RADIO-ELECTRONIC ENGINEERING EDITION

RADIO & TELEVISION NEWS

DECEMBER 1953

INCLUDING

TV & RADIO ENGINEERING

IN THIS ISSUE

A ZIFF DAVIS PUBLICATION

A serviceman's "best friend" is an RCA Tube

An RCA Tube starts working for you from the instant the customer first sees the familiar red, black, and white carton. You have her confidence from the start, because she knows and respects the RCA trademark.

But the big payoff to you begins when the tube goes to work. For, experience has proven that the superior quality of RCA Receiving Tubes and Kinescopes is your best measure of protection against premature tube failures. With RCA Tubes, you can be sure the job is well done.

Helping you to safeguard your reputation is a vital, everyday service of RCA Tubes. And that protection is yours at no extra cost.

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Here's *your* key to better business... RCA's dynamic Dealer Identification Program. Ask your **RCA Tube Distributor** for your copy of the colorful, 16-page booklet "A Magic Pass-Key to Customer Confidence." It tells you how you can become a Registered Dealer . . . and get *extra* sales benefits.

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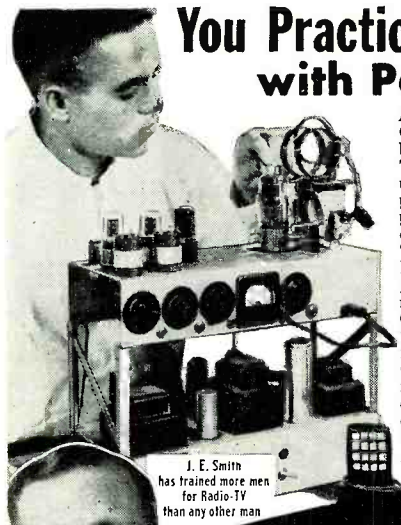
RADIO CORPORATION of AMERICA

ELECTRON TUBES

HARRISON, N. J.

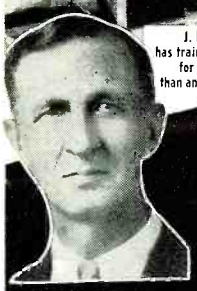
You Practice Broadcasting with Parts I Send



As part of my Communications Course I send you kits of parts to build the low-power Broadcasting Transmitter shown at left. You use it to get practical experience putting this station "on the air," performing procedures demanded of broadcasting station operators. Training plus opportunity is the PERFECT COMBINATION for job security, good pay, advancement. An FCC Commercial Operator's License can be your ticket to a better job and a bright future and my Communications Course gives you the training you need to get your license. Mail coupon below and see in my book other valuable equipment you build. All equipment I send is yours to keep.

You Practice Servicing with Parts I Send

Nothing takes the place of PRACTICAL EXPERIENCE. That's why NRI training is based on LEARNING BY DOING. You use parts I furnish to build many circuits common to both Radio and Television. With my Servicing Course you build the modern Radio shown at left. You build an electronic Multitester which you use to help fix sets while training at home. Many students make $10, $15 a week extra fixing neighbors' sets in spare time, starting soon after enrolling. I send you special booklets that show you how. Mail coupon for my big 64-page book and actual Servicing Lesson, both FREE. See other equipment you build and keep.



J. E. Smith has trained more men for Radio-TV than any other man

I Will Train You at Home to be a RADIO-TELEVISION Technician

TELEVISION
Today's Good Job Maker

TV now reaches from coast-to-coast. Over 25 million TV sets are now in use; about 200 TV stations are on the air; hundreds more being built. This means more jobs, good pay jobs with bright futures. Now is the time to get ready for success in TV. Find out what Radio-Television offers you. Mail coupon now for my 2 Books FREE!

America's Fast Growing Industry Offers You Good Pay, Success

Do you want a good pay job, a bright future, security? Then get into the fast growing RADIO-TELEVISION industry. Hundreds I've trained are successful RADIO-TELEVISION TECHNICIANS. Most had no previous experience, many no more than grammar school education. Keep your job while training at home. Learn RADIO-TELEVISION principles from easy-to-understand lessons. Get practical experience on actual equipment you build with parts I send you.

Make Extra Money in Spare Time While Training

The day you enroll I start sending you SPECIAL BOOKLETS that show you how to service neighbors' Radios in spare time while training. Use MULTITESTER you build to help service sets, get practical experience working on circuits common to both Radio and Television. Find out how you can realize your ambition to be successful in the prosperous RADIO-TELEVISION industry. Even without Television, the industry is bigger than ever before. 115 million home and auto Radios, over 3000 Radio Stations, expanding Aviation and Police Radio. Micro-wave Relay, FM and Television are making opportunities for Servicing and Communications Technicians.

Mail Coupon — Find Out What Radio-TV Offers You

Send for my FREE DOUBLE OFFER. Cut out and mail coupon below. Send in envelope or paste on postal. You will get actual Servicing Lesson to prove it's practical to learn at home. You'll also receive my 64-page Book, "How to Be a Success in Radio-Television." Read what my graduates are doing, earning, see photos of equipment you practice with at home. J. E. Smith, President, Dept. 3NE National Radio Institute, Washington 9, D. C.

I TRAINED THESE MEN

Has Growing Business

"I am becoming an expert Teletrician as well as Radiotrician. Without your practical course I feel this would have been impossible. My business continues to grow." —Philip G. Brogan, Louisville, Ky.

Good Job with Station

"I am Broadcast Engineer at WLPM. Another technician and I have opened a Radio-TV service shop in our spare time. Big TV sales here. As a result we have more work than we can handle." — J. H. Bangley, Jr., Suffolk, Va.

Praises NRI as Best Course

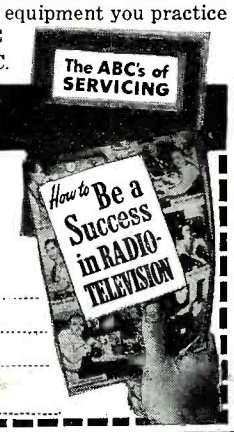
"I was a high school student when I enrolled. My friends began to bring their Radios to me. I realized a profit of $300 by the time I completed the course."—John Hopper, Nitro, West Va.

AVAILABLE to all qualified VETERANS UNDER G.I. BILLS

NRI Training Leads to Good Jobs Like These

Broadcasting: Chief Technician, Chief Operator, Power Monitor, Recording Operator, Remote Control Operator. **Servicing:** Home and Auto Radios, P.A. Systems, Television Receivers, Electronic Controls, FM Radios. **In Radio Plants:** Design Assistant, Transmitter Design Technician, Tester, Serviceman, Service Manager. **Ship and Harbor Radio:** Chief Operator, Assistant Operator, Radiotelephone Operator. **Government Radio:** Operator in Army, Navy, Marine Corps, Coast Guard; Forestry Service Dispatcher, Airways Radio Operator. **Aviation Radio:** Transmitter Technician, Receiver Technician, Airport Transmitter Operator. **Television:** Pick-up Operator, Voice Transmitter Operator, Television Technician, Remote Control Operator, Service and Maintenance Technician.

Tested Way to Better Pay



Good for Both—FREE

MR. J. E. SMITH, President, Dept. 3NE
National Radio Institute, Washington 9, D. C.

