential data on the company's self-tapping screws.

Included is application data, recommended hole sizes, and corresponding drill size numbers.

This pocket-size reference book is available to those requesting Form No. 480 from the company. —30—

MATCHING LINE AND BEAM

By HERBERT S. BRIER

ONE popular method of matching a transmission line to the driven element of a parasitic array is by means of a quarter-wave linear transformer, whose impedance is the geometric mean between the antenna and the line impedance, expressed by the formula:

$$Z_{trans} = \sqrt{Z_{ant} \times Z_{line}}$$

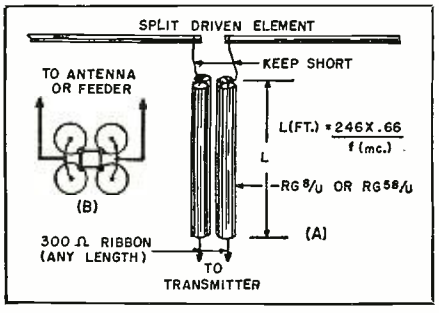
Substitution shows that RG8/U or RG58/U coaxial cable (nominal impedance 53 ohms) will permit a very close match between 300-ohm line and the 8 to 10 ohm impedance of a three-element, close-spaced array.

Unfortunately, coaxial cable is inherently unbalanced and, when used in this manner, there is always a question of how much it unbalances the feed system. Connecting four quarter-wave lengths of cable as shown in Fig. 1 will resolve all doubts by providing a balanced transformer with the same impedance as a single length. The lighter RG58/U will suffice for all but the highest power permitted to the amateur, although RG8/U will exhibit somewhat lower losses.

Because cables of the same type manufactured at different times vary somewhat in their nominal characteristics, cable manufacturers recommend that, when parallelling radio frequency cables, they be cut from the same length of cable.

—30—

Fig. 1. Connect each pair of center conductors together at top and bottom and to antenna or 300-ohm transmission line. Also connect all shields together at the top and bottom. Protect ends from moisture and lash the cables together with tape.



Television Boosters

(*Continued from page* 38)

the adverse effects of the noise. The reader will recognize that here again we are acting to improve the signal-to-noise ratio.

An analysis of current commercial boosters reveals that, for the most part, they fall into one of two categories. Either they contain separate stages for the high and low band TV signals, or else all signals pass through the same circuits. See diagram Fig. 2. Tube types found are surprisingly few, consisting of 6AK5's where pentodes are employed and 6J6's or 12AT7's when triodes are desired. In the use of these tubes we can see the problem which the booster designers faced. A pentode will give more gain than a triode, but a triode generates less noise. (The noise generated by a tube rises as the number of positive electrodes increases.) A pentode possesses an additional element (the screen grid) that must be powered, but a triode must be carefully neutralized or it will oscillate. There are other advantages and disadvantages for each type but you can see how difficult it is to make a clear cut choice.

The 6AK5 is a miniature tube developed for good gain at high frequencies and with low internal noise. The 6J6 and the 12AT7 each contain two high frequency triodes. The dual nature of these triodes permits them to serve economically as two-stage amplifiers. In this way the gain obtainable from a 6J6 or 12AT7 can be made to equal the gain of a pentode.

While we are on the subject of gain, some booster manufacturers indicate in their sales or service literature what gain can be expected from their booster on the low and on the high bands. Other firms simply state that the unit supplies high uniform gain on both high and low channels, without revealing any definite figures. Actually the latter practice conveys as much information as the former since gain figures, when they are given, are for some average booster of the same model. The one you get may have a higher or a lower gain, depending upon the conditions (in parts and personnel) existing at the time it was built. The tubes in your unit may be particularly "hot" or they may be below normal. The wiring may be cleaner, or the components better (or worse) or one of a thousand different causes may be responsible. Thus gain figures, while they do serve to indicate or establish an average value, should not be regarded as absolute.

Where the booster contains a single signal path for all signals, manual tuning is a must. Tuning methods are as varied on boosters as they are on television receivers. Thus we find condenser tuning, inductor tuning, permeability or eddy-current tuning, and selector switch tuning. Of the circuits inspected, the preference among de-

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ALLIANCE TENNA-ROTOR is in a class by itself! No other TV accessory sold to the consumer can equal Tenna-Rotor in volume of sales, public acceptance or in proved performance in the field! More than 600,000 are in use! The new deluxe Model HIR (illustrated above) is fully automatic.

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ALLIANC MANUFACTU ING COMPANY · Alliance, Ohio

signers appears to lean toward permeability or eddy-current tuning.

In the majority of boosters there is a three position switch which is labeled *"Off,"* "2-6," and "7-13." In the off position, the unit is not in operation and any signal appearing at the input terminals is then transferred to the output terminals directly. This, in effect, bypasses the signal around the booster and feeds it from the transmission line into the receiver with little or no loss. The purpose of this arrangement is to facilitate use of the booster in areas where some incoming signals are weak and some are strong. If you pass a strong signal through a booster the chances are excellent that you will cause the TV receiver to overload with resultant signal distortion accompanied by possible loss of sync (due to sync clipping).

The switch in the second position, marked 2-6 or sometimes *"Lo,"* turns the booster on and brings in the low band tuning circuits. The switch in the next position, 7-13 or *"Hi,"* brings in the high band tuning circuits.

Then a second dial generally labeled "Tuning" permits you to tune for best signal on whatever band you happen to be. In essence this latter knob is a fine-tuning control. With it you peak the tuning coils for maximum response.

There are variations, of course, of the foregoing arrangement. Thus, some boosters use continuous tuning and do away with the fine-tuning control. Other models are designed specifically for automatic operation. These can be installed in some out of the way place inside the set or at the antenna. Should peaking be found necessary, it can be accomplished quite easily by means of screwdriver adjustments. Finally, there are some boosters which contain a special gain control, in addition to the channel selector switch and the fine-tuning control.

So you have your choice.

Incidentally, with continuous tuning, most manufacturers warn you that the channel numbers on the dial are for reference only and best results frequently may be obtained at settings of the booster tuning dial slightly off the selected channel number. This is normal and does not indicate misalignment of the unit.

Another fairly widespread practice among booster manufacturers is the inclusion of balanced and unbalanced input and output terminals. The unbalanced terminals are designed to match the 75-ohm characteristic impedance of a coaxial cable; the balanced arrangement, of course, is for the popular 300 ohm twin-lead polyethylene line. The provision for the coaxial cable is especially advantageous in areas where the external noise is high and the signal is weak. Although the preceding discussion has placed great emphasis on the deteriorating effects that internal receiver noise have on a picture, we must not forget that external noise can be just as destructive and in some instances, even more so. In noisy locations it is particularly important to be able to use a coaxial cable between the antenna and the receiver.

Where the surrounding noise is not bothersome, 300 ohm twin-lead is preferable to coaxial cable because of its

DIRECTORY OF TELEVISION BOOSTER MANUFACTURERS IN THE UNITED STATES

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Alliance, Ohio

ANCHOR RADIO CORPORATION
2215 S. St. Louis Avenue
Chicago 23, Illinois

APPROVED ELECTRONIC INSTRUMENT CORP.
146 Liberty Street
New York 6, New York

THE ASTATIC CORPORATION
Conneaut, Ohio

BLONDER-TONGUE LABORATORIES
20 Gunther Avenue
Yonkers, New York

DAVID BOGEN CO., INC.
663 Broadway
New York 12, New York

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200 Central Avenue
Newark 1, New Jersey

DECIMETER, INC.
1430 Market Street
Denver 2, Colorado

ELECTRO-VOICE, INC.
Buchanan, Michigan

I.D.E.A.
55 North New Jersey
Indianapolis, Indiana

INDUSTRIAL TELEVISION, INC.
360 Lexington Avenue
Clifton, New Jersey

JFD MANUFACTURING CO., INC.
6101-6123 Sixteenth Avenue
Brooklyn 4, New York

LA POINTE-PLASCOMOLD CORPORATION, THE
Windsor Locks, Conn.

NATIONAL COMPANY, INC.
61 Sherman Street
Malden, Massachusetts

PHILCO CORPORATION
Tioga & C Streets
Philadelphia 34, Pa.

RADIO MERCHANDISE SALES, INC.
1165 Southern Blvd.
New York 59, New York

MARK SIMPSON MANUFACTURING COMPANY, INC.
32-28 49th Street
Long Island City 3, New York

SONIC INDUSTRIES, INC.
221 West 17 Street
New York 11, New York

STANDARD COIL PRODUCTS CO., INC.
2329 N. Pulaski Road
Chicago 39, Illinois

SUTTON ELECTRONIC COMPANY
426 West Short Street
Lexington, Kentucky

TECH-MASTER PRODUCTS COMPANY
443-445 Broadway
New York 13, New York

TECHNICAL APPLIANCE CORPORATION
Sherburne, New York

TEL-A-RAY ENTERPRISES, INC.
Box 332
Henderson, Kentucky

TELEVISION EQUIPMENT CORPORATION
238 William Street
New York 7, New York

TURNER COMPANY, THE
909 17th Street, N.E.
Cedar Rapids, Iowa

T.V. DEVELOPMENT CORP.
2024 McDonald Avenue
Brooklyn 23, New York

lower attenuation. It is important to remember that it is not the signal that develops at your antenna that counts, but the signal which actually reaches your set. The situation here can very well be likened to the difference between your yearly income before and after taxes.

While we are on this point, it might be well to note that in weak signal areas it is quite common to use highly elaborate and sharply directional arrays. While the ability of these arrays to develop signals at one frequency (or over a relatively narrow range of frequencies) is generally superior to that of a simple dipole or folded dipole, the more elaborate the array, the more difficult it is to achieve a proper impedance match between it and the attached transmission line. Inability to achieve this match will reduce the amount of signal which the set receives.

To determine whether this condition exists in your installation, proceed as follows: Turn on the TV set and set it at the highest channel on which a signal is to be received. Then wrap a 2-inch square piece of aluminum foil around the lead-in between the antenna and the booster. Starting with the foil near the booster, gradually move it towards the antenna. If the picture improves with the foil in some position, it indicates that standing waves (due to a mismatch) are present along the line. This same procedure should be followed on the lead-in between the booster and the set, again with the metal foil closest to the receiver at the beginning. Now move the foil toward the booster and note whether or not there is any improvement in the received picture. Sometimes the mismatch can be partially corrected by means of these aluminum foils. If so, merely tape the foils in place with transparent tape. Where the set is to receive several stations, use of the foils may improve the reception on one channel, but impair it on the others. In this case you have two alternatives. You can either change the positions of the foils when you change the station or you can try to achieve a better overall match in the antenna lead-in system. Admittedly, the latter course is not simple but it is important because the quality of the received picture depends upon it.

Booster Placement

To maintain the maximum signal-to-noise ratio at the input of the booster, it is frequently desirable to position the booster where the signal is strongest, namely, at the antenna. In this way whatever signal is received is amplified immediately and then sent down the transmission line. The signal will be attenuated by the line but, being stronger, it will arrive at the set in better shape to overcome whatever noise exists there.

Power for these boosters can be brought to them either by extending a weatherproof a.c. line from the house to the antenna, or, by using the twin-

lead to conduct the power up and the signal down. All antenna-mounted boosters are constructed so that their power can be turned on or off by the television receiver power switch. A junction box at the set contains a power plug for the wall socket and an a.c. power outlet for the receiver into which the line from the set is plugged. Now, when the receiver is off, there is no complete path for the power current to flow through the relay coil. Under these circumstances, the relay contact points remain open, preventing power from reaching the booster.

When the television receiver is turned on, current flows through the relay and this, in turn, closes the relay contact points. Power is now also provided for the booster via the twin-lead line.

In spite of their obvious and highly desirable advantages, antenna-positioned boosters are not extensively used. One reason for this is the higher cost of such units, occasioned in part by the weatherproof construction required and in part by the fact that since these boosters cannot be manually tuned, they require (for suitable operation) separate high and low band amplifiers. And finally, if you are not doing the work yourself, you will have to pay additionally for the booster installation.

A compromise along these lines that is frequently practiced is to place the booster as close to the antenna as possible but still keep it in the house. Thus, suppose you live in your own home and the antenna is mounted on your roof. A good place for the booster could be in the attic where it would be near the antenna, but still within the house. With such an arrangement it is not necessary for the booster to be weatherproofed, and there is no power problem. Turning the booster on or off can still be accomplished at the set.

While we are on the subject of power, it should be noted that all boosters require a.c. None of those inspected would work off d.c. The turning on and off of the power can be controlled at the set, as discussed before, or at the booster (for both the booster and the TV set), or separately at the booster and the set. In addition some boosters can be placed in a standby condition wherein the filaments of the tubes in the booster are lighted but the rest of the unit is inoperative. The signal, in this instance, is bypassed around the booster and fed directly to the set. This permits the user to bypass the booster on moderate or strong signals, but to return it instantly to operation on weak signal stations.

Conclusion

To summarize this discussion, it should be emphasized that with only a few possible exceptions all of the boosters manufactured in the United States have been shown in the illustrations accompanying this article. The most notable exception are boosters which are designed for multi-set opera-

tion which were purposely omitted as this discussion has been limited to units used with individual television receivers.

All of the boosters illustrated are designed for 110-125 volt operation and, unless otherwise specified. are intended to be used with 60 cycle a.c. power sources.

Without exception, these units employ selenium rectifiers to obtain the necessary d.c. voltages. There is, however, quite a variation in the operation of "On-Off" switches. As explained in the captions accompanying the illustrations, some of the "On-Off" switches on the boosters turn the receivers on or off simultaneously while other units are designed in such a way that the receiver's "On-Off" switch turns the booster on or off. Where no specific mention is made, it may be assumed that the "On-Off" switch performs an independent function in which case it is necessary to turn both units on separately. Although this is somewhat inconvenient, this type of operation makes it possible to eliminate a relay or *Micro Switch* which naturally adds to the cost of the unit.

As can be seen from the units illustrated, there is a wide choice of designs available. Most of the boosters in use today are designed to be placed on top of or near the television receiver. All units of this type require manual operation. Still other boosters are designed to be completely automatic and require no adjustment after installation. These boosters can be placed at the antenna, close to the antenna, or directly behind the receiver.

These antenna-mounted boosters are especially advantageous in noisy locations, as explained previously. Their installation generally requires the services of trained television technicians.

In the matter of tuning systems, here again there is a wide choice available to the prospective buyer. Most boosters employ a "low-high" bandswitch, Channels 2 through 6 being covered on the "low" setting and Channels 7 through 13 on the "high" position. In a few cases this bandswitch is also used as the fine tuning control, permitting the user to peak the booster to the particular channel desired. Other units feature an entirely separate fine tuning control.

Other boosters employ continuous tuning, in some cases the same unit being used to cover the FM band. All of the automatic-type boosters illustrated are, of course, wideband amplifiers which cover all channels unless specifically excepted in the data accompanying the photographs.

The input and output impedances of the boosters shown, unless stated otherwise, are designed for 300 ohms. As mentioned before it is extremely important to obtain a perfect match between the antenna lead-in, the booster, and the receiver. Should the booster be designed for a 300 ohm input and output and the set and antenna lead-in with which it is to be used is of some

Radio Merchandise Sales, Inc.'s Model SP-5. 6AK5; high-low band coverage; separate fine tuning control. Metal cabinet. Price $37.50.

other impedance, it is possible to obtain a relatively inexpensive matching transformer which will handle this situation nicely. Such transformers are available from your local radio parts jobber. In many cases a piece of tinfoil wrapped around the lead-in wires can be used in lieu of the matching transformer to provide a fairly close match.

Signal-to-noise ratios and gain measurements have been purposely omitted from the data accompanying the illustrations. While some manufacturers do include this information in their literature, many of them simply refer to their boosters as being "high gain" and "high signal-to-noise ratio" (low internal noise) units. Any comparison between boosters is meaningless unless all of the boosters are measured by the same standards and under the same conditions. Needless to say, the most desirable booster will be the one having sufficient gain for your requirements and possessing the lowest possible internal noise. As mentioned previously too much gain can be a detriment, overloading the r.f. stages of your television set. Many television technicians familiar with your particular location will have a pretty good idea of the signal strength in your area. The average set requires approximately 500 microvolts for good reception. If the signal strength in your area is below this figure, a booster is required. The gain, of course, that the booster must have will depend on how low the signal strength is in your location.

Boosters designed for use at the set are attractively housed, often in woods that are finer in texture than those used for the set. Many are available in several shades (such as blonde or mahogany) permitting the close matching of the booster coloring to that of the television receiver cabinet. If the set owner prefers, the booster can be hidden from sight—perhaps behind or underneath the receiver. Most booster manufacturers have evidently given careful consideration to the appearance of these units, realizing that while performance is of prime importance, the unit also has to be lived with as part of the house furnishings. Obviously, fancy housings

have no place in the scheme of things when the booster is to be antenna-mounted. These units are designed for rugged, year-around, all-weather use with a minimum amount of servicing. The owner of today's booster can display it with as much pride as he displays his television set.

Prices quoted in connection with the boosters illustrated were furnished by the manufacturers as "list prices." These prices are subject to change and, in some cases, there may be a variation in price in the Far West and in certain other sections of the country. Prices should be checked with your local dealer or distributor.

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Clamp Tube Operation

(*Continued from page* 58)

power output. The carrier output of the 807 is only one-fourth of the peak power output, or in the neighborhood of twelve to fifteen watts. The power on modulation peaks reaches the c.w. value. Inasmuch as the tube is resting much of the time, it is possible to increase the input slightly over the usual figure on peaks.

Under full modulation, the 807 plate current should remain steady, only flickering slightly as the modulation percentage reaches 100%.

The author has purposely omitted details on the speech amplifier and r.f. amplifier circuits, as everyone will use his own pets here. In the author's case, the speech amplifier is a single 12AT7, with a carbon microphone in the cathode of the first section, and the grid grounded. The various r.f. chokes and associated bypass condensers shown in the 807 r.f. stage are standard procedure for reducing TVI and are included as a matter of course in every piece of r.f. gear around the shack.

All in all, this keyer-modulator is a very worthwhile addition to the low-power rig. As the clamper tube is practically standard these days, it costs very little to modify the circuit to utilize its full capabilities. It gives the c.w. man the sweetest-sounding keying he ever heard, while making it possible to do some phone work without expensive class B audio equipment. Once adjusted, either phone or c.w. may be selected by throwing a single switch. What could be simpler? —30—

W. U. SERVICES EXPANDS

WESTERN Union Services, Inc., the television installation and servicing subsidiary of Western Union Telegraph Company, has announced an immediate expansion of its business to include the installation and servicing of all standard makes of television receivers.

In addition to handling all television brands, the company has increased its servicing territory to include Bergen and Hudson counties in New Jersey. The service, which started May 1, was initially confined to Essex, Passaic, and Union counties in New Jersey. —30—

Technical BOOKS

"RADIO HANDBOOK" edited by R. L. Dawley. Published by *Editors and Engineers, Ltd.*, Santa Barbara, California. 715 pages. Price $6.00. 13th Edition.

This is a new and enlarged edition of one of ham radio's best known reference works.

Divided into 28 chapters, this book covers both fundamentals and advanced theory. Some of the topics treated include d.c. and a.c. circuits, vacuum tube principles, vacuum tube amplifiers, the fundamentals of radio receivers, the generation of r.f. energy, AM and FM, transmitter design and adjustment, radiation and transmission lines, antennas and antenna matching, high frequency directive antenna arrays, antennas for use at u.h.f. and v.h.f., rotatable antenna arrays, TVI and BCI, construction tips, mobile equipment and installation, receiving equipment, exciters and low power transmitters, high frequency power amplifiers, speech and amplitude modulation equipment, transmitter construction, power supplies, a discussion of various pieces of test and measuring equipment, and a summary of radio mathematics and calculations necessary in ham work.

The final chapter is given over to a concise compilation of the most-often-needed reference data.

Hams will find this new edition a valuable addition to their reference libraries.

* * *

"RADIO AND TELEVISION SOUND EFFECTS" by Robert B. Turnbull. Published by *Rinehart & Company, Inc.*, New York. 325 pages. Price $6.00.

Since the demand for sound effects men far outstrips the supply this handbook should be a boon to the personnel of smaller radio and television stations who must "double in brass" in this demanding role.

Although the book is a serious "how-to-do-it" work, the author's touch is light and the text makes interesting and, at times, humorous reading. The book is divided into nineteen chapters and a glossary and covers such subjects as the types and uses of sound effects, the psychology of sound, manual and recorded effects, electronic and acoustical effects, microphones, sound in television, improvised sounds, and the construction of sound effects equipment.

The book is lavishly illustrated with photographs of sound effects devices and studio shots of actual programs. The section on construction contains line drawings with dimensions for building various pieces of standard studio sound effects equipment.

Even those not connected with broadcasting or telecasting will enjoy being "let in" on the secret of how sound effects are achieved. —30—

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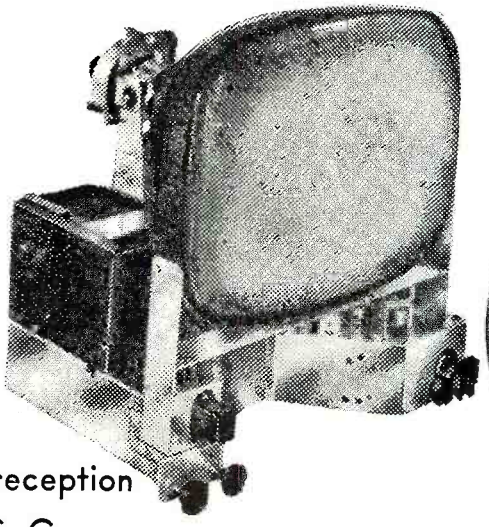

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Sound Engineering

(*Continued from page 74*)

where N equals the number of mixer positions.

Thus, for a six-position mixer,

$$20 \log 6 = 20 \times 0.778 = 15.56 \text{ db}$$

This loss will hold true only if the mixer pots are of the "*T*" variety, which have no insertion loss at their *zero* position. If ladder type pots are employed, the 6 db insertion loss of one pot is *added* to the network insertion loss. Thus, the total insertion loss becomes,

$$15.56 \text{ db} + 6 \text{ db} = 21.56 \text{ db}$$

The reason why the loss of only one ladder pot is taken into consideration is that each input is a *separate* circuit, and the incoming signal sees only the insertion loss of the pot in that particular circuit, therefore, only the insertion loss of *one pot* is considered. Plain or bridged-T attenuators are used for the sub-master and master-gain controls, variable in steps of one or two db.

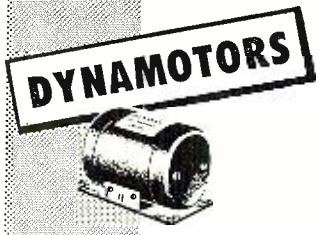
Every recording and reproducing system has one point in common; that is, the frequency characteristic caused by either the media or the method used in recording, or both. Generally, some form of frequency correction or compensation, called "equalization," must be employed to secure a uniform recording or reproducing characteristic. An equalizer may then be defined as a "device for altering the existing frequency characteristic of an electrical circuit."

Equalizers are composed basically of resistance, capacitance, and inductance, connected in definite and specific configurations which are quite similar to those used for attenuators. The circuit elements comprising these configurations offer an impedance to certain predetermined frequencies, and thus control the frequency response of the equalizer and the circuit in which it is inserted.

When dialogue is recorded using a flat recording channel, the reproduced sound will have an unnatural quality and may even lack intelligibility. The reason for this is that the reverberation in the recording stage *accentuates* the lower frequencies.

In the construction of motion picture "sets," as well as those used for television production, the materials used have less absorption at the low frequencies than at the high. Thus, the high frequencies have a tendency to be absorbed and the low frequencies accentuated. This condition will vary with microphone placement and is far less noticeable on "close-up" shots because less reflected sound is recorded. When such recorded material is reproduced the low frequencies are still further accentuated because the reproduction is generally heard at a higher level than normal.

In general, normal speech levels are



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MANUFACTURER	TYPE OR NO.	VOLTAGE	RPM	DIMENSIONS	SPECIAL INFORMATION
Stewart Warner	.....	6VDC	....	2¼"x2¾"	¼"x½" Lg. shaft
John Oster	B-9-2	12VDC 1.4A	5600	2¼"x3¾"	¼"x3/16" Lg. shaft. Shunt Wd.
General Ind.	62800	13VDC 9A	6800	2⅛"x4"	¼"x¾" Lg. shaft. 1/12 HP
Emerson	D-26-BT	24VDC 24A	100	2¼"x5½"	160 Ft.-Oz. torque
Redmond	7-N	24VDC .96A	6000	2¾"x3¼"	Complete blower assembly
F. A. Smith	40H	115VAC 60 Cy	....	6"x5½"x5"	100 CFM blower ($12.95)
Western Elect.	FL	115VAC 400 Cy	6700	3¼"x4"x4½"	25 CFM blower
Signal Elect.	D-4272	24VDC .66A	2100	2¼"x2⅞"	¼"x1" shaft. 1/190 HP
General Elect.	5 BA50MJ64	24VDC 13A	....	3⅜"x7½"	Shunt wound
Stromberg	D-4496	24VDC .45A	....	2½"x3⅛"	¼"x¾" shaft. .003 HP
Amglo	.....	24VDC	....	1½"x2⅛"	Telephone ringing circuit motor
John Oster	A-16B-26R	26VDC	....	1½"x2⅛"	3/16"x5/16" shaft. Series Rev.
John Oster	DEST-8-1R	27VDC 1.4A	3800	2¼"x4⅝"	⅜"x¾" shaft. 1/40 HP
Delco	5069267	27.5VDC .25A	6000	1⅝"x2½"	¼"x1⅛" shaft. 1½ Oz-In Tq.
Western Elect.	KS5996-LO4	28VDC	....	2"x2⅞"	3/16"x7/16" shaft. Series Rev.
Bendix	M05B	28VDC 1.75A	3200	1½"x2½"	¼"x1⅛" shaft. Series Rev.
Bendix	E-11500-1	28VDC 1A	9000	1½"x2½"	¼"x1⅛" shaft. Series Rev.
Fractional Mtrs.	SH-280	28VDC 3.1A	3900	3¼"x5½"	¼"x⅜" shaft. Used in ART 13
Electrolux	20100	28VDC .1A	....	2"x2 15/16"	5/32"x⅜" shaft. 20 Deg. rotation
John Oster	A-21-E-12R	28VDC .4A	....	1½"x2⅜"	3/16"x⅜" shaft. Series Rev.
Emerson	D-26-BV	28VDC 3.1A	3900	2½"x3½"	¼"x⅜" shaft. 1/20 HP
Electrolux	16876	28.5VDC 1.8A	2200	3¾"x5"	¼"x1¾" shaft. 1/35 HP
Western Elect.	KS 9303	50-60VAC 175 Cy	....	2½"x3½"	.....
General Elect.	2J1H1	57.5VAC 400 Cy	....	2¼"x3¾"	Selsyn differential
General Elect.	2J1G1	57.5VAC 400 Cy	....	2¼"x3½"	Selsyn transmitter
General Elect.	5BN38HA10	80VDC .25A	3000	2⅞"x5⅛"	¼"x¾" lg. shaft
General Elect.	2J1F1	115VAC 400 Cy	....	2¼"x3"	Selsyn generator
Diehl	11-1	110VAC 60 Cy	....	4"x5¼"	Synchro repeater selsyn
Bendix	.....	110VAC 60 Cy	....	3¼"x5½"	Synchro differential selsyn
Bendix	.....	110VAC 60 Cy	....	3¼"x5½"	Synchro transmitter selsyn

MANUFACTURER	TYPE OR NO.	INPUT	OUTPUT	DIA.	LGTH.	SPECIAL INFORMATION
Eicor	ML3415-254	27.5VDC 1.5A	250VDC .060A	4"	8⅜"	With bracket mounting
Eicor	ML3412-42	13.8VDC 2.45A	220VDC .070A	3⅛"	5¼"	No mounting
Western Elect.	DM53AZ	14VDC 2.8A	220VDC .080A	2¾"	4½"	With base plate
Westinghouse	1171187A	27VDC 1.4A	285VDC .060A	2⅛"	4½"	No mounting
General Elect.	5DY82AB52	27VDC 1.5A	285VDC .060A	2¾"	4½"	No mounting
Western Elect.	1171091B	27VDC 1.6A	285VDC .075A	2¾"	4½"	No mounting
Redmond	5047	27VDC 1.75A	285VDC .075A	2¾"	4½"	No mounting
Eicor	ML3415-254	27.5VDC 1.5A	100VDC .150A	3½"	5½"	With base plate
Eicor	ML3420-194	27.5VDC 4.0A	325VDC .200A	3⅜"	6½"	With base plate
C.Q.R.	355D2BA	27.9VDC 1.25A	220VDC .070A	3⅜"	5⅜"	No mounting
Continental	DM310A	28VDC .5A	100VDC .01A	2¾"	4½"	No mounting
C.A.Y.	DM32A	28VDC 1.1A	250VDC .060A	2¾"	4½"	With base plate
Pioneer	PE86M	28VDC 1.25A	250VDC .060A	2¾"	4½"	With base and filter
Bendix	DA-1A	28VDC 1.6A	230VDC .100A	3⅜"	5½"	No mounting
Redmond	DM5 3A	28VDC 1.4A	220VDC .080A	2¾"	4½"	With base plate
Redmond	5056	28VDC 1.4A	250VDC .060A	2¾"	4½"	With base plate
Eicor	ML-3420-90	28VDC 3.3A	400VDC .125 A	3½"	6½"	With base plate
Continental	DM33A	28VDC 5A	575VDC .160A	3½"	7½"	Cont. duty. No mounting
Winco	41S6	13VDC 13A	250VDC .060A	4"x	8⅜"	With base plate
		13VDC	300VDC .225A	.....	.....	Intermittent
Continental	DMX310A	12VDC 2.8A	150VDC .100A	2¾"	4½"	Cont. Duty. No mounting
Airs	VA 137	115VAC 60 Cy	90-135VAC 7.6A	3¾"	5¾"	⅜"x1" Shaft. Ind. Volt Reg.
				DIMENSIONS		
Pioneer	PE 55	12VDC .16A	500VDC 0.2A Cont.	7¼"x12⅛"x13½"		Pwr. Unit W/DM 19G DYN, Filter and Mounting
Westinghouse	PE 94C	28VDC 10.5A	300VDC .260A 150VDC .010A 14.5VDC 10A	8¼"x6½"x12½"		Pwr. Unit W/DA3A DYN, Filter and Mounting

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considerably lower than those heard over the average radio or in a motion picture theater, particularly when close-up shots are made, because it is customary for the actors to speak at a low level, which accentuates the low frequencies. If the reproducing level is high, the low frequencies are increased over those of the middle range due to the characteristic of the human ear, which *varies* with a change in *sound intensity*. The higher this intensity, the greater is the ear's response to the low frequencies.

In such a situation, in order to obtain realism in the reproduction, it is necessary to *attenuate* the low frequencies during the recording of dialogue to prevent the loss of low frequencies during the reproduction of music.

The amount of low frequency attenuation required is dependent upon the type of microphone, the amount of reverberation on the set, and numerous other factors. For the recording of music, the frequency response of the recording channel is made flat between 40 and 10,000 cycles because the reproduction levels are about the same as the original sound.

In recording on film, it is usually found desirable to increase the high frequency response above 1000 cycles for both dialogue and music to compensate for the loss of high frequencies encountered in the various stages of the recording and reproducing processes. This was discussed in Part 6 of this series.

The losses may be summed up as: recorder slit loss, laboratory processing, printing losses, and losses resulting from the reproducer optical system. In the theater, losses occur from the acoustic treatment of the house, which produces the high frequency response. Some high frequency loss results from absorption by the motion picture screen, a loss which is corrected by the projection equipment.

Equalizers may be designed for balanced or unbalanced operation, either fixed or variable in their loss. In commercial installations equalizers are designed to operate in circuits of low impedance, ranging from 150 to 600 ohms, and are generally normalled into the circuits. They are of such design that they present, for all practical purposes, a constant impedance to both the input and output circuits. Equalizers having these characteristics allow a greater flexibility, because the amplifying equipment may be designed for flat frequency characteristics, thus increasing their usefulness. This also facilitates patching and maintenance.

Simple equalizers may be designed using the *circuit diagrams* illustrated in Fig. 9. These equalizers are not constant impedance and are very elementary. Nevertheless, they may be used to a very good advantage under certain circuit conditions. The curves illustrated above each configuration show the transmission characteristic and illustrate how the frequency response of the circuit is

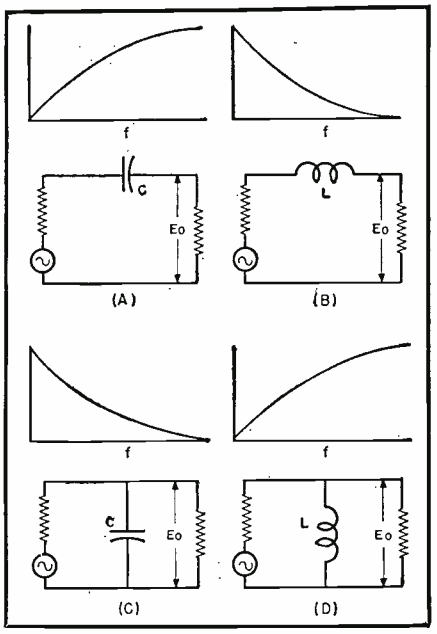


Fig. 9. Simple frequency correction networks.

affected after the element has been inserted. It will be noted only a *single* reactive element has been used.

When a condenser is connected in series with a circuit, the low frequencies are attenuated because of the *increased* reactance of the condenser at the lower frequencies. On the other hand, a condenser connected in parallel with the circuit reduces the high frequency response because of the *decrease* in reactance with an increase in frequency.

Connecting an inductance in series with the circuit attenuates the high frequencies because of the *increase* in reactance with frequency. Conversely, an inductance connected in shunt with the circuit attenuates the low frequencies because it *decreases* in reactance with a decrease in frequency. The value of the reactive element will depend on several factors: the circuit impedance, reference frequency, and the amount of attenuation desired.

If several frequencies are impressed simultaneously at the input terminals of such a device, their relative amplitudes will be altered depending on the reactance of the element in the circuit.

To provide a simple means for attenuating the low and high frequencies, a single reactive element of the type described is inserted at the input of each attenuator pot. Such devices are called "frequency attenuators." These attenuators reduce the low- or high-frequency response in fixed amounts. Standard low-frequency "cuts" are; 3, 6, 8, and 12 db with reference to 1000 cycles. For the high-frequency cut, the reference frequency is taken as 10,000 cps or lower if desired, then tapering up to 1000 cps.

If a steeper cut-off at the high frequencies than a condenser will permit is desired, a series-resonant circuit may be substituted for the condenser. High frequency attenuators are sometimes referred to as "dullers" because in reducing the high frequency re-

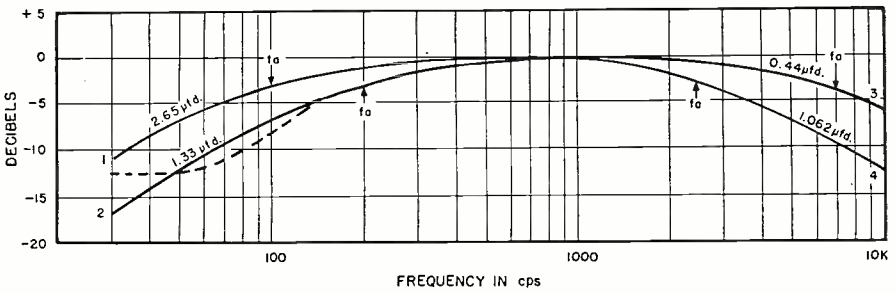


Fig. 10. Low and high frequency attenuators for dialogue equalization (600 ohm circuit).

sponse the reproduction is dulled or shows a lack of brilliance.

Fig. 12 shows a mixer with two input circuits. The upper half employs condensers to obtain both low and high frequency attenuation, while the lower half obtains its high frequency attenuation by means of a series-resonant circuit in shunt with the input.

Key switches are used to cut the various components in the circuit. One precaution, however, must be observed; the frequency attenuators must be placed ahead of, and in the *high side* of, the attenuator pot as shown to keep the circuit a "T" configuration and prevent leakage at the high frequencies.

An equalizer may be viewed from two standpoints: first the over-all frequency response obtained with the equalizer in the circuit (called the "transmission curve") and second, the attenuation or "loss curve" which is an inverse of the transmission curve and shows the loss induced by the equalizer with respect to a given reference frequency. To simplify the discussion, all curves illustrated are transmission curves.

The first step in the design of a frequency attenuator of the type described is to determine the desired frequency response. To illustrate this, assume it is desired to construct a low

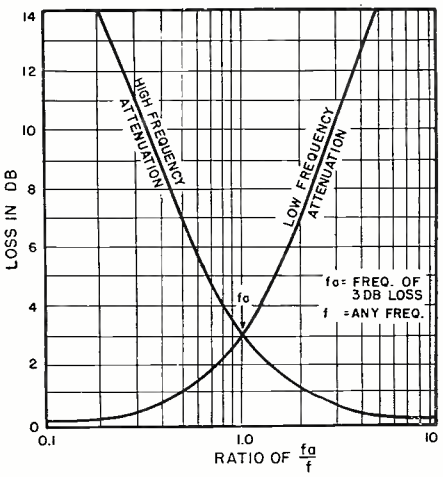
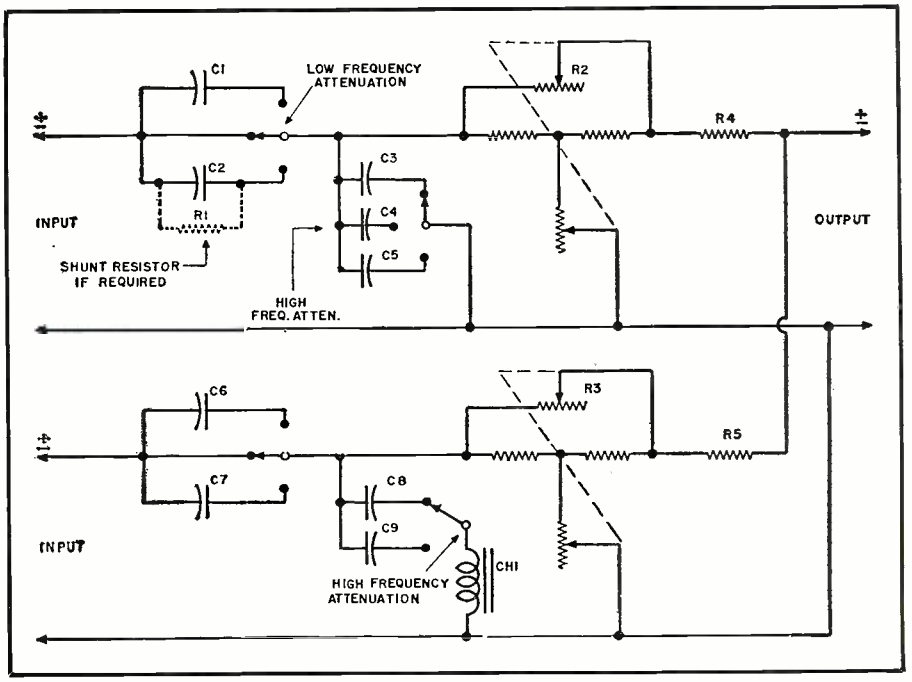


Fig. 11. Losses at various frequencies.

frequency attenuator with a response similar to that shown in Fig. 10, Curve 1. It will be observed that this curve starts to "drop" noticeably at 200 cycles and is down 3 db at 100 cycles with respect to 1000 cycles, then tapers off to where it is down approximately 8 db at 40 cycles. This is a typical low frequency "cut" employed in mixer panels when recording dialogue with ribbon velocity microphones, to remove the "tubby" quality of voices when working close to the ribbon. Such a

Fig. 12. Schematic diagram of a mixer unit employing two input circuits.



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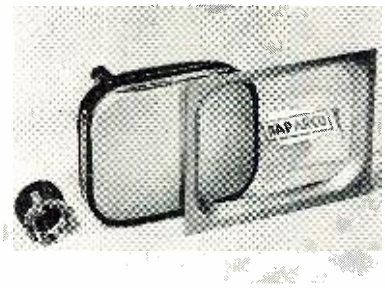

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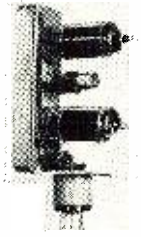

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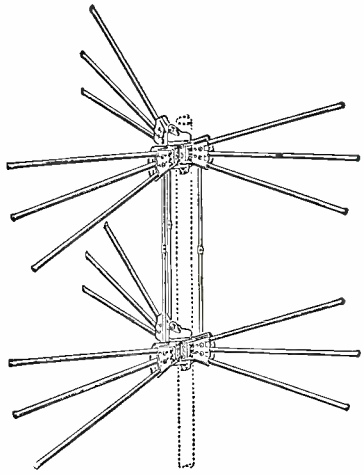

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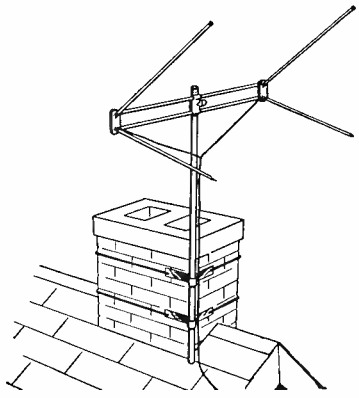

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_____1T4	_____6AK5	_____6BC5	_____6T8	_____12BA6
_____1U4	_____6AL5	_____6BE6	_____6X4	_____12BA7
_____1U5	_____6AQ5	_____6BH6	_____12AT6	_____12BE6
_____1X2	_____6AT6	_____6BQ6	_____12AT7	_____19T8
_____3Q4	_____6AU6	_____6C4	_____12AU6	_____35C5
_____3V4	_____6AV6	_____6CB6	_____12AU7	_____50C5

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response may be secured by the use of a single condenser placed in series with the input such as is shown in Fig. 12.

In Fig. 10 the symbol (f_a) appears at some point on each of the curves numbered 1 through 4. This symbol is the design or reference frequency and is a frequency at which the response is to be "down" 3 db with reference to 1000 cycles.

The value of the condenser required to obtain this response will depend on two known factors, *i.e.*, the circuit impedance, R_o, and the frequency, f_a. With these factors, it is possible to compute the value of the condenser by means of the equation:

$$C = \frac{1}{2\pi f_a R_o}$$

where f_a = the reference frequency and R_o the circuit impedance.

If the circuit impedance (R_o) is 600 ohms and the frequency (f_a) 100 cycles, the value of C becomes:

$$C = \frac{1}{6.28 \times 100 \times 600}$$

$$= \frac{1}{376{,}800}$$

$$= 0.00000265 \text{ farads, or } 2.65 \ \mu\text{fd.}$$

After the value of the condenser has been determined, its frequency response when inserted in the circuit may be plotted with respect to frequencies both above and below the reference frequency (f_a) which, for this example, is 100 cps.

In Fig. 11 are curves to assist in plotting the low and high frequency response of these simple attenuators. By the use of these charts, the characteristics for different ratios of (f_a/f), where (f) is any given frequency above or below the reference frequency, may be obtained.

The curves shown in Fig. 11 have been plotted with (f_a) appearing at 1.0 on the (f_a/f) scale at the bottom of the curve. Thus, if (f_a) equals 100 cps, 2.0 must equal 200 cps, and 3.0, 300 cps, etc. Similarly, 50 cps would appear at points 0.5, 30 cps at point 0.3, etc.

The frequencies to be plotted are first tabulated as shown in Table 1 with the ratios of (f_a/f) in the second column. To determine the insertion loss in db for any given frequency, enter the low frequency curve, Fig. 11, at the bottom, at the correct ratio for (f_a/f) and then follow this line upward until it intersects the curve. The loss in db may then be read directly from the left hand margin.

The loss for each ratio of (f_a/f) is read from the curve and entered in the third column under "DB Loss." In this particular problem, the losses above 1000 cycles are negligible and may be ignored.

It is a good practice to provide a second low frequency cut, such as Curve 2, Fig. 10. This curve was computed in the same manner as the previous example with the exception that (f_a) now equals 200 cps.

By using the condensers in parallel with the circuit, high frequency atten-

f (in cps)	f_a/f	db Loss
1000	0.10	0.01
500	0.20	0.20
400	0.25	0.21
300	0.33	0.40
250	0.40	0.60
150	0.66	1.55
100	1.00 f_a	3.00
80	1.25	3.90
60	1.66	5.60
50	2.00	7.00
40	2.50	8.60
30	3.33	10.80

Table 1. High frequencies to be plotted.

uation may be obtained. The characteristics most commonly employed are indicated by Curves 3 and 4 in Fig. 10. Frequency (f_a) is again selected for a loss of 3 db. The value of the condenser and the plotting of the loss is carried out in the same manner as for the low frequencies and is tabulated as shown in Table 2, using the curve in Fig. 11 and the circuit in Fig. 9C.

An inductance may also be employed to obtain low or high frequency attenuation. To attenuate the low frequencies similar to Curve 2, Fig. 10, the first step is to calculate the value of the inductance required.

$$L = \frac{R_o}{2\pi f_a}$$

where R_o is the circuit impedance and f_a is the reference frequency. Assuming R_o to be 600 ohms and f_a to be 200 cps,

$$L = \frac{600}{6.28 \times 200} = \frac{600}{1256} = 0.478 \text{ henrys}$$

The loss at the various frequencies is read from the curve in Fig. 11 and tabulated in the same manner as the condenser. For an inductance the circuit in Fig. 9B is employed and the losses plotted with the aid of the chart in Fig. 11. Curve 4 of Fig. 10 is a second high frequency "roll-off" with f_a equaling 2500 cps.

The four curves illustrated in Fig. 10 are approximately those used by the motion picture industry. By paralleling resistors of 100,000 to 500,000 ohms across the condensers, the frequency response may be altered near the frequency of maximum attenuation to produce a "shelving" effect, as indicated by the dotted line over Curve 2, Fig. 10.

(To be continued)

Table 2. Low frequencies to be plotted.

f (in cps)	f_a/f	db Loss
1,000	6.0	0.18
2,000	3.0	0.40
3,000	2.0	0.90
4,000	1.5	1.60
5,000	1.2	2.30
6,000	1.0 f_a	3.00
7,000	0.85	3.70
8,000	0.75	4.40
9,000	0.66	5.20
10,000	0.60	5.60

Music Maker
(*Continued from page 57*)

ments later. R_1 should be set for 115,000 ohms; R_2 and R_4 to 8000 ohms; R_3 to 7000 ohms; R_5 to 13,000 ohms; R_6 and R_{11} to 2500 ohms; R_7 to 8500 ohms; R_8 to 6000 ohms; R_9 to 9000 ohms; R_{10} and R_{12} to 15,000 ohms; and R_{13} to 10,000 ohms. The instrument is tuned against a piano, or lacking that, the builder can use any other musical instrument which is in tune or a pitchpipe.