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COVER PHOTO: Mimi Benzell, world-famous singer, and husband, Walter Gould, eye newly-acquired music system Record changer (Garrard), tuner (Pilot), amplifier (Bogen), speaker (University) enclosure (Cabinart) and the tape recorder (Wilcox-Gay). Ektachrome by J. Seymour

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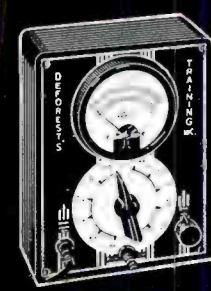
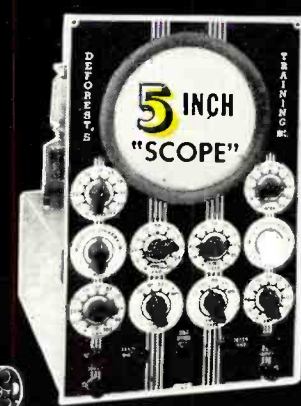


Multimeter



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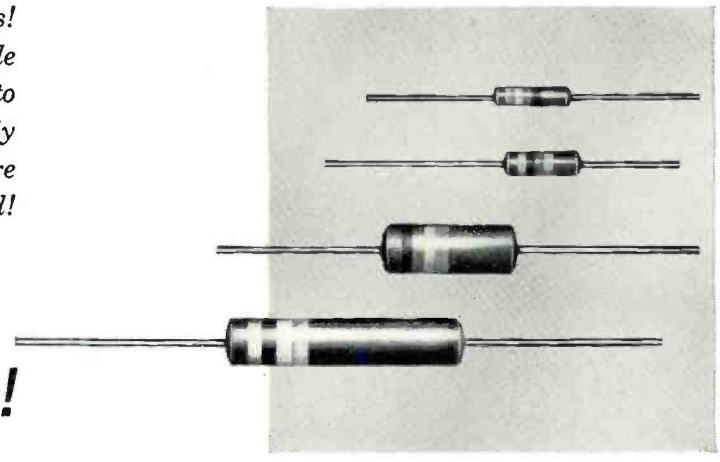

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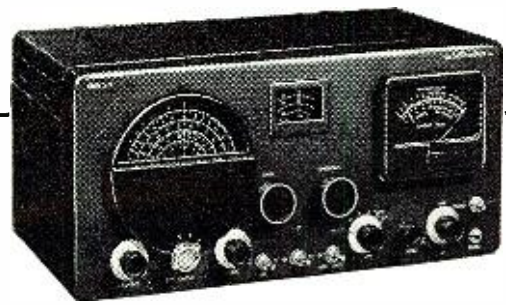


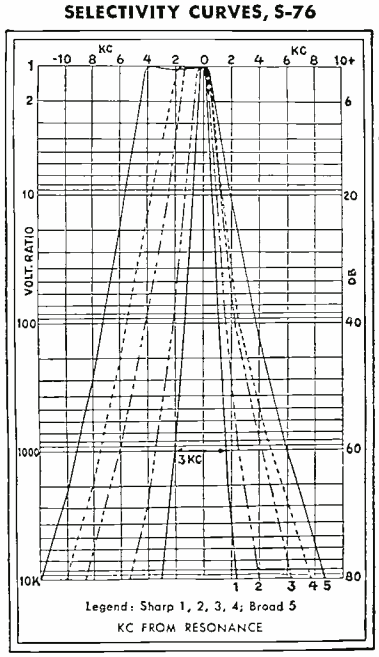
Model S-76

Double conversion receiver. Broadcast Band 538-1580 kc plus three short-wave bands covering 1720 kc-34 Mc.

Calibrated electrical bandspread for easy tuning. Double superhet with 50 kc second i-f and giant 4-inch "S" meter. Five position selectivity, one r-f, two conversion, two i-f stages, temperature compensated. 3.2 or 500 ohm outputs.

Satin black steel cabinet. 18½" x 8⅞" x 9½" deep. Nine tubes, voltage regulator, and rectifier. For 105/125 V. 50/60 cycle AC. Use R-46 speaker. . . **$199.95**

SELECTIVITY CURVES, S-76



Do you know any better way, any other way, to judge SW equipment than to check the specifications and the performance? Frankly that's the only valid way we can think of to make sure you get your money's worth. Check these specs. Take a look at the selectivity curve for the S-76. It is typical of the outstanding value Hallicrafters offers in every price class.

Model HT-20. T.V.I. suppressed 100 watt AM-CW transmitter with all spurious outputs above 40 Mc at least 90 db. below full rated output.

All stages metered; single meter with eight position meter switch; output tuning indication. Frequency range of 1.7 Mc to 31 Mc continuous on front panel control. Seven tubes plus five rectifiers. For 105/125 V. 50/60 cycle **$449.50**

Model SX-71. Covers Broadcast Band 535-1650 kc plus four short-wave bands covering 1650 kc-34 Mc. and 46-56 Mc.

Narrow Band FM one r-f, two conversion, and three i-f stages. Temperature compensated, voltage regulated. Three watt output (terminals for 500 and 3.2 ohms).

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Model R-46. Matching 10" PM speaker for use with Hallicrafters communications receivers SX-71, SX-76, SX-73 or SX-62. 80 to 5000 cycle range. Matching transformer with 500-ohm input. Speaker voice coil impedance, 3.2 ohms.

Satin black steel cabinet matches all Hallicrafters receivers. Cloth covered metal grille. 15" x 10⅞" x 10⅞" deep. Ship. wt. 17 lbs. **$24.95**

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For the RECORD

BY THE EDITOR

NEW HORIZONS FOR INDEPENDENT SERVICE

BY THE TIME this issue is distributed, it is probable that the FCC will have approved a compatible color TV system. The study of color TV is a responsibility for all service technicians who expect to derive any measure of income from this new advance. Service technicians cannot afford to leave their shops in the evening and forget about their profession. Television in company with electronics moves too rapidly. Many changes in circuitry, manufacture, and transmission have occurred since 1947. Service has had to keep abreast of these developments to be successful.

In color TV, the service technician cannot assume that he will learn all he needs to know after he has practiced on a few sets. He may never get the chance to practice on those sets. The man who learns the circuitry involved, and the techniques needed for successful servicing of color, will establish a reputation early and will beat out his competitors. The facts on color TV have been appearing in this magazine, and we will continue to present them in the many articles we have planned for our service readers. Read them, they are for your own good.

Not long ago, Chicago was host to the 4th annual convention of independent service associations, sponsored by the National Alliance of Television and Electronic Service Associations. This 3-day meeting was significant in that it brought together the representatives of many of the manufacturers of television sets and of the parts used in TV repair, and a large number of independent service dealers from different parts of the country.

The number of independent service dealers attending the show was approximately 500—five hundred out of an estimated total of 20,000 service businesses employing upwards of 75,000 service technicians. If the convention was not the total success numerically that it deserved, many things were accomplished for independent service, and those who attended benefited from a variegated group of talks and seminars. In particular, there were seminars on business and sales promotion, stressing how to use many of the promotional items available to service dealers from manufacturers and suppliers. Representatives of the *RCA Service Company* delivered two stimulating and enlightening talks on color TV and transistors, and there were other interesting lectures on u.h.f., consumer relations, and labor problems in the service shop, by representatives of *Amphenol, General Electric,* and Chicago Better Business Bureau.

Without a doubt, whether independent service endorses NATESA or not, a national service organization representing independent service is important in what it can accomplish for service. Such a group can represent the service dealer in his desire for closer cooperation with the set manufacturer in making his sets more serviceable; in eliminating such time-consuming service headaches as tubes which slope forward on the chassis and fit so closely under the picture tube that they cannot be removed for checking unless the picture tube and chassis are removed first. A national organization can strive for better test equipment when necessary—not to mention the legislation that such a group can fight for or against in the interests of independent service.

However, such a group must be truly representative to help all segments of service. To be representative, it must have as many active members or member groups as possible. Many local service associations have preferred to combine into regional alliances, rather than combine on a national basis. Such groups have been formed in Texas, Pennsylvania, New York, Michigan, and a few other states. It is to be hoped that these regional groups will find some basis for cooperation on a national level, for it is becoming more and more apparent that independent service must organize itself for its own betterment, and to oppose the curbs that some pressure groups would force upon it.

R & TV News Acquires TV & Radio Engineering

In line with our policy of keeping our readers up-to-date on the many facets of radio, television, and electronics, we are happy to announce that we have recently acquired *TV & Radio Engineering,* a magazine which has been authoritatively serving the interests of this rapidly expanding field for many years.

Effective as soon as possible, the *Radio-Electronic Engineering* Edition of RADIO & TELEVISION NEWS will incorporate many of the regular features of our new acquisition. You will also find our *REE* Edition greatly expanded to include articles of interest to development and design engineers in TV, AM, and FM broadcasting.

We welcome the regular readers of *TV & Radio Engineering,* and are happy for this opportunity to broaden the scope of our *REE* Edition . . O.R.

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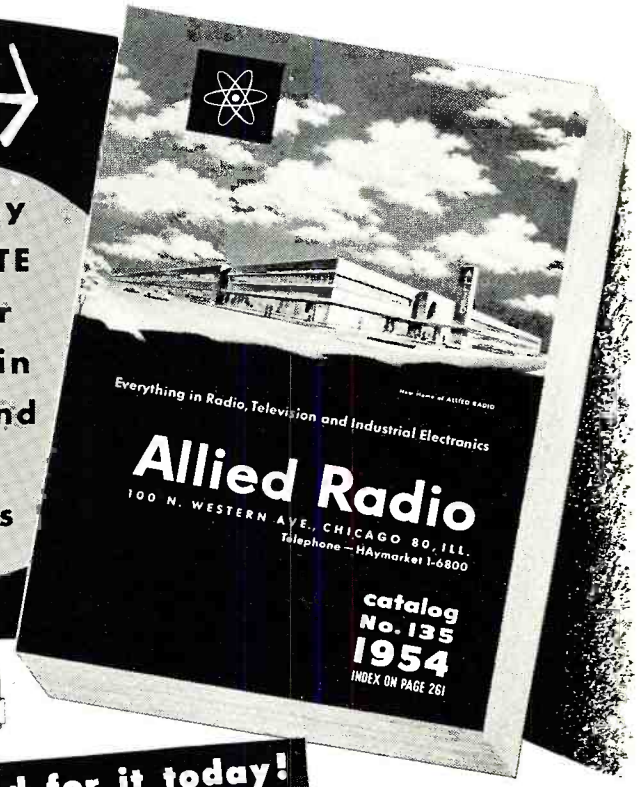

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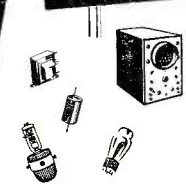

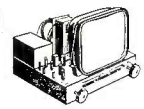

You'll want the *one* complete Buying Guide to *Everything in Electronics*—268 pages packed with the world's largest selection of quality equipment at lowest, money-saving prices. See all the latest releases in custom TV chassis, TV antennas and accessories; AM and FM tuners and radios; *everything* in High-Fidelity custom components; latest P.A. Systems and accessories; recorders and supplies; Amateur receivers, transmitters and station gear; specialized industrial electronic equipment; test instruments; builders' kits; huge listings of parts, tubes, tools, books—your choice of the world's *most complete stocks* of quality equipment. ALLIED gives you *every* buying advantage: speedy shipment, expert personal help, lowest prices, liberal terms, assured satisfaction. Get the 1954 ALLIED Catalog. Keep it handy—and save time and money. Send for your FREE copy today.

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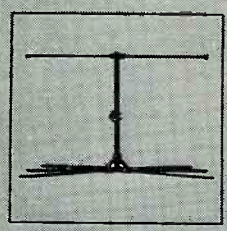
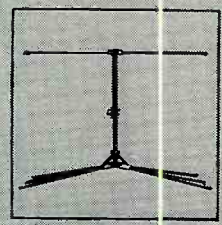
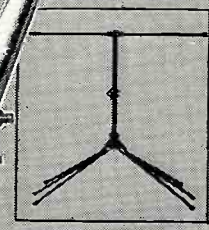


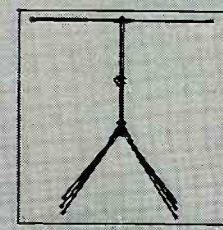
Channels 2-13, peaked for low channels (2 thru 6)



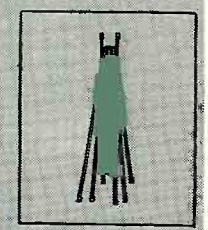
Channels 2-13 normal position, peaked for all VHF channels (2 thru 13)



Channels 2-13, peaked for high channels (7 thru 13)



Channels 2-83, peaked for UHF channels



Falcon "VARI-CON" folded for packing

Model VC-1

Model VC-2

Model VC-4

Stack them for added gain.

FALCON easiest of all antennas to assemble merely open like an umbrella and tighten wing nuts

There is NO ASSEMBLY problem with a FALCON "VARI-CON". It takes longer to explain the operation than to accomplish it! Your FALCON "VARI-CON" comes folded into one compact unit. You need only swing the reflector into position and tighten the wing nuts. Move the sliding sleeve to the calibrated channel setting you desire and tighten. The butterfly springs snap the elements into position and lock them securely. The FALCON "VARI-CON" is ready to install, ready to provide peak performance. *Changing the channel peaking of the "VARI-CON" is just as simple and easy as making the original setting. No tools are needed for either operation.*

Calibrated sleeve for quick peaking of antenna.

THE HEART OF THE "VARI-CON"

Above is a view of the new mechanism which enables anyone to adjust the peaking of the FALCON "VARI-CON" to any range of channels desired. The sliding sleeve, on the calibrated boom, automatically fans out the elements to their correct position.

A simple, trouble-proof, snap-action spring in the butterfly keeps the elements solidly in place. The insulated hinge assembly is extremely strong, durable and weather-resistant and has an extra long leakage path. Weight has been kept to a minimum, strength at a maximum in order to assure long life and freedom from wind and weather damage. A heavily plated mast clamp is supplied.

the "VARI-CON"

(The conical that's variable)

Provides all Channel Performance...

Yet can be Peaked for Increased Gain on any Channel Range

The FALCON "VARI-CON" was designed for today, tomorrow and years to come. Its unusual construction permits setting the "VARI-CON" for all-channel performance peaked to provide the additional gain needed on special channels. In addition, the variable patterns obtainable are of great value in ghost elimination.