If a transformer from a BC 456 is not available, almost any small 3 to 1 ratio audio transformer can be used. Satisfactory results have been obtained with a *Stancor* A 53C. If the circuit does not oscillate try reversing the leads to either the primary or secondary.

The output transformer may be one of the common type used in table model receivers. The exact impedance of the primary is not important.

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2J26	2992-3019 mc.	275 KW	37.50
2J32	2780-2820 mc.	285 KW	
2J38 Pkg.	3249-3263 mc.	5 KW	39.50
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			1030	.050		
			2/8			
PE101C	13/26	12.6	400	.135	SRC 515	5.95
		6.3	800	.020		
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B-19 pack	12	9.4	275	.110	Mark II	
			500	.050		
D-104	12		225	.100		
			440	.200		
DA-3A	28	10	300	.060	SCR 522	8.45
			150	.010		
			14.5	.5		
5053	28	1.4	250	.060	APN-1	3.95
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CW2IAAX	13	12.6	400	.135		9.95
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		9	1.12			
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			150	.010	522	
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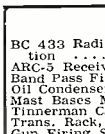

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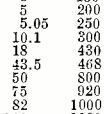

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2	1000	.90
4	1000	1.75
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1.5	1500	1.40
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Primaries 115V, 60 Cycle
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PE 218: Input: 25 28 vdc. 92 amp. Output: 115 v, 350-500 cy 1500 volt-amperes. Dim: 17"x6½"x10". New $49.50
PE 206: Input: 28 vdc, 38 amps. Output: 80 v, 800 cy, 500 volt amps. Dim: 13" x 5½" x 10½". New $12.50

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The Color Wheel

(*Continued from page 45*)

efficiency. It should be pointed out that the 12AU7 phase comparer can develop error voltage if the wheel is too slow or if it runs too fast. In one instance the error voltage will be more negative than the steady-state bias, in the other instance it will be less negative. The technician must adjust both the "color-phase" and the "anti-hunt" control carefully when the color wheel is in sync so that slowing or speeding of the wheel will be corrected properly. If it appears that on slower speed the control circuit tends to slow it up even more, connect the leads now going to pins 3 and 6 of the 12AU7 to pins 1 and 8 and *vice versa*.

In some early models the *CBS* sets used modifications of this circuit, some containing a magnetic brake winding on the motor to bring it closer to the correct speed. Other versions include a d.c. relay, operated through a selenium rectifier and filter, several different ways to reduce the motor speed permanently, and a special button which cuts the a.c. off for an instant to take care of the eventuality that the motor locks in at the wrong color phase. We have omitted these modifications here and presented only the essential features of this circuit. At the time of writing the circuit shown in Fig. 5 is the basic system used in the first *CBS-Columbia* receivers and most of the other projected models announced to date.

The saturable reactor method seems to be the most widely used at the present time, but other automatic systems are under consideration. The one which shows the most promise so far is one using a synchronous motor. This is a type of motor which is not affected by the magnitude of the a.c. line voltage but runs in relation to the supply frequency. The motor used in electric clocks is of that type. Such motors can be operated only at a speed which is a multiple of the line frequency and for 60 cycle operation the most widely used has a speed of 1800 rpm. Assuming that we have a motor which will run at exactly 1800 rpm and will change its speed only as the 60 cycle line frequency is changed, the problem is to have it drive the color wheel at 1440 rpm. The obvious solution would be a set of gears. Aside from the expense, the noise and vibration of most gear arrangements makes this impractical for our purpose.

A rim drive arrangement similar to that used in phonomotors is not practical because of wobbling and the general construction of the color wheel. The best solution is a V-belt drive with pulleys of proper proportion. Most V-belt arrangements have considerable slippage which can't be tolerated in this application. Thus it may be advantageous to use a toothed belt and pulleys having internal notches. For experimental purposes a regular V-belt will be satisfactory, but if this

system is used in a commercial set, a toothed belt may be required. If the motor pulley, running at 1800 rpm, has a diameter of 2 inches, the pulley on the wheel rotating at 1440 rpm must have a diameter larger by the same ratio as the speed difference.

$$\frac{1800}{1440} = 1.25$$

$$2 \times 1.25 = 2.5 \text{ inches}$$

Thus the correct diameter for the pulley mounted on the color wheel shaft is 2½ inches. This is the inside, or useful, diameter for both pulleys.

At the present time the *CBS* color telecasts originating in New York are synchronized to the local a.c. line. Use of a 60 cycle synchronous motor is therefore entirely practical in this locality. However, in suburban areas where the power is furnished by a different company and may not be synchronized to the same mains as the *CBS* station, a synchronous motor may show phase slippage and lose the correct synchronization.

The third type of automatic speed control for the color wheel makes use of a gas filled electron tube, the thyratron. This is a tube which permits very small changes in grid voltage to control large plate currents. In modern industry this type of tube is used as a power rectifier and the grid controls the amount of current passed. Since the output of a thyratron is a pulsating d.c. it is usually used in conjunction with d.c. devices. For our application it is possible to utilize a low-voltage d.c. motor such as the 12 or 24 volt types presently available on the surplus market. The motor speed is directly proportional to the d.c. voltage supplied and this voltage can be controlled by the thyratron. The grid bias for the thyratron could be obtained from a phase comparer and alternator as described previously and shown in Fig. 5. By proper selection of circuit components the bias can be set so that the amount of current passed by the thyratron is sufficient to run the motor at the proper speed. To obtain the correct d.c. voltage for the motor, a stepdown transformer is connected between the a.c. line and the thyratron. It is understood that the motor speed and the correct 1440 rpm rotation of the disc must be correlated by means of suitable pulleys just as in the previous systems. The cost of thyratrons, stepdown transformers, and the right d.c. motors is hardly less than the cost of the components used in the saturable reactor system. Both systems perform equally well but until a lot more units have been built and tested it is impossible to say which method of synchronization is better. It should be emphasized again that to date no manufacturer has produced any color receivers in production quantities nor has any particular design been proven superior. Experimentation and development are still the order of the day rather than mass production.

In conclusion we would like to describe a complete unit, such as shown in Fig. 1, that can be put in front of a set adapted for the *CBS* system and used to inject color into the picture. The color wheel itself, its diameter slightly more than twice the diameter of the picture tube, is the largest item in the converter. For silent and efficient operation, the shaft of the wheel should be mounted in a very fine, silent type ball or roller bearing. The color wheel housing can be either square or round, but should be completely closed so that the air inside rotates with the wheel thereby reducing noise and wobbling. A screen cut-out is located in the housing where the picture tube shows through. In some instances the outer screen cut-out contains an enlarging lens to produce a bigger picture. It should be kept in mind, though, that such a lens will reduce the brightness by introducing additional light loss and will restrict the viewing angle somewhat. The motor and belt driving mechanism are usually located on the side facing the TV set and have an additional cover and housing. The motor mounting is usually a rubber base or else vibration-proof rubber washers are used to eliminate vibration and noise. The use of a thick housing for the belt and pulleys also helps reduce noise.

For commercial use the *Webster Corp.* of Chicago has announced some converter models similar to the one described before. These models employ accurately balanced color wheels, special motors, drive mechanisms that are practically noiseless, and an automatic control system based on the use of a saturable reactor. Other companies are working on the design problems for a good color converter but there is room for the ambitious technician or experimenter who can come up with some novel solutions to these problems.

Although building and adjusting a color wheel may seem involved, it can provide valuable training for the tyro color technician. —30—

20-Meter Beam

(*Continued from page* 63)

in the photo. A tip on bending these pieces is to fill the tubing with sand and use a good pipe bender or bend over a round drum. The wood support frame for each dipole is made of 1" by 2" by 18' fir mounted on edge with a reinforcing piece of 1" by 1" by 10' fir mounted under the mid-section for rigidity. See Fig. 3A. The spacers are 1" by 1" by 10" fir using small clamps to hold the aluminum tubing in place. No insulators are used. A small piece of plastic tape under each clamp will help to keep the spacers from twisting in the wind (we found this out after our beam had been up about 6 months).

Any type of boom that is at least 8' 6" long can be used as support. Our boom is made of 1½" by 1½" aluminum angle spaced twelve inches apart.

In actual comparative tests on the air over the past year this beam has performed as well as three-element beams and in some cases the R reports exceeded those of the three-element beam. Since there are so many variables in a three-element parasitic type beam, one constantly affecting another, few beams of this type are operating efficiently. Then, too, the average amateur does not have the time required to properly tune up such a beam. So here's the answer—construct a two folded dipole driven beam as outlined, hook on your transmission line, and enjoy some beautiful QSO's.

—30—

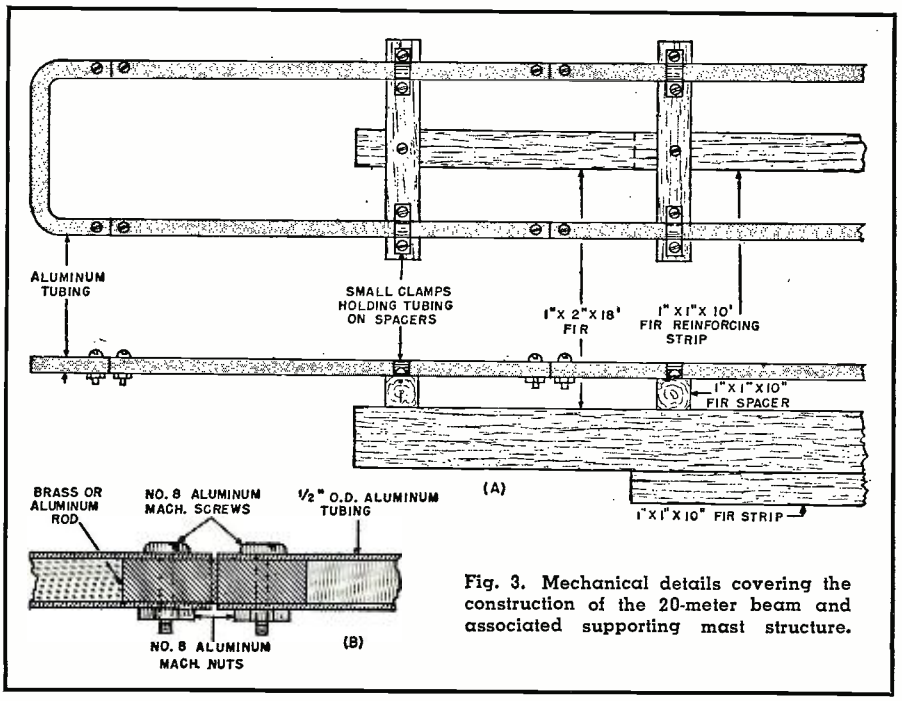

Fig. 3. Mechanical details covering the construction of the 20-meter beam and associated supporting mast structure.

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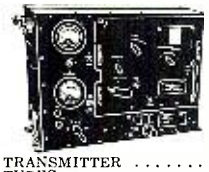
UNSURPASSED VALUE!

SHIP-TO-SHORE BC-223 TRANSMITTER



A 30 watt Transmitter, ideal for ship-to-shore or Ham Rig. Crystal or MO control on four pre-selected channels. 2000 to 5250 KC. Use of 2 plug-in coils, five tubes: 2—801 and 3—46, and TU 17-18-25 tuning units.

TRANSMITTER $39.95
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TRANSMITTER-RECEIVER

Navy Model ABA-1 (CG-43AAG)
Army Model SCR-515A, known as the BC-645
450 MC
15 Tubes

BRAND NEW — ORIGINAL CARTON.

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Distance Range	Phone Miles	CW Miles
Low Power	10	15
High Power	35	65
Auxiliary Power Supply	40	80

Complete, brand new, equipped for immediate installation. $429.00

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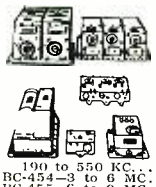

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BC-453—	USED	NEW
190 to 550 KC	$17.95	$37.50
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BC-456 Modulator	3.95	6.95
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Plugs: PL-147, 148, 151, 152, 153, 154, 156—EACH	1.25	
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3 Receiver Rack	2.25	
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HEADSETS

HS-33 low impedance with cord and plug, used, fine condition $1.89
HS-23 high impedance. BRAND NEW with ear pads 3.95
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CD-307A Cords, 6 ft. NEW ..... .89

ALSO AVAILABLE!

SCR-284
Brand new, ready for installation $329.00

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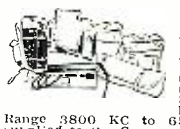


Presently manufactured complete ready for installation—pack, ground and mobile. Operating range 15 miles voice, 30 miles CW. Frequency Range 3800 KC to 6500 KC. As supplied to the Government, outlined in Manual, less spare parts $1250.00

Multitester Foundation BIAS METER I-97A

Contains a zero center 3½" round Marion voltmeter calibrated 0-100 volts each side. Movement is one mill each side of center. The unit is mounted in a steel box 7"x5"x4½" and contains 8 contact push button, line cord dual 100 MFD at 200 V DC condenser, a potentiometer 6 1RC 1% wire wound non-inductive resistors: one 400 ohm, two 2500 ohm, one 5000 ohm, one 10,000 ohm, one 15,000 ohm. Excellent for building a zero center multitester with ranges of 1, 10, 100, 1000 volt.

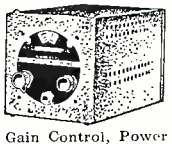
COMPLETE BRAND NEW $7.95

BC-348 RECONDITIONED GUARANTEED LIKE NEW

All letters, Frequency Range 200 to 500 KC, 1½ to 18 meg. OLD RELIABLE OF WORLD WAR II.
SPECIAL!
$165.00

BEACON RECEIVER BC-1206-C

Manufactured by Setchell-Carlson



Frequency Range—195 KC to 420 KC. IF Frequency—135 KC, Receiver Sensitivity—3 Microvolts for 10 Milliwatts output, Output Impedance—300 Ohms and 4000 Ohms to be selected internally, Power Output—230 Milliwatts, Volume Control—RF Gain Control, Power Supply—24-28 Volts Aeroplane Battery, Current—.75 Amperes.

BRAND NEW—ONLY $10.95

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Army surplus, completely reconditioned and electrically tested, using 2 flashlight cells and a pair of interconnecting wires. GUARANTEED—like new.
ONLY $16.95

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AIRBORNE COMMAND EQUIPMENT

Frequency Range 100 to 156 mcs. in 4 channels receiver and transmitter. Crystal controlled. Complete equipment. Consists of trans/rec, control box BC-602, dynamotor PE-94, AN104A antenna, plugs, etc. Power input with PE-94 is 28 v.

Electrically Tested—Complete as Shown.
Only $99.50
BRAND NEW—PRICES ON REQUEST

BC-221 Frequency Meter

Real Value! QUANTITY IS LIMITED — so first come, first served. They are just like new, with original calibration charts. Range 125-20,000 KC with crystal check points in all ranges. Complete with crystal and tubes.

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For DY-12 Power Supply for ART-13

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DUAL PURPOSE EMERGENCY UNIT

- Fire Extinguisher
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Made by leading Detroit Auto Mfr. Especially recommended for oil, gas and electrical fires. Tested and stamped in accordance with I.C.C. regulations. Guaranteed by mfr. against defects.

Order two — one for your home; one for your car in case of flats or fires.

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PRE-AMPLIFIER MODEL K-1

The K-1 is used to amplify output level for microphones and phonographs. Operates on 24-28 VDC, can be converted to 110 A.C. Comes complete with PL 55 plug and 2 foot 119-B cord, 2 terminal blocks and instruction book. BRAND NEW.

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Meter is contained in a metal box 5½" long x 3¾" wide x 3¼" deep. Comes complete with test leads and instruction book. Can be used for testing between AC and DC measuring resistances of circuits, checking fuses and testing capacitors.

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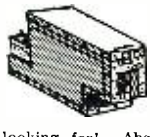
ARC-5/R-28 2 MTR RCVR $29.95



Here is the 2-meter superhet you have been looking for! Absolutely one of the BEST available today! Tunes from 100 to 156 Mcs. in four crystal channels. (Easily converted to continuous tuning.) Tube lineup is as follows:

717A—R.F., 717A—Mixer, 2-12SH7—1st and 2nd K.F. 16.9 Mc.
12SL7—Det. AVC Squelch, 12SL7—1st audio-spelch amplifier.
12A6—2nd audio, 12SH7—R.F. Osc.—4th Harmonic Gen.
717A—Trip, 12th Harmonic Gen., 717A—Dblr.—12th Harmonic.
Sealed Cartons $29.95

FREE one copy of Vol. 2 "Surplus Radio Conversion Manual" (Reg. price $2.50). This volume contains circuit diagram and full description of above receiver.

ARC-5/T23 XMTR $49.95

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Can easily be converted for use with many types of transmitters and receivers.
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80/115 V 400-260-26 VDC. Designed primarily for aircraft operation, NEW $42.50

AIRBORNE EQUIPMENT DESIGNED FOR AIRCRAFT

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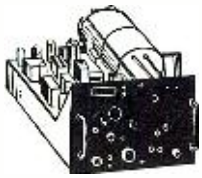

Radar Set AN/APT-5 operates on 80 or 115 volts A.C. at 400 to 2600 cycles requiring 640 volts amperes at 0.90 power factor. Complete with all tubes. Brand new in original packing.

A TERRIFIC BUY AT ONLY.. $99.50

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BOMBSIGHT Used Exclusively with B29 Planes

This bombsight is a buy-of-a-lifetime! It was developed by Sperry Gyroscope Co. in conjunction with other leading U.S. firms. Here is a veritable gold mine of costly parts! Excellent for experimenters, schools, and for advanced development. **Consists of 3 Assemblies.** Total shipping weight—350 lbs.

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APN/1 Radio Altimeters

Was used in conjunction with automatic pilot system, providing direct measurements of altitude by a radio beam. Designed to operate from 28 volts DC. Equipped with double range altitude indicator ID-14 and ID-14A, power switch and range switch.

DC operation—22 to 29.5 volts, consuming approximately 2.6 amperes with 27 volts delivered to the battery input receptacle of radio transmitter receiver. Weight—24 lbs. BRAND NEW and complete in original government cases with operating instruction manual.

FOR IMMEDIATE SHIPMENT $79.95

AN80A Antenna for BC-645 49c

Minimum Order $2.00

Immediate Delivery — Send 25% deposit on C.O.D. orders. All shipments F.O.B. N.Y.C. (N.Y.C. residents add sales tax to your remittance.)

PLATT ELECTRONICS CORP.

DEPT. A, 489 BROOME ST., NEW YORK 13, N. Y.
PHONES: WO 4-0827 and WO 4-0828

Sales Aids

(*Continued from page* 69)

the cost of replacing their picture tubes. With the necessary dollar outlay on this type of service a little higher than usual, the *Hytron* arrangement will serve as an incentive to the consumer to make this kind of purchase.

Hytron has made special arrangements with *Personal Finance Company* to take care of the details. The company has all the free tools to help put the plan to work: rate charts, budget forms, and promotional material.

An Advertising Guidebook

Word-of-mouth has long been the foundation of radio and television service promotion. In a business which depends upon volume for success, the word-of-mouth approach becomes picayune compared to other forms of advertising and promotion. Yet most service dealers continue to ignore modern promotional patterns, not because they don't want to promote, but because they just don't know how.

It is against this background that the new advertising "Guidebook for Radio and TV Service Dealers" put out by *Tung-Sol* make a tremendous contribution. It outlines simplified patterns of advertising and promotion, and tells the service dealer what is available to him and how to use it. By following the "Guidebook" the service dealer can determine his local market and the best means of reaching it at low cost. Written and illustrated by Don Herrold, it is a presentation which should be of interest to all radio and TV service dealers.

Picture Tube Promotion

With many small screen television receivers two or more years old, the CR tube replacement market has become an important one. The service dealer should realize that the efficiency of a picture tube decreases after years of use. The answer to this is replacement, which will provide greater picture quality.

A new *General Electric* promotion campaign aimed at exploiting the picture tube replacement market, features a new window-counter display (17"x26"). Kicked-off in the spring with large national space insertions and local radio and television cooperative programs, *G-E* hopes to maintain this emphasis on picture tube replacement through its new service dealer display and a varied assortment of window streamers. The colorful picture tube display imparts the message—"For a Better Picture let us install a new *G-E* picture tube in your set". It's a replacement pitch which can't be repeated too often. A new picture tube does mean a "Better Picture".

Sterling silver picture tube tie clasps and copies of *General Electric's* "Tele-Clues" are also offered to distributors and dealers as part of the

When answering Advertisements please say you saw it in RADIO & TELEVISION NEWS

promotion. The pictorial "Tele-Clues" aid technicians in localizing circuit defects within TV sets. Introduced as part of a long-range program, the "Tele-Clue" book is looseleaf and allows for inclusion of additional "Tele-Clues," as they appear in the company's service magazine, *"Techni-talk"*.

A new, highly visual display has been introduced by *Sheldon Electric* which is intended for both counter and window. Realistically portraying the feminine theme emphasized in their trade advertising, the display is aimed at both service dealers and jobbers.

A National Service Pitch

A full page ad inserted in *Life* magazine by the *Hytron Radio and Electronics Corporation* promotes the local service technician as the man to see to keep your set in perfect order. In the lower left-hand corner of their full page ad, the reader is told:

"HOW TO KEEP YOUR SET IN PERFECT ORDER. Rely upon your local service repairman. He knows how to make your set perform at its best . . . you'll find his name in the classified telephone directory under "Radio-Service."

Year-round Battery Promotion

The realization that the sale of batteries is not necessarily limited to just one season of the year but rather is a year-round business is becoming more and more apparent to many service dealers.

To augment a program of four-season selling, *Eveready* has developed a sales promotion package to tie batteries in with every season of the year. At the same time, the program coordinates the sale of batteries with the sale of portables. A panoramic window display, made of metal and wood, features the product against a changing sales background in which four signboards, measuring 23 inches wide and 18 inches high, vividly suggest each season of the year. In short, *Eveready* has provided a single display to do the job of four. You have only to change the display card and you have changed the sales emphasis to meet a new market environment. Space is provided on the card to show the package price of both portables and batteries.

The new *RCA* radio battery promotion package, possibly one of the biggest in the company's history, features dealer sales aids and point of sale displays designed for year around merchandising.

Possibly the most unique feature in this promotion package is the "Battery Fact-Finder." This is a mechanical index which automatically places at the finger-tips of counter personnel all essential battery information, including interchangeability data, prices, and technical information. Similar to the familiar desk telephone index, you merely set the index pointer and press the release button. The "Fact-Finder" contains battery replacement data on more than 500

portable radios made by 32 different manufacturers.

Another unusual item in the *RCA* package is an "interchangeable types" automatic pencil. Following the pattern set by the company's color code resistor pencil, it has a revolving section which shows the *RCA* type replacement with the corresponding types of three competitive battery manufacturers (*Eveready, Burgess,* and *Philco*). The pencil lists the 10 fastest moving battery types which account for about 85% of your battery sales.

The point of sale display signs, colorfully designed to attract the in-store customer and the window shopper, take into account every type of display fixture. There is a permanent display sign (8" x 20") which promotes the sale of portable radio sales-service as well as *RCA* batteries. Next, a giant illuminated display that constantly flashes on and off, standing 12 inches high, is intended to draw passers-by interest during evening hours. Lastly, there is a smartly styled "Fireball"—Clock Sign, which calls attention to the time and *RCA* radio batteries and serves as a store fixture. The clock is 8 inches in diameter and copy free.

A well-rounded battery promotion program has been introduced by the *Burgess Battery Company.* The campaign features colorful window streamers, counter and window display cards, and local advertising mats to tie the dealer in with the *Burgess* national advertising campaign. The familiar red-headed zebra is constantly high-lighted among colorful yellow, red, black, and white display material. Eye-appeal is the theme of the package, with streamers, displays and counter merchandisers, all vividly colored, just shouting for attention.

-30-

IMPROVING TONE

By JIM KIRK, W6DEG

WHILE experimenting with different ways of improving the tone of my electronic music, I found you could improve the wave shape and thus the tone quality by operating the transformer closer to the oscillation point by introducing resistance in the grid circuit.

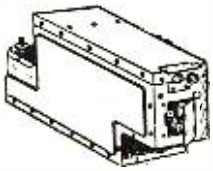
Every BC 456, in addition to many other useful parts, has one gold-band 30,000 ohm resistor. In the lower and middle ranges, if you will just unsolder the grid lead to the transformer and insert this 30,000 ohm resistor in series with it, the pitch is made higher and more pleasant sounding. You can then bring the pitch down to the correct note by use of more potentiometer resistance.

On the very high notes, it works out better to simply solder the resistor between the grid connection of the transformer and the ground. This is our old friend the "losser" resistor that you used to find connected in the grid circuits of manufactured t.r.f. receivers. In fact, if you can remember when these were first used you can probably thumb your nose at the draft board.

-30-

Niagara's SENSATIONAL RECORD BREAKING VALUES!

NEW LOW PRICE



ARC-5/R-28
2 MTR
RCVR
$25.95

Here is the 2-meter superhet you have been looking for! Absolutely one of the BEST available today! Tunes from 100 to 156 Mcs. in four crystal channels. (Easily converted to continuous tuning.) Tube lineup is as follows. Sealed Cartons **$25.95**

FREE

one copy of Vol. 2 "Surplus Radio Conversion Manual" (Reg. price $2.50.) This volume contains circuit diagram and full description of above receiver with purchase of either unit.

ARC-5/T23 XMTR

FAMOUS AIRCRAFT 2MTR EXTR. COMPANION TO ABOVE RECEIVER

This desirable VHF xmitter has turret switching coils for all stages. Uses 1625 osc., 1625 tripler, 832A tripler, 832A final. Range 100-156 Mc. 4 channels are provided using 4 separate coils in an automatic turret using 12 or 24V. motor or a manually operated system. These coils can very easily be rewound for 6 & 10 meters. Xmitter w/tubes, xtals & diagram; only **$44.95**

SPECIAL $44.95

WATCH FOR OUR NEW TUBE LIST NEXT MONTH

REMOTE CONTROL

FOR THE

?? THING! ??

(Plus $1.00 Book FREE!)

The answer to the "Remote Control" Experimenter's dream! A completely wired, 3-tube Remote Control Unit, originally used as ELECTRONIC BRAIN for remote thermostatic control of electric blankets. Can be used, with slight modification, to control model trains, planes, trucks, remote on-off for radios, open and close garage doors from your car, or to remotely control any device in accordance with your own ingenuity. AND THAT'S NOT ALL! With each unit we will give you, **ABSOLUTELY FREE,** one copy of Gernsback Library's popular new book "Model Control by Radio." 112 pages containing more than 125 illustrations, diagrams, tables, formulas, crammed full of theory and practical uses for electronic remote control. Remote control unit, including fil. xfmr, 3000 ohm plate circuit "trigger" relay, completely wired with circuit diagram, and above described book, less tubes. Shpg. wt. 3 lbs. All for only..... **$5.50**

A NIAGARA SPECIAL

REGENCY TV SIGNAL BOOSTER MODEL DB-410

Installs simply . . . Single knob tuning control . . . Contra-Wound Bifilar Coils with push-pull triode. . . . Electrical symmetry . . . No external impedance matching devices needed . . . Rich mahogany plastic cabinet with gilt dial panel. Underwriters' approved. Your Net Cost **$19.11**

ASTATIC BOOSTER

MODEL BT-1

A simplified high gain booster using the famous Mallory inductotuner for continuous tuning over entire TV and FM spectrum. Gives exceptional improvement on all channels. Single tuning knob. Mahogany finished metal case. Low noise. For either 72 or 300 ohm line. Wgt. 5 lbs.

SPECIAL $19.10

ASTATIC BOOSTER

MODEL AT-1

Astatic four-tube deluxe models—no other booster can do so much in improving TV picture contrast and clarity, in improving sound, in eliminating interference. Feature exclusive variable gain control and dual-tuning. Model AT-1 in fine furniture finish mahogany.

SPECIAL $29.10

LIMITED QUANTITY

WEBSTER CHICAGO

AUTOMATIC RECORD CHANGER

TYPE 100— SERIES

3-SPEED

A fortunate purchase makes it possible for us to offer these fine, new record changers at less than regular manufacturer's cost. Made by Webster-Chicago and only introduced on the market a few months ago as one of their latest models. Plays 12, 10 or 7 inch records at 33⅓, 45, or 78 R.P.M. New spindle carefully lowers unplayed record stack. Balanced arm assures light needle pressure and long wear. Needle-tip (included) for standard or micro-groove records. Inside-out records played without any adjustment. Pickup arm comes to rest position after last record has played. Complete factory packed and sealed record changers, normally listing at $47.50 — While they last. Shipping Wgt. 00..... **$24.85**

OIL FILLED CONDENSERS

Top Grade Units at Terrific Savings! All leading makes—Aerovox, C-D, GE, etc. Some have mounting brackets. While They Last!

Cap.	*Volts	Each	Cap.	*Volts	Each
.035-.2	600	1.49	1	1,000	1.90
.005	15,000	7.95	1	2,000	2.70
.005-.005-.01			1	3,000	2.75
	10,000	10.50	1	3,600	2.95
.1-.1	600	1.30	1	5,000	3.15
.1-.1-.1	400	1.30	2	440A.C	1.95
.1	3,000	.98	2	600	1.90
.1	6,000	1.55	2	1,000	2.40
.1	12,000	12.50	2	2,000	3.50
.2	5,000	2.89	2.5-2.5-5	600	1.95
.25	600	1.40	3	600	1.95
.25-.25	600	1.12	4	330A.C	1.75
.25	1,000	1.65	4	400	.95
.25	4,000	6.40	4	600	2.70
.25	10,000	12.00	4	1,500	3.15
.25	20,000	22.00	4	2,000	4.50
.4-.4	7,500	9.95	4	2,500	4.75
.5	400	1.05	4	3,000	5.50
.5-.5	600	1.50	5	220A.C	1.60
.5	1,500	5.50	6	440A.C.	1.85
.5	2,000	2.50	6	600	1.85
.5	5,000	4.95	6	1,500	3.65
1	400	1.25	10	600	1.85
1-1	400	1.35	10	1,000	7.50
1	440A.C.	1.70	15	330A.C.	1.95
1	500	1.25	25-25	450	2.20
1	600	1.60	40	120	1.25

*DC UNLESS OTHERWISE INDICATED

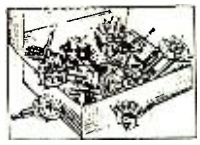
SEND FOR FREE BARGAIN FLYER "N"

KITS

HARDWARE

10 lbs. assorted brackets, nuts, bolts, screws, etc.

$1.49



RESISTORS

Kit of 50 assorted all popular sizes and values. **$2.49**

3 Kits $2.25 ea.

$129.00

Manufacturer's Closeout—Brand New

ORIGINAL 630 TYPE 16"-20" TV RECEIVER

Completely Wired, Aligned and Tested—Ready to Install With Big 12" High Quality PM Speaker.

- **30 TUBES (including 3 Rectifiers)!**
- **High Efficiency High Voltage Circuit!**
- **Advanced Model 12 Channel Tuner!**
- **AGC for Fringe Area Reception!**
- **Magnificent TV Performance!**

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100 Greenwich Street, New York 6, N. Y.

RADIO-TV Service Industry News

AS REPORTED BY THE

TELEVISION TECHNICIANS LECTURE BUREAU

EMERSON once said "We boil at different degrees" which, in our industry, is usually shown by the speed and apparent spontaneity with which all of the organized segments rise to fight any action or development that threatens to impede or obstruct its orderly growth and expansion or to encroach upon its prerogatives of self-management. Through their established and capably-managed associations, manufacturers, distributors, dealers, and representatives have fought zealously to protect their rights within the patterns of their activities and have been able to dodge responsibility for any of the mistakes that marked the sensational growth of television. The whipping boy for all of them, of course, has been the independent servicing industry.

It appears to be an accepted fact that the independent servicing industry has no boiling point. The industry opinion of the independent servicing business seems to tag it as an activity operated by a heterogeneous group of rugged individualists who, *en masse,* represent a tremendous market for parts and equipment but who are of minor consequence as individual business operators. Unfortunately, the independent servicing fraternity has done nothing to refute that contention. As a business activity it has created no recognized national voice. As a result a vacuum exists which provides a convenient dumping ground of responsibility for everything that has made television set owners sore.

But the ostrich-like attitude of manufacturers and distributors who have given nothing but lip service to the problems of the independent servicing activity may soon start bearing some bitter fruit.

Political Football?

As consumer complaints mount they invariably come to the attention of various law-making bodies who are the world's most eager beavers in grabbing opportunities to create more political jobs and increasing tax revenues. The natural result is that bills intended to regulate the servicing of radio, television, and electronics equipment are showing up in a growing number of state legislative hoppers. As fast as they are brought to the attention of the organized groups in the industry their representatives charge in to defeat them.

This purely negative approach to the problem is not enough. Unless a thoughtfully planned, intelligently conducted, industry-wide program is developed to eliminate the causes of legitimate user complaints the entire industry will find itself straddled with political controls and regulations that will handicap every phase of its operation.

It would be a most unfortunate development for servicing to become a state-licensed activity. The ramifications of this industry are so complex and extensive that licensing could easily convert the entire servicing activity into a gigantic racket. Certainly it would not supply one answer to the industry's problems.

However, these expanding efforts to regulate television service through legislation are symptomatic of faults that are the combined responsibility of the entire industry. They cannot be corrected by licensing measures. They cannot be eliminated by a well-organized service industry.

The Complaints Against Service

Legitimate service operators have been confused and bewildered by the criticism and abuse their activity has suffered, most of which is unfair and unjustifiable. They have looked in vain to other segments of the industry for guidance and help. There has been none.

Since the criticism of independent service stems from customers' complaints, an examination of these complaints will provide an accurate basis for assessing the degree of fault that rests with the independent servicing industry:

1. Business failure of television service contractors with the resultant loss of service by contract purchasers.

How can legitimate service businessmen force a competitor to escrow contract monies or to manage his business in a manner that would minimize the possibility of failure? The power to control the placement of service contracts has been in the hands of set distributors, dealers, and financing agencies since the inception of contract service. Why haven't they used it?

2. Service companies collecting from set users for "in-warranty" parts replacements.

The tie-in sale of 12-month parts warranty contracts has been very badly abused by many manufacturers, distributors, and dealers. Nationally the independent servicing industry lost thousands of dollars in time and material in an effort to cooperate with distributors on "in-warranty" parts replacements during last year's period of critical parts shortages. The in-warranty parts debacle is a sorry story. The independent service operator, of course, was the man in the middle who got hit both in his pocketbook and in his reputation.

3. Failure of the service technician to adjust the receiver to produce the quality of picture the manufacturer advertised.

Television—the miracle achievement of our age—has been poorly sold to the public. The independent servicing industry certainly has no control over that.

4. Non-servicing dealers who sell contract service, bank the contract monies as a sales profit and then when forced to render service assign the service calls to part-time and shoestring technicians.

This type of business moron worms his way into all types of business. The independent service industry is powerless to control him or to make him change his tactics. It is this type of vicious operation that has caused many legitimate service contractors, dealers, and technicians to become interested in regulatory licensing. Only through the co-ordinated efforts of the entire industry can this type of parasitical business be eliminated.

The Federal Trade Commission is conducting an investigation of radio-television industry practices and it is interesting to note that they are seeking specific information on the following, as well as other facets of industry operation:

1. Forced sales of parts warranties.
2. Failure of warranty sales agencies to stock replacements.
3. Charges for shipping costs made by distributors and manufacturers when warranty parts are back-ordered.
4. Misrepresentation in advertising.
5. Copies of written parts warranties issued by distributors and manufacturers.

What Is Needed?

First, it needs the help of the entire industry including broadcasters, manufacturers, distributors, and dealers in a consumer educational program on receiver maintenance and service requirements. Television has been oversold. Thousands and thousands of sets are improperly installed because the selling agency was too weak-willed to sell an adequate antenna installation. The novelty of television has worn off in present TV areas. Top set performance is necessary now to hold a TV audience on run-of-the mill programs.

It is time the industry took united

action to up-grade set users on the need for adequate television maintenance and service. It is high time to quit kidding the public that television receivers are so simple that anyone can take a screwdriver and insert a strip in his TV receiver that will let him receive u.h.f. telecasts. These visionary ads that make such nice reading today are the independent servicing industry's headaches tomorrow.

Second, independent service operators must realize on their own account that television installation, maintenance, and service is big business. It will not eventually gravitate into the hands of numberless thousands of one- and two-man neighborhood service shops. When its true stature on the scale of business is recognized then intelligent study will be applied to its operational problems.

The tremendous volume of service from television that blossomed almost overnight did not allow the time for study of the best operational practices for a TV service business. Since every segment of the industry has an important stake in the success of independent service as a business activity the successful solution of its operational problems should be of deep interest to the entire industry.

Third, the service operator who is trying to build a business for himself must learn to cooperate with and work with his competitors. This can best be accomplished through a local association which, in turn, should be affiliated with a national organization.

TV Service as a Business

The advent of the *Western Union Telegraph Company* into the television service business through a subsidiary, *Western Union Services, Inc.*, was announced some months ago. Initially, this company said that it would handle the installation and servicing of *Du Mont* receivers but there was a great deal of speculation about whether their ultimate plans included the handling of all standard brands of TV receivers.

The news broke in a recent advertisement.

Under a box-car head that read *"TELEVISION OWNERS!"* the ad stated that *"Western Union Services, Inc.* now installs and services *any* standard brand television receiver."

The copy in the body of the ad will be of interest to every independent service operator:

"Call . . . for the best in television service. Trained technicians—men who *know* their business—will install or service your set. . . .

"A subsidiary of the *Western Union Telegraph Company, Western Union Services, Inc.*, is equipped to render dependable and responsible service. Modern shop facilities, a fleet of service cars, and a corps of trained antenna installers and repairmen are at your service from 8 a.m. to 5:30 p.m., Monday through Saturdays.

"You may pay for each call or avail yourself of an annual service contract.

ARROW "The Home of Values!"

TUBES!

39¢

01A	1E7GT	2C26A	33	954
01B	1F4	3B7	34	1619
01C	1F5G	3D6/1299	38	1625
1A6	1G1	10Y	39/44	1626
1B4P	1G6GT	15R	49	
1B5/255	1H4G	19	CRP 72	
1C6	1H6G	30 spec.	843	

49¢

0Z4A	6J7G	6Z7G	12F5	12J5GT	211
2V3G	6T7G	12A6	12H6	77	957

69¢

CK1005	2X2	6L7G	6ST7	705 A
1A5GT	6J5GT	6R7GT	6W7G	

89¢

1B26	1S4	6AC7	6K8G	717A
1B32	2A4G	6AL5	6SH7	1613
1LD5	3S4	6C4	6V6GT	6W4
1LN5	5W4	6K6GT	VR90	6CB6

$1.59

6AG5	6L6G	100TH	9.95	805	$3.29
6AK5	1624	304TH	10.95	807	1.59
6AK6	1B3	304TL	10.95	813	9.95
		307A	4.95	866A	1.69
		803	2.89		

CATHODE RAY TUBES

3FP7	$1.95	5GP1	$3.95	16JP4	$19.95
4AP10	.95	5BP4	3.95	16DP4	19.95
5FP7	1.95	5CP1	4.95		

OIL FILLED CONDENSERS

.00025 mfd. 25,000 VDC, oil-filled, new ..... **$2.95** ea.

1.75 mfd. 330 VAC, 60 cycle, G. E. Pyranol motor starting condenser with mounting bracket, NEW ..... **59c** ea.

4 mfd	500 VDC 39c	3 for	$1.00
1-1-1 mfd	1200 VDC 59c	2 for	1.00
.5 mfd	750 VAC 39c	3 for	1.00
.25 mfd	1500 VDC 39c	3 for	1.00
.25 mfd	600 VDC B/T 24c	5 for	1.00
40 mfd	25 VDC Electrolytic 24c	5 for	1.00

50 mmfd 5000 VDC vacuum condenser, NEW **$1.29**

9 mfd. 90 VAC, 400 CPS, 3 phase Delta GE Pyranol ..... **98c** ea.

CABINET CH-118

Olive drab in color, this cabinet has a full length interlock access door on the rear. The front takes the standard 19" panels with 60 inches of height and 20 inches deep. It is shock mounted on a heavy steel platform and has a two-inch protrusion fully covering one side to accommodate wave trap and wiring. Louvered vents allow air circulation top and bottom.
Each F. O. B. Chicago **$34.50**

A few on hand need paint jobs, or small repair . . . as is. Only **$19.95**

RA 52-RECTIFIER

A transtat controlled rectifier to produce high voltage DC from 110 VAC 60 cycle source. Up to 11,500 volts DC at 50 watts. Metered high voltage (0-15KV) and current (0-20 MA). New **$74.50**

Some available with small repair or minor part replacement, less tube. Only **$49.50**

BC 769 Transmitter, P/O RC 100, new less tubes **$6.95**
BC 770 Keyer P/O RC 100, new less tubes **4.95**

MN 26Y COMPASS RECEIVER

Twelve stage superhet covering frequencies of 150 to 325 KC; 325 to 695 KC; and 3400 to 7000 KC in three bands. These units are brand new but with Dynamotor, Band Switch motor and tubes removed. Schematic Furnished. While they last, ea. ... **$4.95**

PE 206 INVERTER

24 VDC to **80 VAC** at 800 CPS **500 VA** ..... Used **$3.95**

SCOTT HI-FI OUTPUT TRANSFORMER

Made for Scott Navy Receiver. Fully Potted. Primary 5000 ohms. Secondary: 600 ohms center tapped and 60 ohms center tapped with inverse feedback. ..... New **$1.49**

MONTHLY SPECIALS!

BC 229 or BC 429 or Navy equivalent Receivers

These units are in good used condition with tubes, but less coils ..... **$3.95** ea.

Less tubes and coils, as is ..... **1.50** ea.

BC 230 or BC 430 or Navy equivalent Transmitters.

Good used with tubes, less coils .. **$4.95** ea.

Less tubes and coils, as is ..... **2.25** ea.

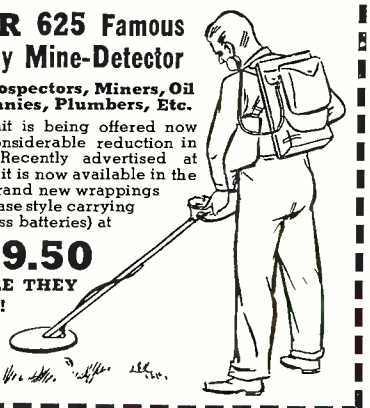
When stock of any particular model is depleted, substitution will be made unless order specifically states otherwise.

SCR 625 Famous Army Mine-Detector

For Prospectors, Miners, Oil Companies, Plumbers, Etc.

This unit is being offered now at a considerable reduction in price. Recently advertised at $79.50 it is now available in the same brand new wrappings in suitcase style carrying case (less batteries) at

$59.50
WHILE THEY LAST!



Used, like new $39.50

COMMAND (SCR 274 N) EQUIPMENT

	Used	New
ARA (same as command receiver) 1.5 to 3 MC, like new with tubes, less dynamotor, black crackle finish		$19.95
ATA 2-3 mc transmitter		17.50
BC-455 6-9 mc receiver	$7.95	14.95
BC-457 4-5.3 mc transmitter	4.95	.....
T-19 ARC 5, 3-4 mc transmitter	10.95	.....
T-21 ARC 5, 5.3-7 mc transmitter	7.95	11.95
T-23 ARC 5, 100-156 mc xmtr		49.50
BC-496, 2 position Rec. Control Box		1.95
MC-215 Mechanical Drive Shaft, per length		2.45
BC-450 3 Receiver Remote Control		1.95
BC-451 Transmitter Control Box	.69	1.50
BC-442 Antenna Relay, complete		2.95
3 Receiver Rack	1.95	.....

MIKES and HEADSETS

HS 23 High Impedance Headset	new	$4.95
HS 33 Low Impedance Headset	new	4.95
HS 30 Miniature Headset	new	1.50
	used	.75
CD-307 Ext. cord for HS 23-33	like new	.59
J41 Key	new	.98

T-32 Desk Stand microphone. Good used cond. **$2.95**
Throat Mike—T 30—New **98c**
Lip Mike—Navy Type—New **98c**
Extension Cord and Switch Assembly for lip and throat Mikes—New **98c**
CW 49505 High impedance headset complete with leather headband and rubber cushions. Used **98c**

SURPRISE PACKAGE

20 pounds assorted radio parts. A real value at **$1.95**

RECORD PLAYER

Original Government cost $150.00. Contains husky three tube Amplifier, Large PM Speaker and two speed (33⅓ & 78 RPM) 110 Volt AC and DC motor. In portable leatherette carrying case.
Good operating condition ..... **$19.95** each
Or with repairs required, as is ..... **12.95** each
Also available straight AC with one speed 33⅓ RPM motor.
Good operating condition ..... **$14.95** each
Repairs required ..... **9.95** each

MISCELLANEOUS SPECIALS!

	Used	New
RA 10 DA Receiver	$17.50	$24.95
BC 347 Interphone Amplifier		2.95
BC 442 Less Condenser	1.49	1.95
APS 13 UHF Antenna, Pair		.98
I-97 Bias Meter	3.95	4.95
RL 42 Antenna Gearbox Motor and Reel	4.95	7.50
Circuit Breaker 40 Amps		.59
Collins VFO Dial—5 calibrated ham bands form 3.2 Mc to 32 Mc; complete with pointer, gears, logging dial and flywheel. Scale 6" on 8" plate, each		.95
I 82 F Five Inch 360 degree compass indicator and Selsyn receiver		4.95
A-81-2 Transmitters Selsyn for I82 indicator (both I82F & Trans. Selsyn for $7.00)		2.45
PE-101 Dynamotor		2.75
Model 507, Thermal-converter Weston Type D, range .12 amp		.59
BC-1023 Marker Beacon Receiver, complete with tubes, shock mount and instruction manual		9.95
BC-924 27-38 MC. FM Transmitter, complete with tubes	19.95	.....
BC-684 27-38 MC. FM Transmitter, less dynamotor	19.95	.....
BC-610 10 meter modification kit		3.95
SCR-183 complete 12 volt set with all coils, tubes, dynamotor and control units		49.50
ARB Control Box		1.95
ARR2 Control Box		.89
BC 1206C Receiver, new		7.95

ASB 7 EQUIPMENT

CPR-46 ACJ Receiver—509 to 556 mc, new with tubes **$29.50**
CAY-52 ACV Transmitter, new with tubes .. **7.95**
CJP-55 AER Scope, new with tubes **19.95**
CJP-20 ABX Power unit, new with tubes ... **4.95**
used with tubes **3.95**
CJP-14 AAV Antenna switching unit, new complete **4.95**

AM 61 Indicator amplifier—New with blower and all parts except tubes **$7.95**

BC 709

Battery operated lightweight interphone amplifier. Complete with tube and shock mount, but less battery. New ..... **$3.95** ea.