There is no guess work; no tedious assembly; no field strength equipment needed to peak the "VARI-CON" for high-gain, sharp pattern performance in your area. It's as simple and easy as opening an umbrella. Here's all you do: Unpack the "VARI-CON"— Slide the adjusting sleeve to the calibrated marking on the boom for the best reception of channels in your area — Fan out the reflector elements — Tighten the locking wing nuts. The "VARI-CON" is automatically peaked WHERE YOU WANT IT and ready to install. It is the only conical that enables you to provide a custom-made installation resulting in higher gain and increased customer satisfaction.

The NEW FALCON "VARI-CON" is ruggedly constructed. Heavy-duty heads will not crack or break. The steel spring snap-action butterfly assemblies are unbreakable. Full length, 48 inch, elements are used. One of the most capable engineering staffs in the industry has worked out every last detail of this truly remarkable TV antenna. To the high gain all-channel performance and excellent line match of the conical, FALCON engineers have added the "plus" feature — adjustable, calibrated channel range peaking!

FALCON

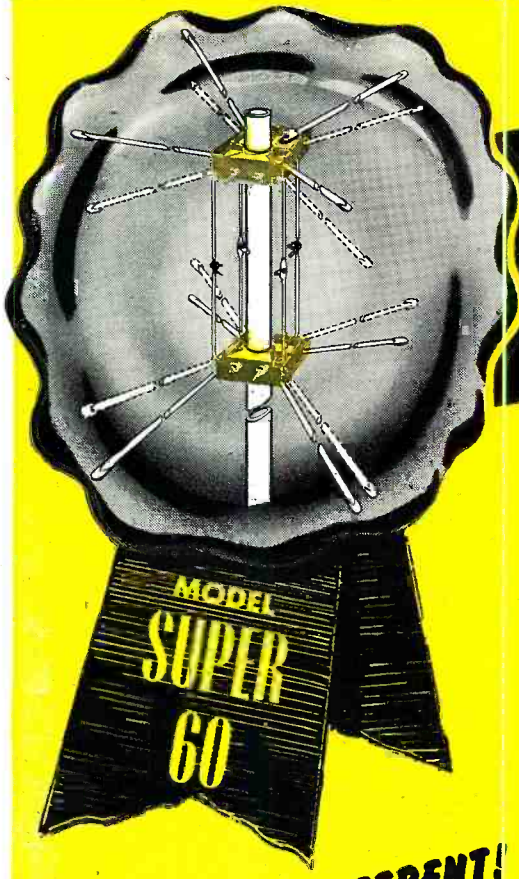
The new "VARI-CON" is one of the most significant additions to antenna design. Watch for the other new FALCON antennas which will be announced in the near future! Each will represent the most advanced, most efficient antenna design of its type.

WRITE FOR ILLUSTRATED FOLDER AND PRICES

FALCON ELECTRONICS COMPANY • 2003 CEDAR ST. • QUINCY, ILLINOIS

NATIONAL ADVERTISING TO BACK NEW FALCON "VARI-CON"

To stimulate sales on all levels, FALCON is conducting one of the most aggressive advertising campaigns in the industry. Full two-page color spreads are appearing regularly in many of the nation's top trade and consumer publications.



GUARANTEED PERFORMANCE

MONEY BACK GUARANTEED TO RECEIVE *All* UHF and *All* VHF STATIONS IN *All* DIRECTIONS FOR 60 MILES
WITHOUT A ROTORMOTOR OF ANY KIND!!

SO NEW! SO DIFFERENT! IT'S PATENTED!

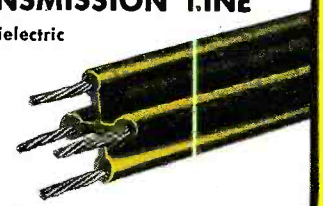
#2,585,670
#2,609,503
#2,625,655
#2,644,091
OTHERS PENDING

WORLD'S MOST POWERFUL UHF—VHF TELEVISION ANTENNA

While antenna reception is guaranteed for 60 miles, perfect pictures have been consistently received as far as 160 miles from stations.

NEW POLYMICALENE 4 CONDUCTOR TRANSMISSION LINE

- Low Loss External - Air Dielectric
- Matched Impedance
- Eliminates End Sealing
- Eliminates Condensation
- Up to 50% Less Loss Than Tubular When Wet
- Easily Spiraled
- No Breaking or Shorting
- Patents Pending - T. M. Reg.



Money Back Guarantee

IN ALL LOCATIONS . . . IN EVERY AREA
WITH STATIONS IN ALL DIRECTIONS

The new All Channel Model Super 60 is guaranteed to bring in, immediately on installation, every UHF and every VHF station within 60 miles in any direction, giving clearer and sharper pictures than any antenna or combination of antennas with or without rotor motors.

If, immediately on installation, it fails to do this, we agree to refund to the jobber to whom we sold and shipped it, his full purchase price.

***All* NEW DESIGN FOR '54**

- LOW-LOSS SWITCH
- LOW-LOSS PHENOLIC INSULATORS
- USES NEW 4-CONDUCTOR MATCHED IMPEDANCE LINE
- ONLY 10 INCH SPACING BETWEEN ANTENNA BAYS

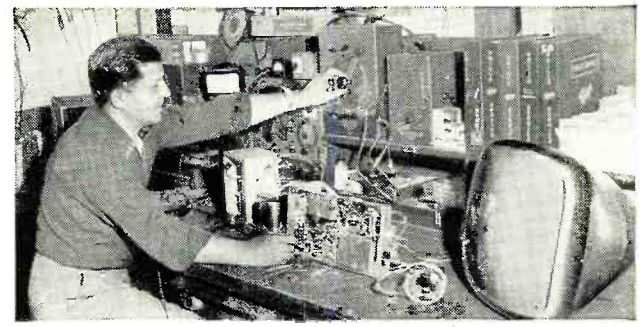
The 9 position selector switch electronically rotates the antenna in a stationary position.

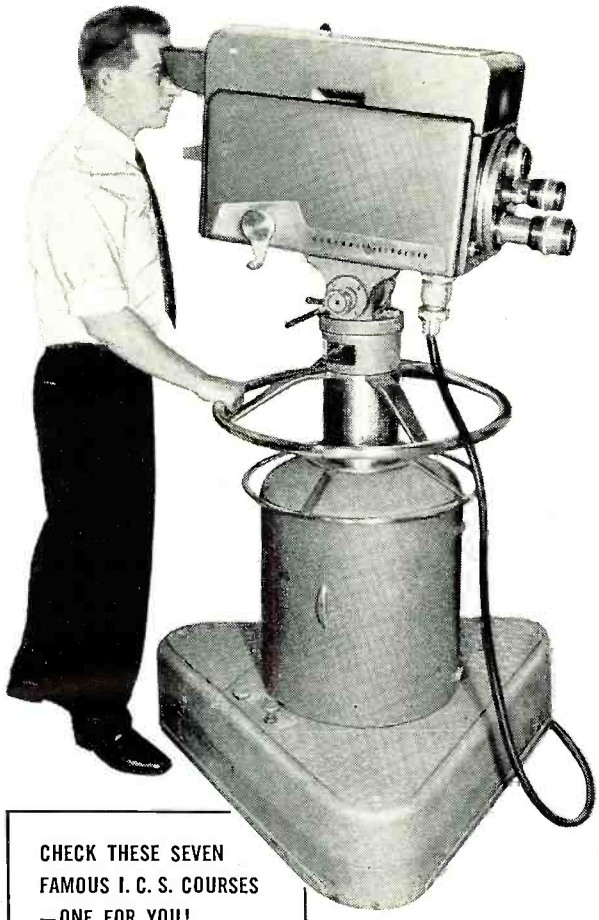
LIST PRICE
$36.75
SEE YOUR LOCAL JOBBER

PRICE INCLUDES
Complete stacked array • 4 stacking bars • 9 position switch • Switch-to-set coupler • 2 - 7½" stand offs • Individually boxed in mailable cartan

ALL CHANNEL ANTENNA CORP.
70-07 Queens Blvd., Woodside 77, N. Y. Hickory 6-2304

...ready or not!