AD-1 MOTOR 24 VDC—1/12 HP 6000 RPM Intermittent Duty **98c**
PE 97 or PE117 Vibrator Power Supply for BC 620 and BC 659. Used—Less Tubes, Vibrator and Condenser **$2.95**
PE 120 Vibrator Power Supply for BC 620 and BC 659 with Tubes, etc.—Complete for 6 or 12 Volt operation ..... Used **$6.95**
PE 218 Inverter, 24VDC input; output 115 VAC, 400 CPS at 13 amps. (1.5 KVA) .... new **$15.00**, like new **12.50**

CHOKES

10 Henry 20 MADC ..... **29c** 4 for **$1.00**
10 Henry 50 MADC ..... **39c** 3 for **1.00**

COMPASS INSTALLATION

MN-26C—Remotely controlled commercial type navigation receiver. Freq. range 150 to 1500 KC in three bands. Has twelve 6 volt tubes, 24 V dynamotor and band switch motor, NEW **$39.95**
MN-28C Control box for above, New **$9.95**
MN-52 Loop control unit, New **4.45**
MN-20E Loop (manually rotatable), New **9.95**
Loop transmission cable 168" long, new **9.95**
MC-124 Mechanical cabling, New. per lgth. **2.45**
IN-4D Left-right indicator, New **9.95**
Plugs, set of three, New **3.75**
Manual, covering complete set, New **1.95**

SCR 508 EQUIPMENT

BC 603 Receiver e/dyn	$24.95	Exc. Used
BC 604 Transmitter e/dyn	12.95	Exc. Used
BC 605 Amplifier e/dyn	4.95	New
BC 606 Control Box	.95	Exc. Used
FT 237 Mounting	9.95	Exc. Used
MP 48 Mast Base	2.95	Exc. Used
DM 34, Dynamotor	10.95	Exc. Used
DM 35, Dynamotor	14.95	Exc. Used
DM 37, Dynamotor	14.95	Exc. Used
TM 11-600 Tech Manual	1.95	
Crystals, Set of 80	19.95	

TS-10 Sound powered phones.
Brand New, each **$9.95**
Used **$5.95** ea.

VIBRATORS

2 Volt—7 Prong Synchronous .... **69c** 10 for **$6.00**
6 Volt—4 Prong Non-synchronous **98c** 10 for **9.00**

Shipments FOB warehouse. 20% Deposit on orders. Minimum order $5.00. Illinois residents, add regular sales tax to remittance. Prices subject to change without notice.

ARROW SALES, Inc. Dept. N, 1712-14 S. Michigan Ave., Chicago 16, Ill. PHONE: HArrison 7-9374

In either case, you get the same prompt and reliable service.

"There are no hidden charges when *Western Union Services, Inc.* repairs your receiver—and no substitution of standard factory parts. Every customer gets an itemized bill showing exactly the time involved and the parts replaced. And it costs *no more* to get this quality service."

It is perfectly logical to assume that *Western Union Services, Inc.,* is using its present operation in New Jersey to create an organizational pattern that can be used in branches in other TV areas. If this supposition is true then service contractors and servicing dealers in all sections can expect to have this competition for service business in the near future.

It is very unlikely that the competition of *Western Union Services,* or any similar national chain of service shops, will put any efficiently managed independent service company out of business.

Big companies like that must maintain a uniform volume of business for their branches to operate profitably. To create that uniform service business volume they will introduce new and long-needed techniques in the sale of service.

A fundamental error in the business planning of the average independent businessman is in expecting the public to patronize his services just because he has set up a business. People like to buy new things but they procrastinate in having anything repaired. The business the average service shop gets is "emergency" repair business. Proof of this is in the millions of inoperative or poorly operating radios, record players, and other home instruments that are lying around homes. Make a house-to-house canvass of any street in your city and you will be amazed at the amount of electronic equipment repair that needs to be done. The amount of service income that could be developed from this market is fantastic yet its possibilities have completely escaped the interest of the average independent service operator.

The ideas that sell service that will be introduced by large servicing companies will be copied rapidly by the more progressive independent service contractors and dealers. This should have a good effect in up-grading users to pay for competent maintenance service on television, radios, and other electronics devices used in the homes.

Is Size an Advantage?

Regardless of size there is no reason why a big company in the service business can give better or more efficient technical service than a capably managed independent service business of moderate size. As a matter of fact, the smaller, independently owned and operated business has a number of decided advantages over a branch operation of a national company.

But if the independent service operator isn't alert the big company may "sell" the public in his area on the idea

that their service is better because they are bigger. The tools they will use to sell this idea are advertising and direct mail promotion. These same tools are available to the independent, too, and he can use them to advantage to maintain his business against their competition.

The tube manufacturing companies have created excellent service-sales programs. They hire the best merchandising minds in the business to create this promotional material. These programs are excellent business builders if they are used regularly and properly along the lines recommended by the sponsoring tube company.

The service operator who is not using at least one of the splendid service selling programs that have been created by *Tung-Sol, Sylvania, Hytron, Raytheon,* or *RCA* is missing a good bet. The material is inexpensive yet effective in building service volume.

Bulletin Still Available

A copy of the brochure "TV Service Business Management," which was originally offered to readers of this department in the June issue, will be sent to any reader who requests it. Please address your inquiry to Service News Editor, RADIO & TELEVISION NEWS, 366 Madison Ave., New York 17, N. Y. Enclose a stamped and addressed envelope.

Progress in Color TV

During the summer the editors of this department kept in very close touch with developments on color television. It appears that manufacturing efforts are being devoted primarily to the production of color companion (slave-type) receivers. *CBS-Columbia* (the new name of the *Hytron, Air King,* and *CBS* merged combination) will introduce a color companion receiver and a dual monochrome-color set in the late summer. *Tele-Tone* is in production on a companion-type receiver and *John Meck Industries* recently announced a receiver of the slave type.

A few companies have announced color converter units for present monochrome receivers but there seems to be little development work under way on units to adapt present monochrome receivers to the *CBS* scanning rates.

—30—

SHOW TV IN GERMANY

A SERIES of ECA-sponsored television demonstrations, held recently in West Berlin, drew a large and enthusiastic audience from both sides of the Iron Curtain.

Both CBS and RCA participated in this demonstration of American television progress. CBS showed its color television system while RCA showed both black-and-white and theater projection television. Home-type receivers, placed throughout Berlin, were used to provide the widest possible coverage. One of the projection screens was placed near the West-East border so that it could be seen in the Russian zone. —30—

What's New in Radio

(*Continued from page 86*)

μμfd. in standard capacitance tolerances, up to 1500 μμfd. in ±20% tolerance while GMV tolerances apply to values up to 3000 μμfd.

The *"Centralab* Engineering Preview" EP-15 carries information on both of these units and is available on request.

"FLUID SOUND" PICKUP

Lindberg Instrument Co., 830 Folger Avenue, Berkeley 10, California has developed a new pickup cartridge which has been tradenamed "Fluid Sound."

The manufacturer points out that the unit does not require the stylus to generate the output voltage. Instead, the stylus motion is used to modulate the applied external d.c. current as it flows through the fluid.

The cartridge used with the pickup features a universal point for reproducing all groove sizes and speeds. The company claims that the new unit offers true reproduction of the full useful range of recorded sound from 20 cycles to overtones.

A folder describing all of the features of this new unit is available from the company.

DAVEN NETWORKS

The Daven Company, 191 Central Ave., Newark, New Jersey has announced the availability of a new series of branching networks, the 1130.

Designed for applications in the broadcast, motion picture sound, and in laboratory fields, the multiple input and output networks are used to equalize incoming signal levels in multi-channel mixers and similar broadcast equipment, to combine two or more incoming lines into a single out-

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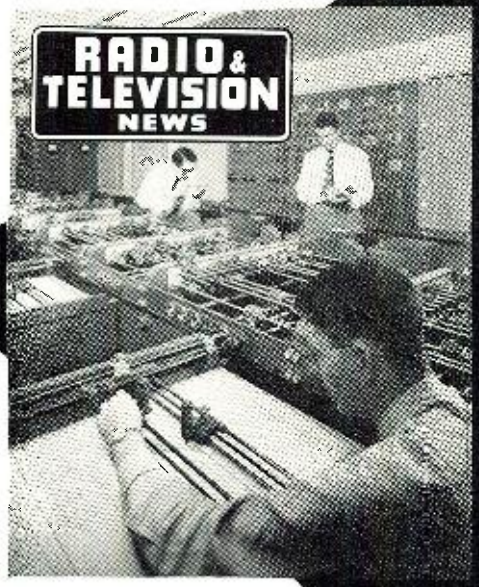

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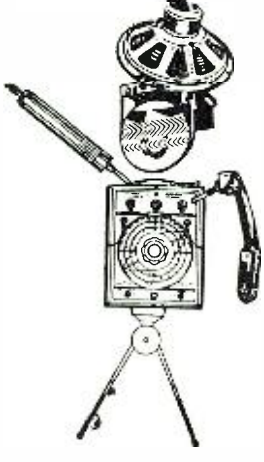

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going line, or to divide one incoming line into two or more outgoing lines. These units may be obtained in either balanced "H" or unbalanced "T"' circuits. All units are designed for minimum loss.

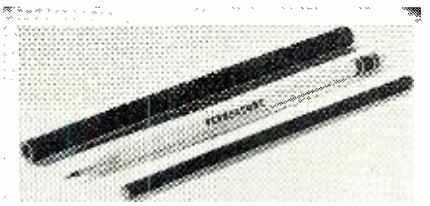
The resistors are of the precision wirewound type with accuracy of ± 2%. The maximum level of these pads is + 24 vu. A maximum number of 10 inputs or outputs is available.

Further data on these multiple networks is available on request.

ANTENNA ROD

Ferroxcube Corporation of America, 50 E. 41 Street, New York, N. Y. has announced the greatly increased production of its magnetic ceramic antenna rods.

Rods of various *Ferroxcube* materials can now be furnished radio manufacturers and coil winding companies in diameters from ¼" to 1" and in lengths up to 8". With single layer windings of insulated wire, these rod assemblies can be used on portable radios in place of collapsible rod antennas or built-in loops.



Because of the high "*Q*" of these rods the company claims that set sensitivity can be increased considerably over the usual air loop. Their compactness permits them to be mounted almost anywhere in the cabinets.

LOW-PRICED "VOLTOHMYST"

The Tube Department of *Radio Corporation of America* has announced production of an all-electronic vacuum tube "Junior VoltOhmyst" which has been designed to meet technicians' demands for a low-priced v.o.m.

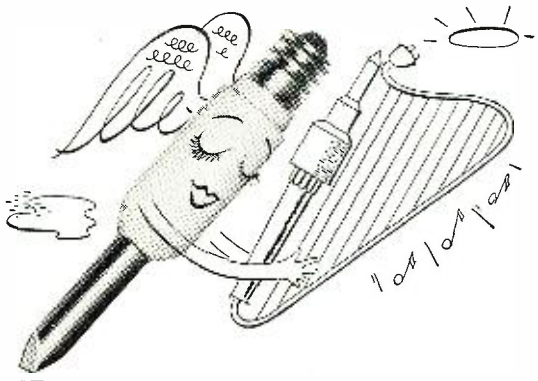
The a.c.-operated unit, the WV-77A, employs a high-impedance diode tube as a signal rectifier. In addition, the test instrument features an electronic bridge circuit similar to the one used in the company's "Senior VoltOhmyst," a 200 μa. movement, and carbon-film multiplier resistors.

The new test unit is calibrated against laboratory standards and is backed by a 12 month warranty. It measures 8" high, 5⅜" wide, and 4½" deep. It weighs four pounds and comes complete with a carrying strap.

TEST PROD ADAPTER

A new test prod adapter which has been especially designed for use with standard RTMA test points or the phonograph needle type has been developed by *United Technical Laboratories,* Morristown, New Jersey.

Designed to permit any point to be used in miniaturized or other compact electronic circuits, the new "Klipzon" Type L "Longie Adapter" provides a slender, insulated point for reaching



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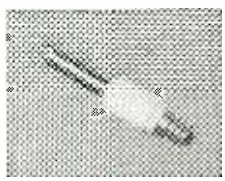

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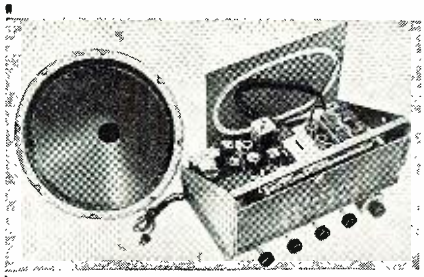

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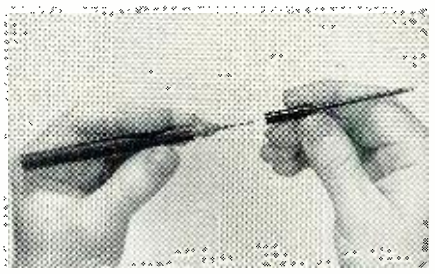
into crowded circuits. The self-holding point permits measurements with both hands free for circuit adjustment, soldering, or other work.

These adapters are about 3" long and are available in red or black. The



prods are made of non-magnetic alloy steel and are needle sharp for piercing insulation, protective coatings, and fungus. They may be easily slipped onto any standard test prod.

—30—

International Short-Wave

(*Continued from page 71*)

Italy's voice reach—as it did before World War II—to any country of the world . . . and especially to build an always more solid bridge to those countries to which Italy is joined through traditional friendships . . . and, more than that, as a supreme need of our trend towards universality."

Our best wishes for the future go to *Radio Roma!*

* * *

"Radio Free Asia"

Alan McPhadden, California, sends along a copy of a feature story from a recent issue of the *"San Francisco Examiner* concerning *"Radio Free Asia."* In part, it says:

"Radio Free Asia, recently launched equivalent of the highly-successful *Radio Free Europe,* will be broadcasting its programs of truth to the peoples of China and southeast Asia within two months. This is the admittedly 'optimistic' estimate of George H. Greene, Jr., president of the Committee for a Free Asia, parent organization of *Radio Free Asia.* . . .

"Initially, *Radio Free Asia,* which is but one part of the extensive program of the committee, will begin sending its program over major transmitters either in Formosa (Taiwan) or Manila, the same facilities over which the OWI successfully beamed broadcasts during the war. Exact mechanics of the operation, whether the program will be transmitted from San Francisco for broadcast in Formosa or Manila or sent on wire tape from San Francisco to the main stations there, have not been finally decided.

"The *Radio Free Asia* programs will differ from the *Voice of America* broadcasts in that they will not attempt to sell the American way of life to the people of the Far East. Rather, they will be directed to the common people of Asia who are interested in maintaining and improving their livelihood. Major accent will be in the

direction of the farmers and workers and the educated classes, encouraging them to protect their freedom and national independence . . ."

I hope to have further details soon. —KRB

* * *

Club Notes

Belgium—Full details of the new short-wave organization for Belgian listeners may be had by writing to M. John Gilliams, 147 Rue Franklin, Brussels, Belgium. Its publications are available in French, Flemish, and *English.* (ISWC, London)

Canada—A "Maple Leaf Chapter" of the *United 49er's Radio Society* has been officially organized in Woodstock, Ontario, Canada. Recently, "49'ers" from Canada gathered to organize the "Maple Leaf Chapter No. 1." The group selected R. A. "Bob" Vance, Woodstock, Ontario, as Canadian director; J. Pat O'Brien, London, Ontario, as assistant director, and Andy W. Jamieson, Woodstock, Ontario, as secretary. Phil Barrett, F/S, R.C.A.F., of Ottawa, Ontario, aided in the organization. Several American members of the "49'ers" were on hand to congratulate the new leaders and members. President of the club, Edw. I. Broome, New Jersey, was presented with a pin by the Canadian members; the pin bears the emblem of the new "Maple Leaf Chapter."

USA—Present QRA of Mr. and Mrs. Henry R. (Hank) Bennett, short-wave editors of the *Newark News Radio Club,* is 834 Belmont Avenue, Collingswood 8, New Jersey.

* * *

This Month's Schedules

Albania—Radio Sweden says *Radio Tirana* is audible on 6.560 in the "mornings" (*GMT*) and at 1130-1700 (*EST*); reception is poor in Sweden. Reports *Radio Shkodra,* 8.215, is good level in Sweden; usually has classical music 1500-1600.

Anglo-Egyptian Sudan—Radio Omdurman, during the daily 2315-2345 Arabic transmission, now seems to be on approximately 9.735 where has bad QRM from HI2T, Dominican Republic. (Stark, Texas; Bellington, N. Y., others) *Radio Sweden* says Omdurman has moved from 18.030 to 17.945.

Angola—Radiodifusora do Lobito, CR6AA, is operating on 5.033 and 7.177 at 0115-0200, 0630-0800, 1400-1600 in Portuguese; on Sundays 0630-0700 and 1400-1500 in Portuguese and *English.* (*WRH Bulletin*)

Argentina—In verifying, SIRA, Buenos Aires, sent copy of Constitution of Argentina and interesting letter. (Buchholz, Wisc.) LRA, 9.69, noted recently with "International Mailbag" program 1950-1958. (Cooley, Pa.) LRU, 15.29, noted 1530-1545 sign-off with music. (Whitman, Ill.)

Australia—VLX, 4.8975, Perth, Western Australia noted in England 1715 with popular "morning" melodies; good level but with CWQRM at times. (Catch)

Austria—Pearce, England, says Innsbruck is now heard on the low fre-

quency side of RIAS, Berlin, which sometimes "splashes" into its signal, so is near 5.997.

Azores—CSA92, 11.090 (measured 11.089), Ponta Delgada, still on summer schedule; noted 1400-1500; good level in Britain. (Catch) Signal good in Ill.; noted signing off 1500. (Whitman)

Belgian Congo—Radio Congo Belge, Leopoldville, broadcasts programs to European listeners in the Belgian Congo in French, Flemish, and Portuguese over OTM1, 6.295, 3 kw., 0000-0200, 0515-0730 (Sun. from 0500), and 1100-1500 (Sat. to 1600); over OTM2, 9.380, 20 kw., 0000-0200, 1100-1500 (Sat. to 1600); over OTM4, 11.720, 20 kw., 0515-0730 (Sun. 0500-0730); programs for native listeners are radiated over OTH, 9.210, 7.5 kw., 1200-1330 in French and various Congo dialects. (Radio Sweden)

Recently, OTC2, Leopoldville, has been using 9.745 to 1815 when leaves that spot to re-open 1830 on 9.767. (Bellington, N. Y.)

Bolivia—La Paz, 9.497, noted mornings from around 0600. (Stark, Texas)

Brazil—ZYC8, 9.610, Rio de Janeiro, *Radio Tamoio,* has music 1700-1715 followed by commentary in Portuguese; good level. PRB22, 9.505, *Radio Record,* Sao Paulo, noted on a Sunday 1930-2000 with what seemed to be "quiz" program in Portuguese; fine level. (Whitman, Ill.) PRN9, 9.29, Rio de Janeiro, noted 1838; at 1846 was completely blotted out by strong c.w. carrier; announces "Departamento Federal do Seguranpublica." (Machwart, Mich.)

Bulgaria—Radio Sofia, 15.33, noted signing off 2315 after *English* news session. (Russell, Calif., others)

Canada—Current International Service schedule of *Radio Canada* is: *European Service*—0850-1130, CKNC, CKCX; 1130-1400, CKNC, CKCS; 1400-1420, CKCS; 1420-1545, CKCS, CHOL; 1545-1600, CHOL; 1600-1830, CHOL, CKLO. *Australasian Service*—Commentaries from UN (*except* Sat., Sun.) 2300-2335, CHOL, CKLO; *English* on Sun., Wed. *only,* 0340-0450, CHOL, CKLO. *Caribbean and Latin American Service*—1850-2240, CHOL, CKLO; *English* 2105-2135. Stations are CKNC, 17.82; CKCS, 15.32; CKCX, 15.19; CHOL, 11.72; CKLO, 9.63.

VED, 8.264, Edmonton, Alberta, noted recently with concert 0130. (Russell, Calif.) CKFX, 6.080, Vancouver, B. C., heard with news and weather report 0930; CFVP, 6.030, Calgary, Alberta, heard 0945. (Rickards, Sask.)

Ceylon—Commercial Service, *Radio Ceylon,* noted on 11.975 signing off 1145 after "When Day Is Done;" has been heard weekdays 0115 on 17.820 announcing a "jam session." (Pearce, England) The 11.975 channel noted ending *Voice of America* relay in *English* 1100; continued with own program. (Guentzler, Ohio)

Chile—CE1190, 11.93847 (measured), Valparaiso, noted in Spanish 1830. (Russell, Calif.) CE1180, 12.000A, Santiago, heard with poor level 1745-1800

when has recorded music; 1800 commentary in Spanish. (Whitman, Ill.)

China—The Communist Chinese on approximately 7.670 is believed to be Mukden, Manchuria; takes the Peking relay of Chinese news 0800-0830. (Dilg, Calif.) Peking, 15.06A, still noted with news 0830. (Graybill, Wn., others) Has Japanese 1530-1545 and Chinese at 1745. (Cushen, N. Z.) In addition to voicecasts in *English, Radio Peking* has daily code newscasts; one is beamed on Europe over BAB, 8.104, at 1000, and one is beamed on America over BAB2, 11.450, at 0900, according to "New China Calling." (Radio Sweden)

The Communist Chinese on 6.340A may be Shanghai as is in dual with 5.980A, Shanghai outlet, mornings (*EST*). (Dilg, Calif.) The Chinese on 15.175A noted around 1020 to *after* 1130, mostly with slow-speed Chinese; short musical interludes 1030 and 1130; weak signal. (Stark, Texas)

Colombia—HJFK, 6.103, Pereira, has orchestral music 2015-2030; popular music 2033-2045; good level in Ill. HJGF, 4.847, Bucaramanga, heard signing off 2300; good level. HJCX, 6.018, Bogota, has program of recorded popular music 2230-2300. HJCT, 6.200, Bogota, noted recently with piano concert 2230-2300, good level; HJDE, 6.145 Medellin, has popular music 2330-2353; signs off 2355, fine signal. (Whitman, Ill.) HJCQ, 11.68, Bogota, noted 1929 with three-gong interval signal. (Machwart, Mich.)

Costa Rica—TIRH, 6.150, San Jose, heard 2345-0000 with music; signs off 0000; poor level. (Whitman, Ill.) A San Jose outlet, with bad distortion, was on 6.190, but seems now to have drifted (or moved) down to 6.184; call is believed TIMC; signs off around 2300. (Stark, Texas)

Cuba—COBC, 9.362, *"Radio Progresso,"* noted signing off 0002. (Machwart, Mich.)

Czechoslovakia—Prague is now scheduled with *English* 1930-2000 (to North America), 0715-0745, 1400-1430, 1600-1625 on 9.550, 11.875; German 1200-1215 on 6.095, 9.504; German 1315-1330 on 9.504, 11.840; French 1630-1700 on 9.504. (*WRH Bulletin*)

Denmark—Copenhagen continues to North America 1630-1715 on 15.320; 2030-2115 and 2145-2230 on 9.520; sessions are in Danish and *English*. (Saylor, Va.)

Dominican Republic—The *English* period of "La Voz Dominicana," 9.735, 5.970, is Mon., Wed., Fri., starting 2215; commentator is Santiago Lamela Geler, according to *"La Nacion,"* a Ciudad Trujillo daily. HI9T, 6.190, Puerto Plata, Tropical Broadcasting, noted 2310-2345 with music; measured 6.1879; considerable intermittent CWQRM noted. (Rastorfer, N. Y.) HI1Z, 6.115, has commentary in Spanish 2030-2040; music 2040-2045; good signal but with QRN. (Whitman, Ill.)

Dutch New Guinea—Hollandia noted around 7.150 at 0530-0630 sign-off; popular music 0530-0615 with all announcements in Dutch; news in Dutch 0615-0625. (Rosenauer, Calif.)

Ecuador—HC1AC, 6.210, "La Voz de la Democracia," noted with improved signal 2355-2336 sign-off with Latin American dance music; measured 6.21076; had appreciable QRM, however, from HJCT, Bogota. (Rastorfer, N. Y.)

Egypt—SUV, 10.055, Cairo, appears scheduled now Thursdays 1915-2030; also was heard once on a Wednesday from 2227 tune-in to 2316 tune-out. (Bellington, N. Y.)

Finland—Helsinki, 15.190, signs on to North America 2200 with chimes, followed by news. (Nelson, Mass.)

France—Paris, 15.24, signs on with "La Marseillaise" 1500 followed by news in French to 1515; excellent signal but slight QSB. (Whitman, Ill.)

French Cameroons—Radio Douala is now operating on 9.657 daily 1245-1500; programs consist of news and recordings; output 1 kw. (*WRH Bulletin*)

French Equatorial Africa—Radio Brazzaville, 11.970, noted with news 1545-1600, 1745-1800. (Sutton, Ohio) *Radio Chad,* 15.596, opens 0025 with interval signal similar to that of *Radio Brazzaville;* has Arabic 0030-0130 closedown. (Radio Sweden) Program is prayers and music. (*WRH Bulletin*)

French Guinea—Sutton, Ohio, says he has heard *Radio Guinea,* 10.230, announce also "Conkara;" seems best Sat., Sun.; heard twice 0710-0732 and three times 1700-1730, once to 1745 sign-off; recordings, all-French; CWQRM bad on this spot. A station noted on approximately 7.549 at 1700; Sutton believes this may be in parallel with *Radio Guinea,* 10.230; the 7.549 outlet is very weak with high noise level.

Germany—Osterloog, measured 11.79438, heard on West Coast 0000, very weak. (Russell, Calif.) This one parallels Hamburg, 7.29, both heard after 2300. (Bellington, N. Y.) RIAS, Berlin, can be heard on a *new* outlet of 6.002A from 2200. (Radio Sweden) ISWC, London, gives power as 50 kw. Noted by Bellington, N. Y., signing on just before 2200 with chimes; some nights carrier comes on as early as 2130. Pearce, England, says RIAS is slightly *below* Rabat, Fr. Morocco, and has been noted with news in German 0100, 1600; takes some relays in German from America.

AFN, Frankfurt, is now audible in Europe on 5.470 at 0000-1800. (Radio Sweden)

Greece—Radio Athens sent schedule via airmail listing *English* to North America daily 2000-2100 on 11.718; further *English* on this channel 1430-1445, followed by French 1445-1500; Russian on 15.345 at 0915-0930; the 7.300 outlet is used 2330-0800, 1030-1300, 1530-1700 for local programs in Greek, at 1300-1400 in various Balkan languages. (Cushen, N. Z., via Radio Australia) During the North American beam 2000-2100 on 11.718, has bad QRM from *Radio Canada* on 11.72. (Bellington, N. Y.)

Forces Radio Station, Kavala, veri-

fied with letter; power 250 w., using Canadian C45 transmitter, ¼-wave directional antenna beamed north-south; schedule is 0000-0130, 0500-0800, 1130-1500; sent photo of town and station. (Cushen, N. Z.)

Guatemala—TGTQ, 6.285, Guatemala City, has marimba music 0030-0045; good level; verifies with letter in Spanish; is owned by the International Schools of Latin America, with headquarters in Scranton, Pa., USA. TGWB, 6.440, heard recently with concert 2315-0015 sign-off. (Whitman, Ill.)

Holland—Radio Nederland, Hilversum, recently tested on 9.59, 11.73, to Australia-New Zealand 2230-2300. (Hutchins, Radio Australia) Also noted by Bellington, N. Y.

Honduras—HRN, 5.875, Tegucigalpa, "La Voz de Honduras," has program of music called "Music of the Americas" 2100-2115; all-Spanish. (Whitman, Ill.) HRA, 5.925, "La Voz de Lempira," noted with music 2210-2230; measured 5.92057; heavy, intermittent CWQRM. (Rastorfer, N. Y.) Good 2100-2300 sign-off. (Saylor, Va.) The Honduras outlet that was on about 6.183 is now on 6.192; is HRFU, San Pedro Sula; signs off around 2300. (Stark, Texas)

Hong Kong—ZBW3, 9.524, noted 0620 with Chinese program in progress. (Machwart, Mich.)

Iceland—Radio Sweden reports TEJ, 12.175, Reykjavik, is still on the air in Icelandic on Sundays *only* around 1115-1130; may run to 1145 as formerly?

India—AIR, 9.59, noted with news 0730. (Stark, Texas) The 15.16 channel remains good in daily native musical program 2030-2200. (Dalton, W. Va.) The 17.83 channel, in parallel, is usually buried by a USA outlet. (Bellington, N. Y.) The 15.29 channel remains quite good in news 1930. (Dalton, W. Va.) The 11.85 outlet, in dual, is poor, with QRM.

AIR is heard on 5.990 in parallel with 7.155 and 9.720 *before* and *after* 1230-1300; also noted on *new* channel of 21.660 in parallel with 21.740 at 0615-0715. (Radio Sweden) Heard signing on *English* program at 1400 to 1500 on announced 9.72, 7.170. Heard signing on 1000 with dance music on 15.29, 11.71. (Pearce, England)

Indo-China (Vietnam)—Radio France-Asie, Saigon, recently reported it was carrying out experimental transmissions on 9.748 in parallel with 9.524 directed to Europe at 1730; 11.83 in parallel with 9.754 directed to India at 2030; news in *English* at those particular times. (Radio Australia) Noted signing on 0519 on 9.754 to after 0600; good signal. (Machwart, Mich.) The 11.83 channel still signs on 0800; has news 0900. (Stark, Texas) This one noted signing off 1000 and saying would return 1730 with news; excellent strength in Calif. (Russell)

Iran—Radio Teheran now has an additional *English* program; schedule is 1330 (*new*) in *English;* 1345 in German; 1400 in Persian; 1445 in French;

1500 in *English;* 1515 in Russian, on 15.100, 6.155. Signs off 1525 to 1530. (Radio Sweden) Confirmed by Pearce, England.

Ireland—Radio Eirrean, 17.84, some days has fair to good level with news 1230-1245; woman announcer gives news. (Saylor, Va.)

Italy—Rome has replaced 15.420 with 15.32543 (measured); announces 15.320; noted with broadcast to North America, opening in *English* 1900. (Russell, Calif., others) The 1900 *English* news period is repeated for West Coast 2045; 15.325 is parallel with 11.905 in the daily North American beam. (Saylor, Va.)

Jamaica—Kingston, 4.950, noted with good level 0645 with program of sacred songs (Wed.) (Saylor, Va.)

Japan—JKM, 4.940, Kawachi, noted with native music 0525. (Russell, Calif.)

AFRS, Tokyo, heard recently 0815-0830 on 6.080 (moved from 6.175), probably on this channel to escape QRM from BFEBS, Singapore, 6.175; good level in Calif. (Rosenauer) Noted with JKI on 11.825 (formerly on 11.8000) and on JKL, 9.605, both heard to 0430; news 0300; at 0430 closes to re-open in 25 minutes as JLK2, 4.865, and JKI, 6.015 (listed); while JKI is still announced as 6.015 it has been heard more recently on 6.080. (Cushen, N. Z.)

Kenya—FBS, Middle East, now moved from Malta to Kenya, is heard daily around 1030 on 17.860. (Radio Sweden)

Korea (North)—Pyongyang, 4.590A and 4.285A seem to be used alternately; at least has been noted "jumping from one to the other, perhaps to escape jamming;" 4.590A is weak and poor; 4.285A better but only fair. (Dilg, Calif.) The 4.285A one noted around 0800 by Rosenauer, Calif., weak; says the 4.590A channel has much stronger signal than 4.285A, but with bad whistle.

A station on measured 4.27729, noted 0710, may be a North Korean; operated intermittently; seemed to be having transmitter trouble. (Russell, Calif.)

Korea (South)—"HLKA, Korea," 7.933 and 4.785, still noted with relay of *"Voice of America"* commentary in Korean 0700. Location is in doubt; may be Pusan or may be Seoul, or both. (Rosenauer, Calif.) Outlets measured 7.935 and 4.77757 noted 0740 with "Hallelujah Chorus" and "Ave Maria;" good signal; in parallel. (Russell, Calif.)

Lebanon — Lebanese Broadcasting Station, 8.036, Beirut, noted 1100 ending *English* session. (Pearce, England)

Malaya—BFEBS, Singapore, has effected these *new* schedules—0415-0630 to North, South, East China, Japan, Indo-China and 0800-1130 to India, Pakistan, Ceylon on 17.755; 0415-0815 and 0930-1030 to North, South, East China, Japan, Indo-China and 1035-1130 to India, Pakistan, Ceylon on 15.300; 0645-0745 to North, South, East

China, Japan, Indo-China and 0810-1130 to Burma and Thailand on 11.955; 0415-0615 to Malaya and Indonesia and 0630-0745 to North, South, East China, Japan, Indo-China on 9.690; 0630-0700 and 0730-0745 to North, South, East China, Indo-China and 0700-0740 and 0800-1130 to Malaya and Indonesia on 7.120; 0415-0615 to Malaya and Indonesia on 6.175. (Radio Australia)

Mexico—XEQQ, 9.680, heard 2300-2315 with Latin American music; verifies with nice card, all in blue. XEFT, 9.545, Vera Cruz, has Latin tunes 2005-2030; station announcement is preceded by 3-note chime; becomes clearer about 2200. XEHH, 11.880, Mexico City, heard with music 0030-0100; frequently interrupts music to announce station; signs off 0100. (Whitman, Ill.)

Monaco—Monte Carlo noted signing on with march 0059 on 9.785; news in French 0101-0106 followed by musical program. (Machwart, Mich.)

Mozambique—The 9.84 channel of Lourenco Marques, used for Portuguese sessions, opens weekdays 0000, Sundays 0100. (Bellington, N. Y.) Is now using 4.914, replacing 4.932, at 1500-1600. (Radio Sweden) A *WRH Bulletin* says Lourenco Marques at present is using four channels for the *English* sessions and four for Portuguese programs—*English*, CR7AB, 3.490, CR7BU, 4.911, CR7BJ, 9.732, CR7BH, 11.762; Portuguese, CR7BM, 3.440, CR7BV, 4.510, CR7BE, 9.855, and CR7BG, 15.180.

CR7BV noted in Portuguese signing off with "A Portuguesa" 1500 near 4.820; CR7BV, 4.915A, noted with *English* sponsored session 1445 and continuing *after* 1500. CR7BJ noted near 9.850 at 1350 with recordings (*English* vocals); chimes and call 1354, then orchestra music. (Pearce, England) *English* session on 11.764 still noted weekdays from 2300. (Bellington, N. Y.)

New Zealand—ZL2, 9.54, and ZL8, 9.62, in parallel, usually sign off 0547. (Guentzler, Ohio)

Nicaragua—YNZZ, 6.450, Managua, has Latin music 2245-2300; chimes and station break 2300; fair level in Ill. (Whitman)

Norway—Oslo, 15.175, noted 0820 in Scandinavian tongue. (Stark, Texas) And with *English* identification 0830 break.

Oslo has *English* program on Sundays 2100-2115 or to 2120. (Bellington, N. Y.) And 1900-1915.

Pakistan—Radio Pakistan sent this schedule for overseas transmissions—*Burmese Service*—0830-0915, 11.726. *Afghan-Persian Service* — 1100-1200, 7.010, 9.755. *General Overseas Service*—1210-1230, 6.235, 11.914. *Iranian Service*—1230-1315, 6.235, 11.914. *Arabic Service*—1315-1415, 6.235, 11.914. (Dary, Kans.) Pearce, England, hears the General Overseas Service on 11.726 and 7.010 (both announced); also news 0110 and 0210 on 17.770A.

Panama—Radio Programas Con-

tinental was measured recently as 5.995. (Oskay, N. J.) Heard evenings (*EST*).

Peru—OAX4Z, 5.895, Lima, heard 2230-2300 with operatic music; fine level in Ill. (Whitman) Noted signing off 2350. (Saylor, Va.) Measured 5.88705; considerable QRN noted. (Rastorfer, N. Y.) Sutton, Ohio, reports as *new, Radio Tacna Peru,* 9.495, with QRM from XEWW, Mexico City; noted 2200-2230 sign-off. OAX4K, 9.524, Lima, heard 2211 with news in Spanish; announces *"Radio Central";* noted another evening signing off abruptly 2301. (Machwart, Mich.) A Peruvian has moved in on 6.247 but has phone and c.w. trouble; weak and QRN bothers; not identified as yet. (Stark, Texas)

Philippines—DZB2, 3.32, Manila, is fair in Australia 0530. (Hutchins, Radio Australia) DYH4, located on the Silliam University campus, Dumaguete City, is operating on 6.055 with 0.25 kw. daily 0500-0900; at opening and closing, this phrase is used—"This is Station DYSR and DYH4—with a call from the Philippines—for Christian Living—and One-World Brotherhood." The station is a combined educational and missionary institution and is purely non-commercial. (*WRH Bulletin*) DZH3, 9.500, noted to *after* 0700. (Stark, Texas) DYH3, 6.100, Cebu, noted 0445-0500 in *English,* very weak level; another day in *English* 0900, also weak then. (Rosenauer, Calif.)

Pitcairn Island—OTC2, Leopoldville, in a recent DX session, said ZBF is operated by the Post & Telegraph Service and is used *only* for weather reports in the 12- and 17-mc. bands (didn't give exact frequencies); also said the 8.290 channel is *inactive at present.* (Bellington, N. Y.)

Poland—Warsaw broadcasts in *English* 1230-1300, 1350-1420 on 9.525 and 1315-1345, 1615-1645 on 9.570; there also is a program for *English* listeners Wed., Sat. 0930-1045 on 9.525 called "Music, the Common Language of All Peoples." (Radio Sweden)

Portugal—Lately, Lisbon appears to use 9.745 afternoons (*EST*) and 9.745 evenings at 1900-2100. (Bellington, N. Y.) Still noted around 0930 on 15.130. (Pearce, England)

Portuguese India—WRH Bulletin says "the Commercial Service of *Radio Goa* is at present on the air 2030-1130 in *English,* Hindu, Marathi, Urdu, Portuguese, and Konkani on an experimental basis with 3.5 kw., 5 kw., and 7.5 kw. in the 31- and 85-meter bands; in the near future, *Radio Goa* will be operating in *English* 2030-1230." However, *Radio Australia* reports *Radio Goa* on 9.610 still scheduled Sundays 2130-0730, weekdays 2030-0930, and with experimental transmissions in the 49- and 85-m. bands.

Portuguese Guinea—In QSL card, CQM, Bissau, gives frequency as 5.838, schedule of 1630-1800. (Pearce, England)

Rumania—Bucharest, 9.252, noted

with news 1530-1545. (Sutton, Ohio) Also heard by Pearce, England, in parallel at 1530 on 6.210, 9.252.

Sao Tome—The 17.677 outlet noted with fair level Sundays 0700-0800. (Sutton, Ohio) CR5SC, 4.807, heard 1450 with dance music, closing 1601 with "A Portuguesa." (Pearce, England)

Saudi-Arabia—Lately, Djeddah has been putting in good signal nightly from 2300 sign-on to past 2341; however, on one Wed. signed off 2332; best on 11.85 although is good also on 11.95. (Machwart, Mich.)

South Africa—Johannesburg III, 4.895, is readable some nights from 2345 sign-on with setting-up exercises in Afrikaans, followed by musical program with *English* announcements. (Saylor, Va.) Johannesburg, 9.870, noted with news 1500. (Pearce, England)

Southern Rhodesia—Salisbury, 3.320, noted closing in *English* 1500 and signing off with "God Save the King;" announces channels of 3.320, 7.290, 9.490; another day was heard 1500 with talk in Portuguese, then closed 1614 in *English,* followed by British Anthem. (Pearce, England)

Spain—Radio Nacional de Espana, Madrid, is still moving about; last noted around 9.357 at 1908. (Machwart, Mich.) *Radio SEU,* Madrid, still noted on 7.14 when checked 1815. Cadiz, 7.20, noted 1820, at times has bad QRM; station noted on about 7.945 at 0825 with Spanish music; is believed Alicante back on this channel. *Radio Mediterraneo,* 7.037, heard 1840 with good level. (Bellington, N. Y.) Alicante was noted recently back on 7.940; clear call 1545 followed by relay from *Radio Nacional de Espana,* Madrid. (Pearce, England)

Surinam—Paramaribo, 15.405, noted often evenings with oriental (Hindu?) music. Good signal. (Bellington, N. Y.) Measured 15.40933; considerable QRN. (Rastorfer, N. Y.)

Syria—Damascus, 11.915 (announced; measured 11.913) now has French 1530-1630; *English* yet 1630-1730 closedown. Recent tests on 15.395 to North America 1900-2000 and to South America 2000-2040 were only fair, with bad QRN. If starts a service to the Americas this autumn, probably will have to use the 25-m. outlet. Pearce, England, notes Damascus on 17.865 with program (some *English*) at 0945-1045 to India-Pakistan.

Tahiti—WRH Bulletin says *Radio Tahiti,* Papeete, is operating on 6.135 with 1 kw. daily 1630-1730 and 2245-0130 in Tahitian and French; French 1700-1730 and 0000-0130; news in *English* also is radiated twice weekly—Sat., Sun. at 0015. However, Art Cushen, N. Z., has checked this one and says he hears it daily 2330-0130 Noted recently by Rastorfer, N. Y., signing off 0138 with "La Marseillaise;" used *both* French and *English* in closing announcements.

Taiwan—The Chinese station on 6.095, believed Taipeh, has been noted around 0745-0800 with talk in *English.*

And on another day (Sat.) at 0740-0800 with what appeared to be a Chinese-*English* lesson. (Rosenauer, Calif.)

BED3, 15.235, Taipeh, noted with Chinese commentary and oriental music 2330; has *English* 2300-2330; gives calls in *English* 0000. BED6, 11.734, noted in Chinese 0500, strong signal. (Russell, Calif.)

Tanganyika—According to an announcement in *The Daily Telegraph,* the first public radio station in Dar es Salaam will shortly come into operation in the short-wave bands. Further details are promised. (*Short Wave News,* London)

Tangier—Radio International, 34 Rue Goya, Tangier, and *The Walter A. Maier Memorial Station* are one and the same station; from the 1 kw. transmitter at Tangier docks, operating on 6.110, the program "Bringing Christ to the Nations" is radiated in many languages Mon.-Fri. 1100-1200; in *English* on Wed. 1100-1130. (Radio Sweden)

Trinidad—VP4RD, 9.624, Port-of-Spain, noted signing on 0545; news 0700; good level in Virginia. (Saylor)

Uruguay—CSA19, 11.835, Montevideo, heard 1615-1630 with recorded Latin American music; fair level; slight QSB. (Whitman, Ill.) Noted very weak 0620. (Russell, Calif.)

USA—AAH, Seattle, Washington, "Alaska Communications System," 14.865, heard with recordings 1445-1500; at 1500 switched to scrambled speech; excellent signal in Ill. (Whitman)

USI—YDC, 15.150 (measured 15.148), Djakarta, noted with native songs 0545. (Russell, Calif.) Djakarta, 15.15, heard 1345 with call in Dutch; and opening in *English* 1400 on (announced) 15.15, 11.77; with news 0930-1030 on 15.15, 11.77, and announcing as also on 61.10 m. (Pearce, England)

USSR—Radio Moscow announces channels of 17.83, 15.44, 15.20, 15.12, 11.96, 11.91, 11.63, and 9.83 for "morning" *English* beam to North America 0800-0830. (Pearce, England) The 11.91 and 9.83 channels probably are really *Radio Budapest* relaying *Radio Moscow.*

Venezuela—YVKR, 4.920, Caracas, heard 2230-2300 with popular music. (Whitman, Ill.) YVKC, 4.89029, Caracas, noted with native music around 2230; YVKF, 4.878, Caracas, *"Ondas Populares,"* heard signing off 2253 after short anthem; YVKM, 5.040, Caracas, heard with native program 0540. (Russell, Calif.) *"Emisora Nacional de los Estados Unidos de Venezuela,"* 6.170, Caracas, noted recently 2115-2245 sign-off with baseball game coverage; measured at 6.1698; bad QRM; is this YVKA? (Rastorfer, N. Y.)

Yugoslavia—Direct from a correspondent in Belgrade, *Radio Sweden* learns that *Radio Belgrade* has dropped 9.505; broadcasts now to Albania, Czechoslovakia, Greece, Poland, Spain, Bulgaria, Hungary, Rumania,

and the Soviet Union on 236.6 and 439 m. medium-wave and 6.100 short-wave; the short-wave outlet is on the air 2315-2345, 0000-0045, 0930-1630; programs consist of news, press reviews, various articles, commentaries, music, and humor. *Any English?*—KRB.

* * *

Press Time Flashes

Cushen, N. Z., flashes that he has logged *Radio Tahiti,* 6.135, Papeete, on Thursdays 0000-0025 with *English,* including news on shipping, weather reports, air flight information, and local announcements; has been heard to announce further *English* for Wed. at 7 p.m. local time (0000 *EST*).

The Far Eastern Broadcasting Co., Manila, lists schedule of 1600-0100, 0555-1400; frequencies are DZH8, 15.300; DZH7, 9.73; DZH6, 6.03; DZB2, 3.32; DZAS, 680 kc. (Hoffman, N. Y.)

A station heard on 6.092A for some time mornings (*EST*) may be *Radio Cambodia,* Indo-China; uses French and Asiatic languages and music; audible only after VLI2, 6.090, Sydney, Australia, leaves the air. (Dilg, Calif.)

Graham Hutchins, DX Editor, *Radio Australia,* says the Indonesian on 4.946 is not yet identified but seems to announce as Bandung; carries the BCC's *"English by Radio"* on Wed. 0600. Hutchins says other Indonesians fairly good around 0530 include Sourabaya, 3.974.

The full schedule of Salisbury, Southern Rhodesia, on short-wave, is weekdays 0400-0615, 1100 (Fri. from 1000)-1500; Sun. 0330-0615, 1300-1500; in addition, a relay of the BBC news is transmitted every weekday at 1100 on 3.320 and 7.285. Regular channels are 3.320, 7.285, 9.490. (*WRH Bulletin*)

Radio Sweden recently reported Buenos Aires, Argentina, with experimental broadcast around 1700 on 15.110 or 15.120.

The clandestine outlet, *"Radio Espana de Independencia"* (believed located somewhere in the USSR), noted using 8.540 at 1400 with "news" in Spanish; also heard around 1645 on this channel; has poorly modulated signal as usual. (Catch, England)

On a recent newscast, *Radio Australia* said that the Fiji Islands is constructing a 2 kw. m.w. station and will have a 500 watt s.w. station, also; should be on the air by the end of 1952. (Machwart, Mich., others)

The Syrian Broadcasting Service, Damascus, recently carried out a second series of tests, on 15.395 (measured 15.3953) to North America 1900-2000 and to South America 2000-2040; reception was poor, signal weak with bad QRN.