- ***Prepare now for the new Radio-TV-Electronics boom. Get in on VHF and UHF . . . aviation and mobile radio . . . color TV . . . binaural sound! The International Correspondence Schools can help you!***

If you've ever thought about Radio or Television as a career . . . if you have the interest, but not the training . . . if you're waiting for a good time to start . . . NOW'S THE TIME!

No matter what your previous background, I.C.S. can help you. If Radio-TV servicing is your hobby, I.C.S. can make it your own profitable business. If you're interested in the new developments in Electronics, I.C.S. can give you the basic courses of training you need. If you have the job but want faster progress, I.C.S. can qualify you for promotions and pay raises.

I.C.S. training is *success-proved* training. Hundreds of I.C.S. graduates hold top jobs with top firms like R.C.A., G.E., DUMONT, I.T.&T. Hundreds of others have high ratings in military and civil service. Still others have successful businesses of their own.

With I.C.S., you get the rock-bottom basics and theory as well as the all-important bench practice and experimentation. You learn in your spare time—no interference with business or social life. You set your own pace—progress as rapidly as you wish.

Free career guidance: Send today for the two free success books, the 36-page "How to Succeed" and the informative catalog on the course you check below. No obligation. Just mark and mail the coupon. With so much at stake, you owe it to yourself to act—*and act fast!*

CHECK THESE SEVEN FAMOUS I. C. S. COURSES —ONE FOR YOU!

- ☐ **PRACTICAL RADIO-TELEVISION ENGINEERING**—Foundation course for radio-television career. Basic principles plus advanced training. Radio. Sound. TV.
- ☐ **TELEVISION TECHNICIAN**—To qualify you for high-level technical positions in television. Camera, studio, transmitter techniques. Manufacture, sale and installation of TV equipment.
- ☐ **TELEVISION RECEIVER SERVICING**—Installation, servicing, conversion. Dealership. For the man who knows about radio and wants TV training.
- ☐ **RADIO & TELEVISION SERVICING**—Designed to start you repairing, installing and servicing radio and television receivers soon after starting the course.
- ☐ **RADIO & TELEVISION SERVICING WITH TRAINING EQUIPMENT**—Same as above but with addition of high-grade radio servicing equipment and tools.
- ☐ **RADIO OPERATING COURSE**—Special course to help you pass the Government examination for operator's licenses. Code. TV. FM. Radio regulations.
- ☐ **INDUSTRIAL ELECTRONICS**—Broad, solid background course devoted to the electron tube and to its many applications.

I. C. S.—the lifetime Christmas gift — **I. C. S., Scranton 9, Penna.**

INTERNATIONAL CORRESPONDENCE SCHOOLS

BOX 2249-D, SCRANTON 9, PENNA.

Without cost or obligation, send me "HOW to SUCCEED" and the booklet about the course BEFORE which I have marked X:

ART
- ☐ Commercial Art
- ☐ Magazine Illustrating
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- ☐ Cartooning
- ☐ Sketching and Painting
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AUTOMOTIVE
- ☐ Automobile, Mechanic
- ☐ Auto Elec. Technician
- ☐ Auto Body Rebuilding and Refinishing
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AVIATION
- ☐ Aeronautical Engineering Jr.
- ☐ Aircraft Engine Mechanic
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BUILDING
- ☐ Architecture
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- ☐ Building Contractor
- ☐ Estimating
- ☐ Carpenter and Mill Work
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- ☐ Civil Engineering
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- ☐ Structural Drafting
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- ☐ Architectural Drafting
- ☐ Electrical Drafting
- ☐ Mechanical Drafting
- ☐ Structural Drafting
- ☐ Sheet Metal Drafting
- ☐ Ship Drafting
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ELECTRICAL
- ☐ Electrical Engineering
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- ☐ Electrical Maintenance
- ☐ Electrical Drafting
- ☐ Electric Power and Light
- ☐ Lineman

HIGH SCHOOL
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- ☐ Sheet Metal Work
- ☐ Sheet Metal Pattern Drafting
- ☐ Refrigeration

POWER
- ☐ Combustion Engineering
- ☐ Diesel—Electric
- ☐ Electric Light and Power
- ☐ Stationary Steam Engineering
- ☐ Stationary Fireman

RADIO, TELEVISION COMMUNICATIONS
- ☐ Practical Radio—TV Eng'r'ing
- ☐ Radio Operating
- ☐ Radio and TV Servicing
- ☐ Television—Technician
- ☐ Electronics
- ☐ Telephone Work