Radio Sweden reports that *Radio Kabul,* Afghanistan, is audible daily 1145-1200 and Sundays to 1215 on 9.975; opens with Toreador Song from "Carmen" and gives news in *English;* at the end, a request recording is played. Heard in Sweden. *Ever heard in USA?*—KRB.

Russell, Calif., flashes that TGNA,

Guatemala, is currently testing on 5.948.

The NZBS outpost station at Apia, Western Samoa, is expected to carry out tests shortly on 3.410 and 6.040, using a 2 kw. transmitter.

Whitman, Ill., says he is hearing a station on 7.800 or 7.810 in Granada, Nicaragua; announces in Spanish 2130 quite rapidly but call seems to be YNWW (listed 8.150); at 2100-2130 has popular orchestra music; announces at 2130 as being in "Granada, Nicaragua, Centro-America;" 2130-2200 has more orchestral music; excellent signal.

Pan-American Radio, Tangiers, noted now near 7.525 to 1700 closedown; sent QSL for report on this channel but did not give frequency or schedule. (Pearce, England)

Pearce, England, reports an unidentified station near 5.890 with Arabic music 1527; announcement 1530 in Arabic, followed by Arabic music; closing 1610 with what sounds like an anthem; appeared to say "Huna Baghdad" and may be Baghdad, Iraq, on test.

At press time, Pearce, England, flashed to me that he had heard Baghdad, Iraq, testing (announced) *"new* high-powered transmitter" on (announced) 11.724, around 0115; at 0123, 0143, 0208, 0237 gave multilingual calls, interspersed with short musical interludes; announced in *English,* "This is Iraq, new high-powered short-wave station on 11.724, 25.58 meters." Asked for reports to Iraki State Broadcasting Station, Baghdad, Iraq, and each time concluded with "Hope you like the program." Still on air with orchestral music 0245 tune-out; another day heard at 0055 tune-in.

Rosenauer, Calif., recently checked Communist Chinese outlets during Chinese session 0800-0845, with these results—5.510, fair; 5.985, good; 6.155, weak; 6.340, good; 6.400, weak; 6.480, fair; 7.000, fair; 7.500, fair; 9.040, fair; 9.330, fair; 9.730, good; 10.260, good.

Dilg, Calif., has received a letter verification from *Radio Omroep Nieuw Guinea,* Hollandia, Dutch New Guinea, for his report of reception on approximately 7.150. Station officials said this was the first report received from a USA listener. "The R.O.N.G. is the official government-operated station for Netherlands New Guinea," it was explained. "We transmit programs in

At a recent organizational meeting of the "Maple Leaf Chapter" of the United 49'ers Radio Society in Woodstock, Ontario, Edw. I. Broome of New Jersey, president of the 49'ers was presented a pin by R. A. "Bob" Vance, Canadian director, on behalf of the Canadian club members. The pin bears the emblem of the new "Maple Leaf Chapter."

Dutch and Malaya over our regional transmitter operating on a frequency of 7.160; power is 0.5 kw. After completion of the new installations, it is expected that power and broadcasting hours will be increased. All transmissions are preceded by a tuning call of five minutes duration (ticking of studio clock); and news in Dutch is preceded and followed by part of the 'Colonel Bogey March'; we are on the air at present at 0415-0630." The Dutch National Anthem concludes the transmission at 0630. According to Dilg's report, the transmitter is actually using approximately 7.148 instead of listed 7.160.

At press time, Rosenauer, Calif., had noted *Radio France-Asie,* Saigon, Indo-China, 1000-1030 sign-off (moved from 9.754A).

And Bellington, N. Y., had picked up *Radio Warsaw* on 7.205 with *English* in progress 2320.

In a DX session, OTC2, Leopoldville, said *Radio Goa,* Portuguese India, is now radiating "Bringing Christ to the Nations" on 6.023 and 9.61 and 17.795 and 21.685; said the Commercial Service is 2030-2330; that, at present, *Radio Goa* is experimenting with transmitters of 3.5 kw., 7 kw., and 7.5 kw.; and that soon will radiate *entirely in English* at 2030-1230. (Bellington, N. Y.)

OTC2 further reported that Djakarta, USI, soon will have a *new* 50

kw. transmitter, on the air around January 1952, to replace the 3 kw. transmitter used now by YDC, 15.15. (Bellington, N. Y.)

* * *

Acknowledgment

Thanks for the fine reports this month. Please keep them coming during the winter DX season to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. Good listening! . . . KRB.

Spot Radio News

(*Continued from page* 18)

Describing the monitoring plan, which has been called a key link in CD center operation, the defense office said that it is expected that broadcasting stations will be grouped and transmit the same program, thus facilitating mass monitoring.

Test schedules have been set up for many areas and are expected to be placed in operation very soon.

THE USE OF THE MAILS and written reports, in lieu of oral hearings for the final stages of the allocation sessions, have flooded the Commission's rooms in the New Post Office Building, and prompted many to wonder if the reading idea was a good substitute for the listening practice normally employed, although, it has been pointed out, lengthy briefs, which usually accompany spoken testimony for the record, must be read and studied, in most instances.

One of the most interesting and perhaps lengthiest exhibits deposited on the desks of the seven air policemen, bore the *Du Mont* stamp, revealing a plan which they felt would provide more stations in all bands.

According to the *Du Mont* statement, FCC has provided 558 assignments of the very-high channels to 342 communities, and it has been found possible, they say, to set up 655 assignments in 375 communities. Expansion of the ultra-high assignments is also possible, the brief declared, by providing 1474 stations in 1153 communities, instead of 1358 setups in 1139 areas, as prescribed by the Commission.

Analyzing the suggested changes, the plan indicated that Norfolk, Va., should have four stations, and Buffalo and Pittsburgh should also have at least four each. In their opinion, in this section of the country where there is a great need for stations, an exceptionally short co-channel spacing should be tolerable. Davenport, Milwaukee, and Chicago require at least four channels apiece, according to *Du Mont*, and Madison, Wisc., and Rockford, Ill., should have at least one very-high channel apiece. This is possible, they point out, by operation of a co-channel setup between Davenport and Milwaukee. Pointing out the need for at least four very-high channels in Fresno, California, the report declared this is an expanding city and could well use these enlarged facilities.

Supporting their views with a series

of maps to illustrate channel allotments, *Du Mont* said that they found that Channel 2 could be used 59 times, instead of 47 as noted by the Commission; Channel 3, 51 times, instead of 42; Channel 4, 57, instead of 46; Channel 5, 63 times, instead of 47; Channel 6, 50 times instead of 47; Channel 7, 59 times instead of 49; Channel 8, 58 times instead of 50; Channel 9, 47 times instead of 44; Channel 10, 53 times instead of 48; Channel 11, 46 times instead of 43; Channel 12, 51 times instead of 47, and Channel 13, 54 times instead of 48.

Under the *Du Mont* plan, it was said, three-fourths of the people in the country would have four or more competitive services, whereas less than two-thirds or 63 per-cent would have those benefits under the FCC plan.

MIAMI has received substantial assurance that it would soon have several more TV stations, from none other than a member of the Commission. Appearing before the Lions Club of Miami, recently, Commander E. M. Webster declared that, at the moment Miami has . . . "but one television station. The likelihood is that it will have more. . . . In view of the many factors involved I cannot give you any assurance as to the exact time. . . . Nor can I, at this time, give you the precise number you will have. I can say, however, that the Commission's proposed allocation table provides for one educational and four commercial stations. . . . Indications are strong that you will have several television stations here."

THE LARGEST RECEIVER site in the Pacific, on the former location of the Japan central meteorological observatory at Owada, about fifteen miles from Tokyo, was recently placed in operation. The project, engineered by the 71st Signal Service Battalion, and serving as a joint station for Army, Air Force, and Navy traffic in Tokyo, features facilities for single-channel radio teletypewriter, single-sideband, and multiplex.

Electric power is supplied by three 60-kilowatt diesel generators and a power line carrying 3300 volts. Over 82,000 feet of antenna wire and 300,000 feet of transmission line went into the new setup.

TV has become quite an international item, with practically every nation considering its possibilities. In Cairo, Egypt, recently, for instance, an elaborate series of tests and demonstrations were conducted by a French group. Involved were two camera chains, a 35 mm flying-spot scanner, 2 200-megacycle transmitters rated at 200 watts for video and 50 watts for sound, control equipment, plus thirty receivers. According to a report on the study in the *European Broadcasting Union's* bulletin, about twenty-two telecasts were provided, at the rate of two a day, one of the transmissions involving a film of the wedding of King

Farouk, shot at five o'clock in the afternoon and sent out a few hours later.

In Morocco, there'll soon be a TV net, according to *EBU*. The Sultan has signed a contract authorizing a Casablanca company to set up and operate such a television system, the concession extending to the whole of the French zone of Morocco. The scheme, reports the *Broadcasting Union,* provides for studios and a transmitting station in Casablanca and transmitters at Rabat, Meknes, and Fez, fed by radio links from Casablanca. The concessions require that the installation be completed within ten years and twenty hours of programs provided weekly. The service will use the French 819-line standards.

It is expected that the Casablanca transmitter will be on the air in about a year and a half, and the station in Rabat will be placed in operation about six months later. It has been estimated that in about five years, there should be a market for over 100,000 receivers in Casablanca and Rabat.

TV has become quite a factor in Germany. Plans indicate that in '52 there will be five transmitters operating in Berlin, Hanover, Langenberg, and Cologne. A seven-year plan has been instituted, during which it is said about 2,000,000 receivers may be made. In '52 around 50,000 sets, moderately priced, are expected to be marketed.

Twenty-seven years ago radio began to rouse Berliners and others throughout Germany. In the early part of '24, there were but 2000 subscribers, but by Christmas of the year, over a half-million had registered with the Post Office for receivers.

THE CONTROVERSIAL debate on the birth of the word television is now at an end, according to the FCC, who in a document describing how TV works, have reported that the term has been . . . "traced to experiments conducted by Rignoux and Fournier in France in 1909." And five years later, says Washington, Marconi predicted *visible telephone.* Actually Jenkins began studying the subject in 1890, six years after Nipkow developed the famous scanning disk. TV is not so young after all. . . . L.W.

Eliminating Interference
(*Continued from page* 56)

aligned, even after the warm-up period. Check manufacturers' instructions for proper alignment procedure.

Vertical sweep circuits using a multivibrator type oscillator will require a relatively weak sync pulse and are more subject to instability than those using a blocking oscillator. In the case of the blocking oscillator a strong sync pulse is desirable and one way to improve the vertical hold in many sets is to reduce the value of the resistor in series with the vertical integrating network and thereby secure a stronger pulse on the blocking oscillator grid. Since noise pulses are usually much shorter and sharper than the vertical sync pulse they are not as apt to upset the vertical sync.

Unfortunately, the difference between individual ignition noise pulses and the horizontal sync pulses is small and it is quite difficult to keep the horizontal sweep in sync under strong ignition noise. Most modern TV receivers use some form of automatic frequency control in the horizontal sweep section and some of these a.f.c. circuits are more stable than others. For example, the "Synchrolock" type of circuit used in the 630 series receivers is least affected by ignition noise and the phase detector type of a.f.c. is probably the most sensitive system. If we can remove or reduce the noise pulses before they reach the oscillator, their influence will be minimized.

All TV sets have some type of sync pulse clipper and limiter circuit between the video amplifier and the sweep section to remove the sync pulses from the picture signal and to separate the vertical and horizontal pulses. Usually these clipper and limiter sections employ one or more diodes as clamping tubes to maintain a certain bias or set the d.c. level. Theoretically, such a circuit should remove the noise pulses but when the pulses are irregular and very strong they are often not clipped enough. That is where a noise diode network can be of great help. The circuit should be substantially the same as that in Figs. 6 and 7, but it may be advisable to reduce C_1 to .05 μfd. This may be necessary in order to avoid clipping a portion of the sync pulse if this network is inserted at a point where the pulses are already separated from the picture signal. Care should be taken to avoid interfering with the operation of the present clipper and limiter. If the d.c. level or the bias of a particular circuit is changed it may result in video signals appearing at the horizontal oscillator, a condition which is usually apparent on the screen by distortion at high contrast levels. Synchronizing on the blanking pulse instead of the sync pulse can also result from changing operating levels in the sync clipper. The best point for connecting the noise diode network is at the output of a

sync amplifier stage, if one is used. Just as in the case of the video amplifier it is suggested that an oscilloscope be connected to the input of the horizontal oscillator and any change in pulse shape be observed as well as the reduction in noise amplitude as different combinations are tried. It is also necessary to consider the polarity of the diode in the same manner as in the video amplifier.

Some technicians may find other methods helpful in reducing ignition noise in certain models and might even modify existing circuits for that purpose, but unless one is willing to do some redesign it is best to follow the manufacturers' service data or try some of the things suggested in this article. -30-

Mac's Service Shop

(*Continued from page 70*)

Mac insisted each set must pass before leaving the shop. For several seconds there was no sound at all, and then the set snapped on with a burst of music. Barney turned the volume down and picked up another set from the to-be-worked-on group.

"You satisfied with that set?" Mac asked without looking up.

"I know from your tone that I'm supposed to say No," Barney replied; "but I don't seem to see much wrong with it. It's a little slow warming up is all."

"How about that popping on so abruptly?"

"Probably an oscillator tube cathode that comes up to operating temperature a little after the others," Barney suggested.

Mac shook his head. "I don't think so. The sound came on too abruptly. Seemed as though something had the audio completely choked off until the set reached a certain temperature."

He picked up a little rubber hammer such as doctors use for testing reflexes and walked over to the set. Removing the back, he tapped the 12SQ7 first on one side and then on the other. Suddenly the set stopped playing as abruptly as it began, but another rap on the duo-diode-high-mu triode started it once more.

"The grid is probably shorting to the cathode," Mac explained as he tossed the tube into the discard box and put in a new one. "In these high-gain triodes the spacing is very close, and quite often a short will occur at one particular temperature. This tube was shorted until it got just so hot, and then the short disappeared; but the slightest jar was all that was needed to make it short again.

"Never let one of these sets that come on with a bang go out of the shop," he concluded. "Even if it is a slow-starting oscillator, find out why it is sluggish and correct it, for the oscillator that starts slowly this week probably won't start at all next."

"Okay," Barney said with a shrug of resignation, "but if you keep on

giving me symptoms of coming trouble for me to keep in mind and correct before letting the set go, I'll be getting out about two sets a day."

A quick frown went across Mac's face.

"I'd rather have you put out *one* set a day and do it right than put out a dozen cobbled-up jobs that will probably bounce or lose customers or do both," he said sharply. "Eventually I want you to learn to turn out *good* work *fast;* but if you will just keep on concentrating on doing your best on every set, the speed will come automatically."

"Now don't get your Scotch up," Barney said soothingly. "I was just popping off without thinking. I know you are doing your best to make a really good technician out of me, and I want you to keep right on doing it. For example, what do you suggest about this job here. The lady says that this set has a very annoying whistle in it at times, but I've had it playing for three hours without hearing any whistle."

He turned on the little three-way portable, and instantly it emitted a little pinging sound and then started to play perfectly normal.

"Put it on the isolation transformer and run the line voltage down a little," Mac suggested.

Barney obeyed, and at one setting of the line voltage the set started to howl with the characteristic musical-saw sound of a microphonic tube.

"There's your 'whistle,'" Mac told him. "As you should know by now, you can't place too much importance in the words a customer selects to describe the way a set sounds. We'd call that a howl, but to her it is a whistle. It only happens when the microphonic tube—and you can find which one that is by tapping them—is at a certain critical temperature. That is why it emitted that little pinging sound as it passed through that critical temperature during the brief warm-up. When we backed the line voltage down until the filament temperature was again at that point, the microphonic condition was sustained. At her home, probably the line voltage often stayed close to this critical voltage-figure for some periods of time, and then her set kept right on whistling—I mean howling!"

—30—

"Yuh mean yuh have to keep yore eyes open to see it?"

Audio Simplified

(*Continued from page 62*)

summarized in Table 1. This table lists the various components of the system, and gives typical values for input and output signal levels (in voltage or decibels), type of input and output signals, input and output impedances, and signal amplification or attenuation of each component. This data can serve as a guide in setting up a complete system, and may be compared with the signal levels and gains of the various units in the block diagram of Fig. 5 to show its application in a specific setup.

The required power output of the amplifier will depend primarily upon the size of the listening room. The amplifier power requirements can be determined from the curve given in Fig. 6, which shows approximately the required amplifier power for rooms of various sizes, for reproduction of music using a standard cone loudspeaker. Generally it is best to have more power available than is shown in this curve, because the sharp transients which are often present in speech and music may require greater power if they are to be reproduced without distortion. In an average-sized room in the home, an amplifier and loudspeaker capable of handling 8 to 10 watts of electrical power will have an adequate reserve power for any purposes.

The physical placement of the various units of the system and the permissible distances between them depend almost entirely upon the impedance of the particular circuit. In a circuit whose impedance is on the order of 0.5 to 1 megohm, a lead with a capacity to ground of as little as 30 $\mu\mu$fd. will appreciably affect the high-frequency response. In the output of a crystal phonograph pickup, which appears as a capacity, somewhat longer leads can be tolerated. Thus, the leads from the radio receiver should be as short as possible if the receiver has a high-impedance output; the leads from a crystal phonograph pickup can be as long as 10 to 15 feet, but should not be any longer for good high frequency response. Lines at low impedance can be as long as desired for mounting certain units remotely. Low-level lines should be shielded to avoid pickup of 60 cycle hum.

Once the complete system has been set up, an over-all test should be performed to determine whether there are any impedance mismatches or overloading at any point in the system. The simplest and most direct test of this type is to apply to the input an audio signal which is known to have good quality, and to listen to its reproduction from the loudspeaker. If the system has been properly set up, there will not be any appreciable distortion introduced by the reproduction system, and the reproduced sound will be the same as the original input signal.

(*To be continued*)

Crystal Diodes

(*Continued from page* 50)

heavy black line and the whisker as a heavy triangular black (or white) area. The reason for its importance is that when positive polarity voltage is connected to the anode, maximum current will flow. See Fig. 6.

If a.c. is applied, the cathode end marked with the bar will develop a positive d.c. potential. See Fig. 7. In the usual schematic symbol the arrow indicates the direction of easy current flow; the arrow points in the direction of low resistance. It should be understood that electron flow is in the opposite direction. Hookup mistakes have occurred where diodes have been shown with plus and minus markings in circuit diagrams. Such circuit errors will not be made if the experimenter or technician makes his connections to the anode or cathode as shown in properly made schematics.

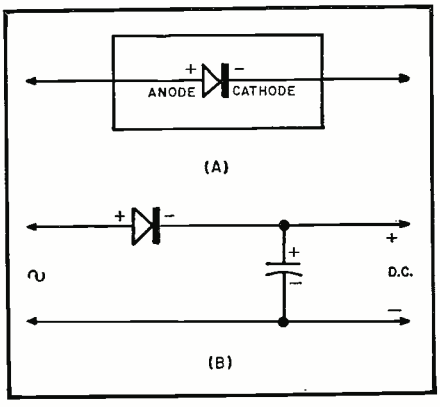
The polarities for the germanium diode are not the same as those for the silicon diode.

The polarity, as read in any circuit using a crystal, will actually be just the opposite from that shown by the markings on the crystal; this is illustrated in Fig. 8. The terminal marked "plus" on crystals or shown as the arrowhead may be considered as the *plate* of the diode; the terminal marked "minus" or shown as a heavy bar may be considered as the cathode of the diode. In a rectifier the cathode would be the positive voltage reading terminal, just as if it were the cathode in a vacuum tube diode. A comparison of the basic series diode rectifier is shown for a tube and a crystal in Fig. 9. The polarities are as indicated for an a.c. supply.

Circuit Advantages

The most obvious advantage of a crystal rectifier is the elimination of filament power consumption and reduction of a.c. hum, particularly that resulting from filament-cathode leak-

Fig. 8. (A) Polarity markings on a crystal diode and (B) polarities in the circuit. In modern practice the cathode is indicated by a band around the crystal. Plus and minus indications are not used because of the resulting confusion. "Cath" is now printed on the cathode end of the crystal.



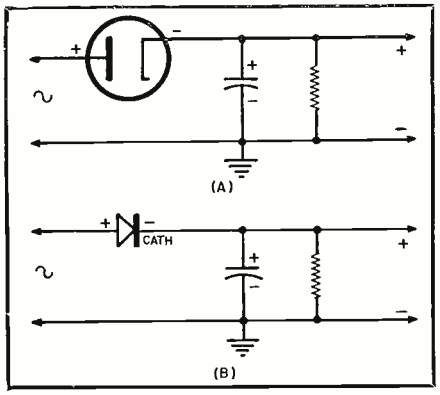


Fig. 9. Circuit diagram of (A) tube type and (B) crystal type series diode rectifier.

age or magnetic field attraction in the vacuum tube. All filament hum prevalent with series filament wiring may be eliminated, or sharply curtailed; feedback may be more easily controlled with crystals than with tubes; and longer and more reliable life may be obtained, particularly in u.h.f. converter applications, where in many cases greater output is possible with crystals as compared to tubes. The germanium diode is a passive element that has zero current flow at zero voltage; this is a distinct advantage of the crystal over any comparable tube type diode.

A crystal circuit has low capacity to ground. The crystal diode has short transit time and low interelectrode capacitance. This latter characteristic becomes increasingly important as the frequency of operation increases. The usual capacitance is 1 $\mu\mu$fd. or less. The transit time is negligible because the rectifying barrier layer between the semiconductor and the metal contact is about a millionth of a centimeter; this barrier layer is the surface of contact between the metal to which the crystal is soldered and the semiconductor. It acts as a rectifier of alternating currents.

This spacing is much closer than any possible spacing of electrodes in modern vacuum tubes. These are some of the factors which contribute toward making crystals so well adapted to detection of r.f. energy in the millimeter wave region.

Circuit Precautions

Crystal components are extremely rugged but care must be given them to prevent burnouts which render them useless. A rectified current should never be permitted to exceed the rated maximum value for any given type. While a crystal may withstand a high current surge for an instant, it is better to design a circuit so that such exigencies are obviated.

Take a case in point: In a shunt detector circuit such as that shown in Fig. 10 the value of the charging condenser, in series with the plate of the tube and the crystal, must be carefully chosen or the amount of charging current may become large enough to damage the crystal. This might happen where the plate impedance is low and the value of the charging con-

denser high, and especially when equipment is first turned on.

As rectified currents approach the milliampere scale, voltages increase in the order of whole volts; resistance in the back direction starts decreasing, putting a limit on the amount of input power which may be used without saturation of rectification. Positive voltages on the order of 3 to 4 volts, or rectified currents greater than 30 ma. will damage sensitive type crystals.

Arrange circuits so that the anode current peaks, either transient or recurrent, through the diode in the forward direction, are at a safe value, well below the maximum current rating in milliamperes. Since recurrent peaks occur in normal operation in certain types of circuits, the design should be such that any recurrent peaks are well within the anode peak ratings of the diode.

In general, avoid excessive reverse voltage. Any current in a reverse direction is high, but something like 200 to 600 microamperes is so high that the crystal is liable to damage of a type which cannot be self healed. Failure of a crystal is usually due to operation beyond the ratings shown in the characteristics table.

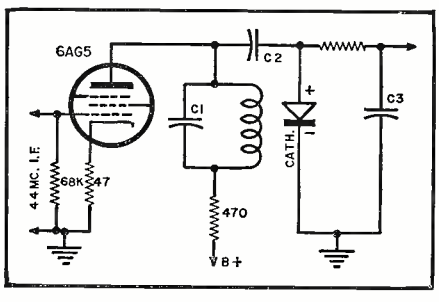
Installation of Crystals

There is no installation problem when the pin ends are used in holders or as clip-in devices, but whenever the diodes are connected point-to-point in a circuit, avoid making the pigtail leads so tight that no expansion elbow exists. There is some thermal expansion of the leads which may affect the contact between the wafer and whisker if the pigtail is pulled very tight to make an extremely short lead.

Some care is desirable in soldering the leads. Crystals should be protected against high temperatures. The use of a soldering gun is advisable and preferable to an iron because the gun applies the heat for a very brief period of time whereas the heat from a soldering iron may become excessive when an improperly tinned iron is held on the lead for any relatively long period of time.

Diode characteristics may be changed during the application of a soldering iron in a point-to-point circuit wiring procedure. Hence, it is a good service practice to grip the pigtail lead between the body and the soldering point with a pair of long nose pliers or to lay two pieces of bare copper wire at the

Fig. 10. A low value condenser for C_2 is desirable in this type of circuit. Here the capacity value is 9 micromicrofarads.



soldering point to help dissipate some of the heat that might flow into the diode housing and affect the basic characteristics of the component. Any excessive heat may result in deterioration of the barrier layer as mentioned previously.

This may seem like laying it on with a trowel, but the point is extremely important. One large manufacturer found that by changing the pin material from steel to grade A nickel the increased thermal capacity helped protect the germanium slab from the adverse effects of soldering heat. Then the pigtail leads were changed from copper to copper-clad steel because this permitted only one-fourth as much heat to be conducted to the germanium during the soldering operation.

It is good practice to test the general condition of a crystal rectifier from time to time, both before installing and after the unit has been in use. Measure the d.c. resistance with a high resistance ohmmeter without subjecting the crystal to any excess current. Reverse the meter leads to determine the resistance both ways. A good unit should have a front-to-back ratio of at least 10 to 1 for a silicon crystal and at least 100 to 1 for a germanium crystal. This figure of merit is the ratio of the forward resistance to the back resistance.

In summary of this introduction to the crystal diode it may be well to recapitulate the outstanding advantages of these new electronic components. They are compact in size and simple to install; engineering and design features have made them units of rugged construction; they have high forward conductance with freedom from contact potential effects; they exhibit low interelectrode capacitance and infinitesimal transit time; the series capacitance (p-k) is low and the reverse leakage is low; there is freedom from hum; and they have an estimated service life of approximately 10,000 hours.

As the applications of germanium diodes are increased new properties are investigated. The low impedance, high efficiency, ultra high frequency germanium diode is an example of research in what was necessary to provide useful germanium diodes at 1000 mc.; this is the *G-E* 1N72. The use of diodes in pulse circuits has brought to light many new diode characteristics. Current flow characteristics of submicrosecond duration become predominant and have resulted in investigations into drift characteristics.

These point contact rectifiers offer many possibilities in addition to present uses as radar mixers, second detectors, beacon detectors, and low frequency diodes. They may replace many tube diodes with a saving in volume, weight, and filament power consumption. Their low capacitance and elimination of contact potential effect make their use in high frequency applications extremely desirable. Their high forward conductance characteristics make them very efficient rectifiers in both low and high impedance circuits,

but they perform at optimum efficiency in low impedance applications.

At the present time they are being used in television receivers to help simplify the circuit and to reduce the amount of weight by making no demands for a transformer heater supply. A TV receiver now may contain fewer tubes and be a better receiver than one made a few years ago, before the application of crystal diodes.

(To be continued)

Grid Emission Control

(*Continued from page* 39)

is extremely important. The engineers responsible for the final quality of the tubes require this test data to be sure that when these tubes are operated within their published ratings they will be free from excessive grid emission current. The tube designer needs this information to make certain that his experimental tubes are properly designed to withstand the operating conditions required in new tube types.

The emission current from the grid is a thermal effect, basically identical to the emission current from the cathode. The amount of current is determined by the temperature of the grid and by its state of activation. The temperature of the grid is primarily dependent on the wattage dissipated by the cathode, the other grids (if any) and the plate, as well as the method of cooling. The state of activation is dependent on the base materials used and on the type of surface layers produced during processing of the tube.

Tube designers employ various methods to reduce the temperature of the grid. The grid is cooled normally by conduction of the heat from the grid supports to the stem leads. Small strips of blackened material are often welded to the top of the grid support wires to help cool the top section of the grid. Furthermore, the use of blackened material for plates helps to reduce the grid temperature because it not only reduces the plate temperature but also the amount of reflected cathode heat thrown back into the grid.

The normal materials used in tubes have been chosen because they have low activity at the temperature at which they must operate. They must also be capable of being drawn into the fine wires that are used in grids and withstand the additional temperatures required during manufacture without distorting. When the normal nickel alloy grid material is inadequate other materials such as silver plated nickel, gold plated molybdenum, or gold plated tungsten are employed. These materials resist activation at higher temperatures even if they are contaminated slightly during processing.

The tube manufacturer, by means of his testing, his choice of material and design, and his control during processing is assured that excessive grid emission will not be present in his tubes when operated within their maximum published ratings. —30—

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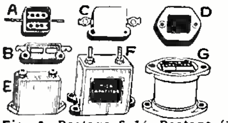

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.000022	.09	.0012*	.23
.000024*	.17	.002	.15
.000025*	.17	.00224*	.27
.00004	.09	.0025	.15
.00005*	.17	.003/1KV	.29
.000082	.09	.0033*	.35
.0001	.09	.004	.22
.0001*	.17	.004*	.43
.0003	.09	.005	.22
.001*	.17	.006	.23
.0011	.09	.01	.29

Fig. B. .001 mf, **10c**; .006 mf, **23c**; .01 mf. **35c.**

Fig. C. Solder Lug Terminals & Mtg Holes

Mfd.	Ea.	Mfd.	Ea.
600 WV		**600 WV**	
.0001	$0.29	.02	$0.76
.00035	.35	.03	1.19
.001	.42	**1200 WV**	
.002	.45	.002	.66
.004	.53	.004	.68
.005	.55	.005	.71
.006	.59	.01	.78
.008	.63	**2500 WV**	
.01	.66	.00047	.59

Fig. D. Screw Term & Mtg

Mfd.	Ea.	Mfd.	Ea.
600 WV		**1200 WV**	
.0001	$0.29	.01	$0.78
.00055	.37	.013	.89
.00085	.42	.03	1.89
.0012	.44	.033	2.39
.003	.49	**2500 WV**	
.005	.54	.0004	.59
.015	.71	.002	1.09
.02	.78	.0022	1.09
.03	1.19	.0024	1.13
.033	1.29	.0035	1.19
.039	1.98	.0036	1.19
.04	2.09	.004	1.25
.05	2.39	.0043	1.25
		.005	1.45
1200 WV		.006	1.55
.001	.61	.01	1.89
.002	.66	.015	2.19
.0051	.71	**3000 WV**	
.0068	.75	.005	1.65

Fig. E. Upright Xmtg Micas

Mfd.	Each	Mfd.	Each
250 VDC		**3000 VDC**	
.05	$0.47	.0055	$1.35
.2	2.59	.008	1.79
1500 VDC		**3500 VDC**	
.04	.89	.000033	.78
.05	1.08	**5000 VDC**	
2000 VDC		.000082	1.65
.003	1.08	.0001	1.79
.005	1.19	.00015	2.29
.006	1.25	.00018	2.39
.01	1.39	.0002	2.49
.015	1.68	.0003	2.75
.02	1.98	.00043	2.85
.03	2.35	.0006	3.59
2500 VDC		.001	3.89
.0025	1.08	.005	4.29
.006	1.65	.01	4.79
3000 VDC		**6000 VDC**	
.00005	.78	.001	4.29
.0001	1.08	.002	4.79
.0003	1.15		
.0007	1.19		
.005	1.65		

Fig. F. Heavy Duty, Upright, Bklte Csd

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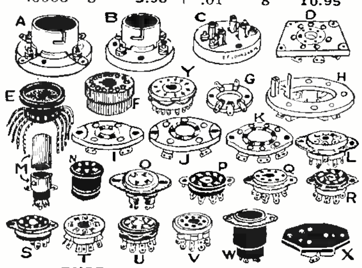
.0003	8	3.98	.01	8	10.95



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Complete, Ready-To-Shoot. Not a Kit. Tube rated at twice no. of pix taken in life-time, 1/1000 sec. flash, every 15 sec. True daylite color. Usable all cameras Oper. 115 VAC, w/lite. AC40 ....**$44.50**
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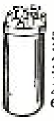

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50 mf/350vdc FP.......**3 for 98c**
30-15-10mf/250vdc .....**3 for 98c**
40-20mf/250-25vdc .....**4 for 98c**
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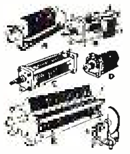
4mf/450vdc "Tynee-Dry"..**2 for 98c**
6000mf/15vac. SPECIAL.....**$3.29**



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A. 150mmf/300VGap HF MILLEN, CARDWELL **$1.39**
B. BUD Dual 75mmf ea. Sect 1000V Gap, HF **$1.29**
C. JOHNSON 70H30 70 mmf/3000VGap **$1.29**
C. 240mmf/7KV HiPwr JOHNSON 250c 70 **$6.49**
D. Cardwell Neut ZT/12 mmf 500 Volt Gap. w/Locknut **98c**
E. CARDWELL TK-300-US 53 to 312 mmf. Can be made Split Stator. BRAND NEW...............**$10.95**
F. HAMMARLUND MC75S 80mmf. List $3.40. Special, each............**98c**
Vernier Drive 10 to 369mmf, each....**69c**
Midget 3 to 15 mmf, Midline, each....**39c**
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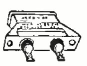

Mfd	Each
25wvdc	
50	$6.98
50wvdc	
4	.49
150wvdc	
1-1-3-5	.69
250wvdc	
1	.39
2x.25	.35
300wvdc	
1.2	.39
400wvdc	
.1	.49
.25	.55
.5	.59
1	.69
4	1.69
6	2.29
8	2.49
10	2.89
2x.1	.75
2x.5	.94
3x.1	.91
3x.25	.99
600wvdc	
.034	.49
.1	.64
.2	.69
.25	.71
.5	.75
1	.85
2	.99
3	1.08
4	1.89
5	2.29
6	2.69
7	2.89
10	3.29
2x.1	.79
2x.25	.85
2x.5	.98
2x1	1.19
2x2	1.39
2x8	3.49
3x.05	.89
3x.22	.98
3x.25	1.09
700wvdc	
4	1.98
800wvdc	
.1	.69
1000wvdc	
.1	.73
.45	.79
1	.99

Mfd	Each
2	$1.69
4	2.29
5	2.98
10	3.98
15	4.98
1400wvdc	
.25	1.29
.5	1.39
1500wvdc	
.5	1.59
.75	1.69
1	1.79
2	2.29
4	2.98
5	3.49
6	3.98
24	8.98
2000wvdc	
.1	1.49
2x.1	1.75
1	1.98
2	2.49
3	3.98
4	4.49
5	5.39
8	9.49
2500wvdc	
.25	2.29
3000wvdc	
.1	2.49
.5	2.98
2	4.49
3	5.39
4	6.49
4000wvdc	
2	8.98
5000wvdc	
.2	4.49
2	10.98
4	19.98
5500wvdc	
2	12.98
7000wvdc	
.002	1.69
.0075	1.98
.1	4.98
7500wvdc	
.03	2.98
.05	3.49
Mfd	**Each**
10000 wvdc	
.03	3.49
12000 wvdc	
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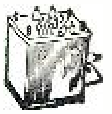
Mfd	Each
12500 wvdc	
.65	$16.98
2	95.00
15000 wvdc	
.0016	9.98
25000 wvdc	
.00025	7.49
1	95.00
AC RATED	
220vac/600dc	
2	.69
4	.89
5	1.29
225vac/630dc	
3.3	.79
230vac/630dc	
5	1.29
330vac/1000dc	
1.25	.79
1.5	.89
1.75	.98
2	1.03
2.5	1.09
2.8	1.15
3	1.19
4	1.29
5	1.49
12	3.49
15	3.98
25	6.49
40	9.98
405vac/1200dc	
.15	1.29
600vac/1800dc	
16	6.98
660vac/2000dc	
5	4.49
6	4.98
10	6.98
16	7.98



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115 V 60 Cyc Input
TV & CR Pwr Xfmr for 7" to 20" Tubes. Hi VOLTS to 20KV (w/quadrupler ckt). ALL Tubes, PL & FIL wndgs dlvrng: 300 VDC/275Ma Full - Wave, 6.4V/10.3A, 5.4V/8A, 2.5/3A Hypersil Core, Oil impreg...............**$8.98**
2500V for CRT, 6.3V/.6A, 2.5V/1.75A Csd Kenyon **$8.98**
1400vct/90ma, 6.3v/4a. 5v/3a H'sld.**$5.98**
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1000vct/150ma, 300v Bias 6.3/5a. 5v/3a, 2x6.3v/.65a, 6.3v/1.25a H'sld.....**$4.98**
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900v/35ma, 2x2.5v/2a. Xcellent 1800 V' Dblr. two 2x2 fil. wndgs. H'sld HVins.**$3.49**
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770v/2.5ma, 2.5/3a RAYTHEON HiVins H'sld Incl Filter Parts for CRT P. .
700vct/125ma, 6.3vct/4A. 5v/3A...$3.98
600vct/150ma, 6.3v/4a, 5v/3a, (Int Shld) **$3.98**
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570V/150ma, 5v/3a, 12v/4a, H'sld.**$4.49**
420vct/90ma, 6.3v/1.9a w/inpts 6-12-24-115vdc & 115 230 vac. **$1.98; 2 for $3.49**

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1100vct/212ma Csd HiVins COLLINS **6.50**
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Hi Gain Dynamic Mike & Xfmr. Buy!

Comb. hi-gain Dyn Mike Xfmr UTC/ Super Elec 3 wdg. 600 ohm CT & 4000 ohms Tapped 250x150 ohms. Fully Shielded H'sld PLUS Exc. Fidelity Dyn Mike.
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6Amp/125V—UL Appvd Single Hole Mtd. Remvd from Equip Bklte Csd. CLEAN. A Real Buy! SPST...**4/$1** DPST...**3/$1**

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SPECIAL—0-15 VAC. 2 1/6" Rd.. G-E. 800 cyc. USN. NEW **$1.69**

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0-5 Volts. 2" sq. Wstghs.......... **2.98**
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Silver & Mica Cndsrs........**30 for $2.50**
Controls, 50 ohm to 2 Megs..**10 for 2.98**
Resistors, ½&1W, to 2 Megs.**100 for 3.98**
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Sockets, Asstd. 8, 7, 5, 4P...**25 for 2.49**
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Resistors, 2 W. Asstd.......**25 for 3.98**
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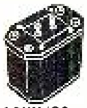

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8HY/200ma **$2.25**
8HY/150ma, New UTC. **1.98**
12HY/300ma, Csd..... **3.95**
3HY/40ma, Csd...**3 for 1.00**
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7470 & 1063 ohm/12 step **2.98**
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Variable Atten. 600 ohm imped/30 step **10.98**

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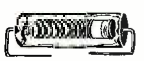

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"TAB"—Specialists in Precision Resistors
No Mfrs Choice—We Ship Types in Stock

0.116	271	1200	3100	14550	90000
0.42	275	1223	3163	14600	91000
0.425	280	1250	3259	15000	93300
0.607	286	1260	3290	16000	95000
0.7	289	1300	3333	16500	100000
1.03	299	1350	3384	16800	110000
1.3	300	1355	3500	17000	115000
1.75	310	1400	3509	17500	116667
2.5	311.5	1488	3700	17977	120000
3	320	1495	3730	18000	130000
3.83	325	1500	3760	18300	135000
4	330	1510	4000	18380	140000
4.35	340	1518	4030	18500	141000
5	350	1600	4200	18800	145000
5.025	360	1640	4220	19000	147000
6.25	366.6	1646	4280	19500	150000
6.5	370	1650	4300	20000	155000
7	375	1670	4314	20441	160000
7.8	380	1680	4440	20500	165000
7.9	389	1710	4444	21000	166750
8	390	1712	4500	21500	167000
10.38	400	1740	4720	22000	169200
11.25	410	1770	4750	22500	175000
12	414.3	1800	4850	22990	180000
13.52	418.8	1818	4885	23000	180600
14.2	425	1830	4900	23150	185000
14.25	426.9	1865	5000	23325	186600
14.5	427	1892	5100	23400	190000
15	440	1894	5210	23500	198000
16	450	1895	5235	24000	200000
17	452	1896	5270	24600	201000
19	460	1897	5300	25000	205000
19.2	470	1898	5500	25200	210000
20	475	1899	5600	25400	215000
22	478	1900	5730	25833	220000
23	480	1901	5770	26000	225000
24	487	1902	5910	26500	229000
25	500	1903	6000	26600	230000
26	520	1904	6100	27000	235500
28	525	1905	6125	27500	238000
30	540	1906	6140	28000	240000
31.5	550	1907	6200	28430	245000
37	575	1908	6300	28500	250000
48	580	1909	6495	29000	265000
49	588	1910	6500	29500	268000
50	600	1911	6840	29990	270000
51.78	612	1912	6990	30000	275000
55	625	1913	7000	31000	294000
56.7	633	1914	7320	31500	300000
60	640	1915	7500	32000	307500
63	641	1916	7700	33000	311000
68	645	1917	7717	35000	314000
74	649	1918	7900	37000	316000
75	650	1919	7930	38140	325000
80	657	1922	7950	38500	330000
81.4	665	1924	8000	39000	333500
88	668	1926	8094	39500	350000
89.8	670	1960	8250	40000	353500
95	673	1980	8500	42000	375000
100	675	2000	8700	43000	380000
101	680	2045	8770	45000	400000
105	681	2080	9000	.....	402000
105.7	684	2095	9100	47500	420000
107	689	2141	9445	48000	422000
120	697	2142	9500	48660	425000
121.2	699	2145	9710	49000	450000
125	700	2150	9800	50000	458000
130	711	2160	9900	52000	478000
135	733	2180	9902	55000	500000
147.5	740	2187	10000	56000	520000
150	750	2195	10430	57065	521000
160	800	2200	10500	58333	525000
166	806	2250	10600	60000	543000
170	850	2300	10900	61430	550000
175	854	2400	10936	62000	570000
179	899	2450	11000	64000	575000
182	900	2463	11400	65000	600000
182.4	910	2485	11500	66600	620000
200	917	2490	11690	66650	650000
209.4	946	2500	12000	67500	654000
216	978	2525	12500	68000	660000
220	1000	2600	12800	70000	690000
220.4	1030	2625	13000	72000	700000
225	1056	2635	13100	73500	750000
230	1059	2700	13550	75000	761300
235	1067	2750	13550	80000	800000
240	1100	2850	13600	82000	813000
245	1110	2860	14000	84000	850000
245.4	1150	2870	14250	85000	900000
250	1155	2900	14400	85750	930000
260	1162	3000	14500	88000	950000

Any Size Above, Each 35c; Ten for $3.29

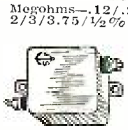
MEGOHMS

1.	1.57	2.25	3.673	6.	8.02
1.1	1.579	2.5	3.75	6.5	8.5
1.2	1.65	2.7	3.9	6.6	9.05
1.25	1.75	2.75	4	6.7	9.5
1.3	1.8	2.8	4.23	7	10
1.35	1.9	2.855	4.25	7.5	11.55
1.39	2	3	4.5	7.62	12
1.4	2.11	3.3	5	7.74	12.83
1.5	2.2	3.5	5.5	8	13
					13.85

Any Size Above, Each 70c; Ten for $6.49

Vacuum Precision HiVolt Resistors

Megohms—.12/.25/.6/.75/.83/.99/1/1.5/2/3/3.75/½% Accy...Ea. **$1; 10/$7.50**



LINE FILTERS

10Amp/130vacdc Csd USN 0.1 to 1000 Mc's....**$1.29**
30Amp/250vacdc Csd USN 0.1 to 1000 Mc's.........**$3.98; 2 for $6.00**
50Amp/600vdc/250vac. Fltrs both sides of line. SOLAR "Elim-O-Stat". New **$9.98;**
100Amp/usable 110 vacdc GE **2 for $1.98**

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EICO
TEST INSTRUMENTS

Guard

CBS-Columbia Inc.
COLOR TELEVISION PRODUCTION QUALITY

In the CBS-Columbia design laboratories, Al Goldberg takes some important readings with the EICO Model 221 Vacuum Tube Voltmeter and Model 555 Multimeter, as Harry R. Ashley looks on.

Mr. Al Goldberg, Assistant Chief Engineer of CBS-Columbia, and Harry R. Ashley, President of EICO, inspecting the use of the EICO Model 221 Vacuum Tube Voltmeter and Model HVP-1 High Voltage Probe at the Sweep Frequency Troubleshooting Position on the CBS-Columbia Color Television production lines.

KITS
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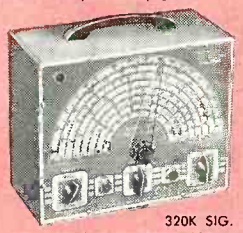
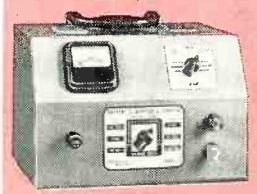
NEW 555K MULTIMETER
KIT $29.95. WIRED $34.95
20,000 ohms/volt



320K SIG. GEN. KIT $19.95. WIRED $29.95

NEW 322K SIG. GEN.
KIT $23.95. WIRED $34.95

NEW 950K R-C BRIDGE & R-C-L COMP. KIT $19.95
WIRED $29.95



NEW 1040K BATTERY ELIM.
KIT $25.95. WIRED $34.95

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WHY does CBS-Columbia, Inc., today's headline-maker in Color Television set production, use EICO Test Instruments on its new Color Television production lines and in its design laboratories?

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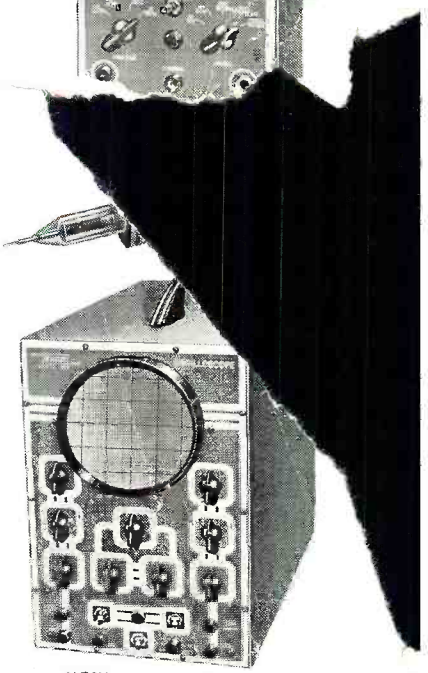

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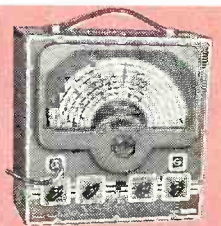

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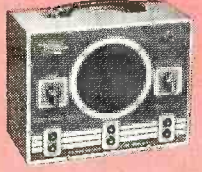

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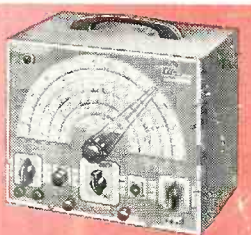

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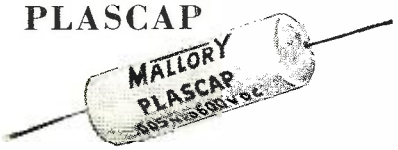

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