RAILROAD
- ☐ Locomotive Engineer
- ☐ Diesel Locomotive
- ☐ Air Brakes ☐ Car Inspector
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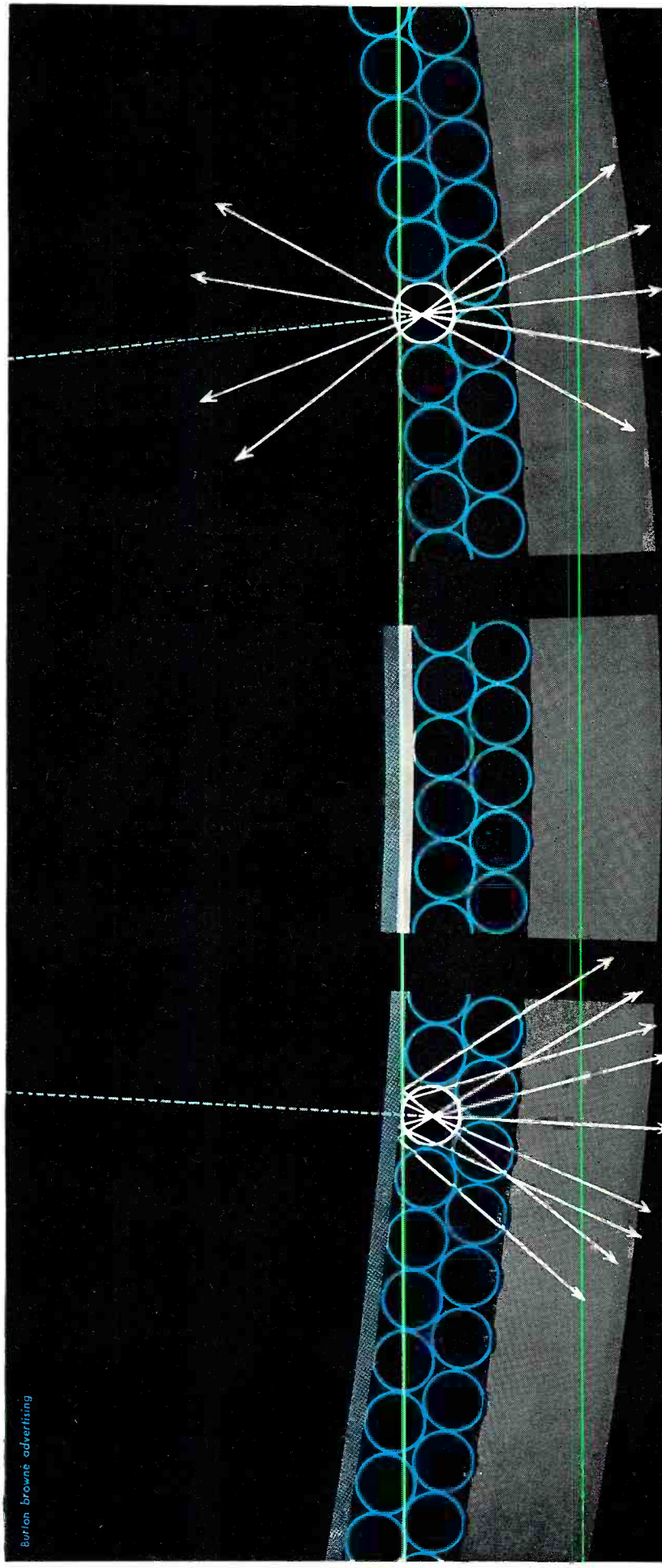
TEXTILE
- ☐ Textile Engineering
- ☐ Cotton, Rayon, Woolen Mfg.
- ☐ Carding and Spinning
- ☐ Warping and Weaving
- ☐ Loom Fixing ☐ Throwing
- ☐ Finishing and Dyeing
- ☐ Textile Designing

Name_____ Age_____ Home Address_____

City_____ Zone_____ State_____ Working Hours_____ A.M. to P.M._____

Occupation_____

Canadian residents send coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada. . . . Special tuition rates to members of the U. S. Armed Forces.



what Aluminizing means

Aluminizing means the efficient use of light—light is energy—energy is the pay-off.

Aluminizing means a brighter TV picture, greater contrast, lower beam current, smaller spot size, sharper focus, reduced screen scorch—*all* from the efficient use of light.

On the inside of any TV tube face is a coating of phosphor crystals—the picture screen. As the electron beam—tracing the picture—strikes these crystals, they glow, giving off light in all directions. And there's the problem! Half the light thus generated is *inside* the tube, either lost to usefulness or lighting areas that should be dark. Both brightness and contrast suffer.

But—put a mirror behind the phosphor and "wandering" light is reflected back through the tube face. *Aluminizing creates this desired mirror!*

To aluminize a picture tube, deposit a nitrocellulose film evenly over the phosphor. Over that, deposit a film of aluminum only millionths of an inch thick—just thick enough to reflect the light and just thin enough to let the electrons pass through. Under heat, evaporate the nitrocellulose film to leave a thin smooth coating of aluminum. Result—an efficient light reflecting mirror to specifications.

Simple as it sounds, Rauland research engineers worked for three years to solve the problem and were among the first to do so.

Rauland

Perfection through Research

ZENITH Subsidiary

Burton Browne advertising

Sweeping the Country!

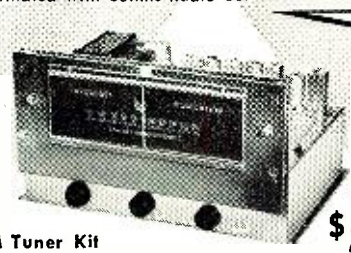
BUY DIRECT AND SAVE

'PRE-FAB' COLLINS TUNERS and RECEIVERS

AUDIO PRODUCTS CO.

Collins Audio Products Co. is in no way affiliated with Collins Radio Co.

Two ALL NEW Complete Kits for Every High-Fidelity Need



FM Tuner Kit **$55**

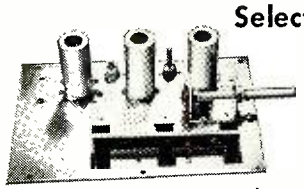
The FM-11 tuner is available in kit form with the IF Amplifier mounted in the chassis, wired and tested by us. You mount the completed RF Tuning Unit and power supply, then after some simple wiring, it's all set to operate. 11 tubes: 6J6 RF amp, 6AG5 converter, 6C4 oscillator, 6BA6 1st IF, (2) 6AU6 2nd and 3rd IF, (2) 6AU6 limiters, 6AL5 discriminator, 6AL7-GT double tuning eye, 5Y3-GT rectifier. Sensitivity 6 to 10 microvolts, less than ½ of 1% distortion, 20 to 20,000 cycle response with 2DB variation. Chassis dimensions: 12½" wide, 8" deep, 7" high. Illustrated manual supplied. Shipping weight 14 lbs.

Each Collins Tuner Kit is complete with punched chassis, tubes, power transformer, power supply components, hardware, dial assembly, tuning eye, knobs, wire, etc., as well as the **completed** sub-assemblies: FM tuning units, AM tuning units, IF amplifiers, etc., where applicable. Since all these sub-assemblies are wired, tested and aligned at the factory, Collins Pre-Fab Kits are easily assembled even without technical knowledge. The end result is a fine, high quality, high fidelity instrument at often **less than half the cost** — because you helped make it and bought it direct from the factory. Bring your present reproducing system up to date with a new Collins Tuner.

FM/AM Tuner Kit **$77.50**

The original 15 tube deluxe FM/AM pre-fab kit redesigned on a smaller chassis. The tuner now measures 14" wide by 12" deep by 7½" high. This attractive new front and dial assembly opens up new applications where space is at a premium. Kit includes everything necessary to put it into operation—punched chassis, tubes, wired and aligned components, power supply, hardware, etc. Kit comprises FMF-3 tuning unit, IF-6 amplifier, AM-4 AM tuning unit, magic eye assembly and complete instructions. All tubes included. Shipping weight 19 lbs.

Selected Basic Components For Special Applications



FMF-3 Tuning Unit **$15.25**

The best for FM. The most sensitive and most selective type of "front end" on the market. 6 to 10 microvolts sensitivity. Image ratio 500 to 1. 6J6 tuned RF stage, 6AG5 converter, 6C4 oscillator. Permeability tuned, stable and drift-free. Chassis plate measures 6½"x4½" In combination with the IF-6 amplifier, the highest order of sensitivity on FM can be attained. Tubes included as well as schematic and instructions. Draws 30 ma. Shipping weight FMF-3: 2½ lbs. Dial available @ $3.85

IF-6 Amplifier **$19.75**

A remarkable value! 6 tubes are used in the IF amplifier: 6BA6 1st IF, (2) 6AU6 2nd and 3rd IF's, (2) 6AU6 limiters and 6AL5 discriminator. High gain, wide-band response (200 KC) for highest fidelity. 20 to 20,000 cycles. Distortion less than ½ of 1%. Draws 40 ma @ 220 volts. Chassis plate dimensions: 11-5/16"x2½" Shipping weight: 3 lbs.

AM-4 Tuning Unit **$24.50**

Tops in AM superhet performance! A 3-gang tuning condenser gives 3 tuned stages with high sensitivity and selectivity. Assembly is completely wired, tested and aligned ready for immediate use. Frequency coverage 540 KC to 1650 KC at a sensitivity of 5 microvolts. Tubes 6BA6 RF amplifier; 6BE6 converter; 6BA6 IF amplifier and 6AT6 detector. Draws 30 ma @ 220 volts. Mounts on a chassis plate measuring 4"x7⅜". Shipping weight 2½ lbs. Dial available at $3.85.

RD-1C Tuner & Dial **$28.50**

The COLLINS RD-IC FM tuner chassis is unique in the field. A whole, compact FM tuner and dial that fits in the palm of your hand. Convert AM sets to FM/AM receivers for only a few dollars! Unlimited applications where space is at a premium. Use in conjunction with your phonograph amplifier. Full frequency response to 20,000 cycles. Sensitivity 20 microvolts, permeability tuned. Tuning unit and IF amplifier on the same chassis plate. Draws 40 ma @ 100 volts. Tubes: 6AG5 converter, 6C4 oscillator, (2) 6AU6 IF amplifiers, 6AL5 in new ratio detector circuit Shipping weight tuner and dial 5 lbs

MAIL COUPON TODAY

To: Collins Audio Products Co. Inc.
P.O. Box 368, Westfield, N. J.
Tel. WEstfield 2-4390

☐ FM Tuner Kit ☐ FM/AM Tuner Kit ☐ Slide Rule Dial Assembly
☐ FMF-3 Tuning Unit ☐ IF-6 Amplifier ☐ RD-IC Tuner and Dial
☐ AM-4 Tuning Unit

NAME.....

ADDRESS.....

CITY.....STATE.....

Amount for Kit $..... See weights, add shipping cost $.....

Total amount enclosed $..... Check ☐ Money Order ☐

WHEN YOU THINK OF TUNERS, THINK OF COLLINS AUDIO PRODUCTS

Spot Radio News

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

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

INDUSTRY'S BRASH and volatile infant, *color TV,* which made its first full-dress appearance before the seven guardians of the airlanes, during the early weeks of the fall, proved to be a polished performer. While many of the Commission had attended preview demonstrations of the reds, greens, and blues, this was the first official show not only before the entire FCC body and members of various departments, but representatives of foreign countries and scores in industry, too.

The historic test was planned at a meeting in Washington, during which all of the nation's leading color and broadcasting specialists appeared. Among those in attendance were Curtis B. Plummer, chief of the FCC's broadcast bureau; David Smith, NTSC vice-chairman; C. B. Jolliffe, *RCA's* vice-prexy; Robert M. Estes and R. M. Johnson, *G-E;* Richard Salant, William Lodge, and Leon Brooks of *CBS;* R. N. Harmon, *Westinghouse;* former FCC headman Paul Porter, now representing *Paramount;* Richard Hodgson, *Chromatic Television;* James R. McRae, IRE prexy, representing *Bell Labs;* Henry Weaver, *Philco;* and Grant Woodside, *Motorola.*

The demonstrations involved subject matter containing a wide range of hue and chroma, including strongly contrasting color patterns for indoor motion featuring normal and rapid movements in closeups and medium length shots, plus outdoor views, slides and color test patterns with selected closeups, and distant shots. Also on the program were transmissions over the present 2.7-mc. coax cable and relays, and simultaneous comparisons of subject matter before studio and field cameras and on the picture-tube screens. Variations in lighting levels at the studios and ambient lighting levels at the receiver were also on the agenda for review.

Color sets from about a dozen set makers were lined up, and these were supplemented by black and white sets for compatibility study. Three nets in New York were selected to put on the special show; *NBC, CBS,* and *Du Mont.* The first part of the program featured a studio color program, followed by a closed-circuit intercity transmission from New York to Washington and return, over a coax cable and microwave link. (This test was similar to that held for NTSC broadcast groups in the lounge of the Center Theatre in New York City, before the official petition was submitted to the Commission.) Remotes from outdoors were next on the program, followed by test patterns and slides.

Although the Commissioners were acquainted with the compatible technique, they pointed out that they wanted to be completely familiar with the system, and would be extremely cautious before approval was granted. Declared Commander Ed Webster, during a recent meeting, on this point: "While we have been apprised from time to time of the progress being made by the NTSC, certainly no fair-minded, serious-thinking person would insist that the Commission could, in a few days, thumb through more than a thousand pages of NTSC reports contained in sixteen volumes, and arrive at an approximate decision based on such a cursory examination. I cannot permit myself to be forced into a premature conclusion by those whose special interests would place them in a position of benefiting by an early decision."

Supporting earlier comments of the Commission's headman, Rosel Hyde, Commissioner Webster added: "I cannot impress . . . too strongly the fact that once this decision is made and color television becomes an actuality, in all likelihood there will be no turning back. Once color television receivers are in general use by the public, it will be impracticable to change the standards, should we subsequently find that an error has been committed." He then warned that he would examine the proposal in an extremely critical manner, to be absolutely sure that his trust to the public is carried out. "This does not mean," he noted, "that I am going to be dilatory . . . Our ultimate goal is a correct decision based on a thorough analysis of the reports and tests, rather than a quick decision, superficially made."

Feeling certain that the compatible setup would be approved, industry began making and announcing plans for production. During the recent electronics convention in Chicago, the company in which the NTSC chairman serves as vice-prexy exhibited a tri-color tube, different from the models demonstrated by others. This

"Kwik-Test"
CAPACITOR CHECKER

A NEW RIGHT ARM
for the service technician

TURNS TROUBLE-SHOOTING HOURS INTO SECONDS! CHECKS CAPACITORS FOR OPENS, SHORTS, OR INTERMITTENTS, RIGHT IN THE CIRCUIT.

Here's the most useful instrument to hit the service bench since the vacuum tube voltmeter—*Sprague's new "Kwik-Test" Capacitor Checker.*

No longer do you have to sweat through the time-consuming nuisance of unsoldering capacitors from a circuit just to check them.

Now by the mere flick of two switches, Kwik-Test tells you whether any bypass, coupling, or filter capacitor within the range of 30 mmf to 2000 mf is open, shorted, or intermittent . . . even when it is in parallel with a resistance as low as 60 ohms. Capacitors between .1 and 2000 mf may be tested for shorts and intermittent shorts even if in parallel with a resistor as low as 2 ohms.

Yes, Kwik-Test is a basic instrument you can't afford to be without. You'll realize that more and more as capacitors in old TV sets begin to go . . . and as the number of capacitors in each set increase with the introduction of new and more complicated receivers.

Get a 10 second demonstration of the amazing Kwik-Test capacitor checker at your Sprague distributor. Don't delay! Once you try it, you'll be sure to buy it! Or write for descriptive data circular M-600 to Sprague Products Co., 51 Marshall Street, North Adams, Mass.

only $34.50 net

PAYS FOR ITSELF IN NO-TIME

DON'T BE VAGUE... ASK FOR

SPRAGUE

WORLD'S LARGEST CAPACITOR MANUFACTURER

model, it was said, would sell for about $175 to set makers and should be available in early '54.

In the east, a chassis maker introduced, during a meeting in New York, a color set that was ready for the production line and would be priced at $700. The receiver, a console model, used a 16-inch tube, and provided a 14-inch picture. Its size was 36 inches wide, 28 inches deep, and 37¼ inches high. The prexy of this company declared that, within eighteen months after the FCC says go, color receivers will carry a retail price about 25 per-cent above that of monochrome models. He felt that color chassis will not replace black and whites for many years, but that there will be a steadily decreasing market for higher priced black and white sets as the production of color models increases and their prices are brought closer in line with black and white models.

It was generally believed that as soon as the Commission reports favorably on the compatible petition, at least a dozen manufacturers will announce their color plans and possibly even bring pilot models to key centers for special demonstrations. Several are mapping holiday shows, *if* color is official by the Yuletide.

WHILE COLOR was on stage, the ultra-highs were in the wings ready for an appearance, too; a private one for the Commission. Seems as if the FCC decided that it should have a u.h.f. progress report from broadcasters and manufacturers, and sent out letters to the networks, industry associations, and individual stations asking for a detailed review of their operations, past, present, and future.

Declaring that the Commission was interested in the progress made by the new post-freeze stations, broadcasters were asked to submit figures . . . "showing . . . total television broadcast revenues, and total broadcast revenues for each month since . . . they went on the air." Networks were asked to reveal all of their affiliates, programs carried on a commercial and sustaining basis, and financial arrangements in force between key and affiliated stations.

In a letter to RETMA, the FCC asked for information on transmitting and receiving equipment made by member companies. They were interested, the Commission declared, in learning how many sets were made for low- and high-band coverage, types being produced, and tuners and converters being made. All information, it was said, would be kept confidential.

PAY-AS-YOU-SEE TV, which has become quite a peppery subject in Washington and among broadcasters, found itself bathed in glowing tribute during a meeting in Philadelphia recently, when twenty-seven TV station owners and permit holders convened to discuss the virtues of home-pay TV.

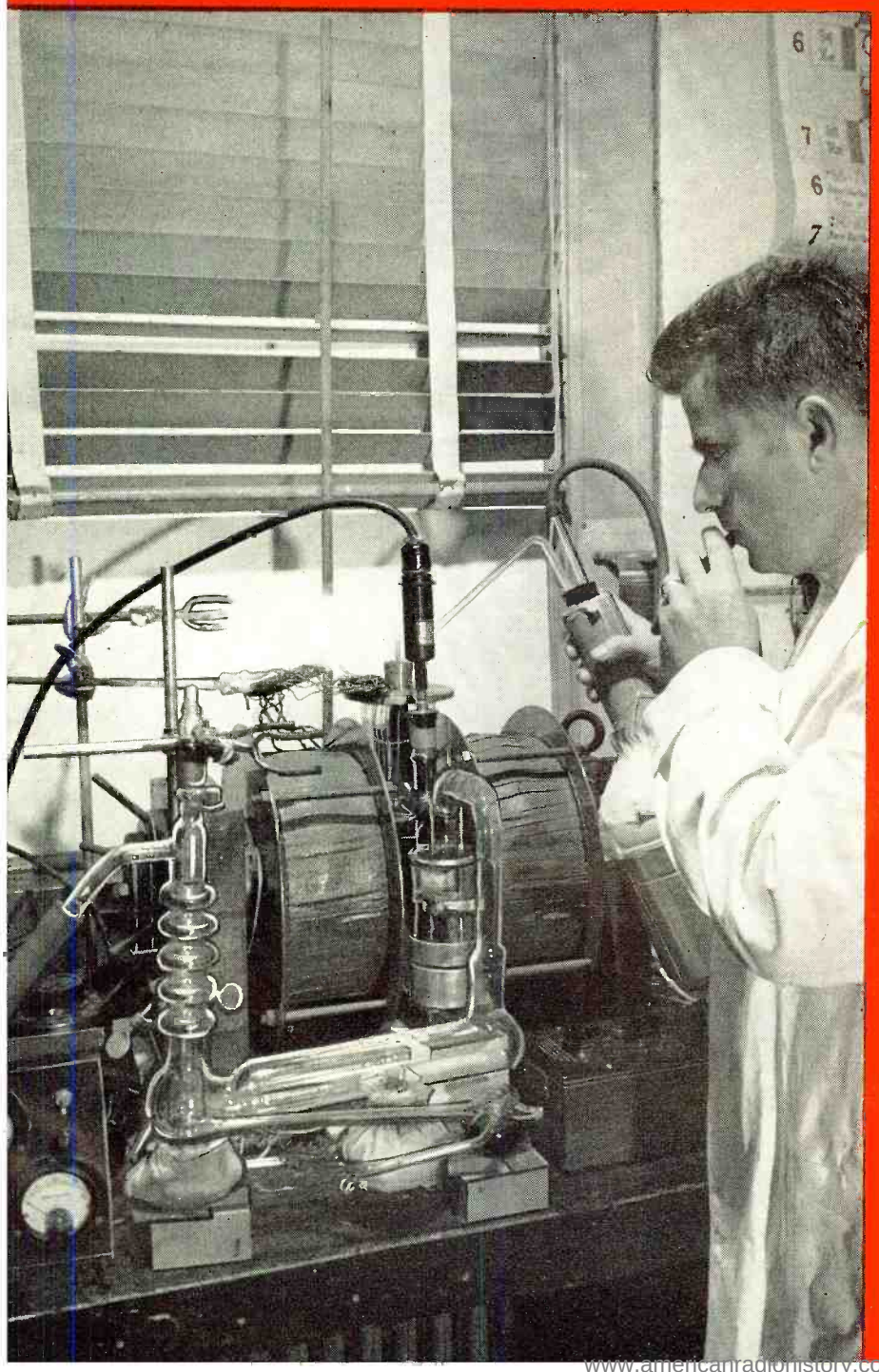
(*Continued on page* 166)

RADIO ELECTRONIC Engineering SECTION

Reg. U.S. Pat. Off.

RADIO & TELEVISION NEWS

INCLUDING *TV & RADIO ENGINEERING*



DECEMBER, 1953

RADIO-ELECTRONIC ENGINEERING is published each month as a special section in a limited number of copies of RADIO & TELEVISION NEWS, by the Ziff-Davis Publishing Company, 366 Madison Avenue, New York 17, N. Y.

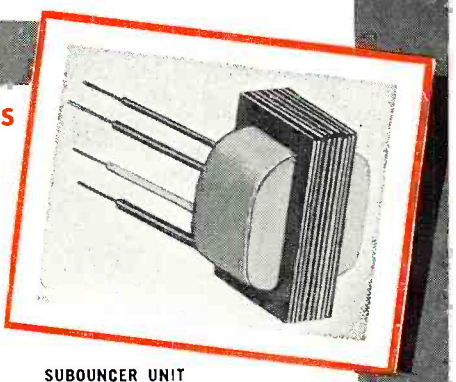
Edited by H. S. RENNE
and the Radio & Television News Staff

Laboratory apparatus in use at the National Bureau of Standards to study the Hall effect and conductivity of various intermetallic semiconducting compounds.

MINIATURE COMPONENTS FROM STOCK...

SUBOUNCER UNITS

FOR HEARING AIDS...VEST POCKET RADIOS...MIDGET DEVICES



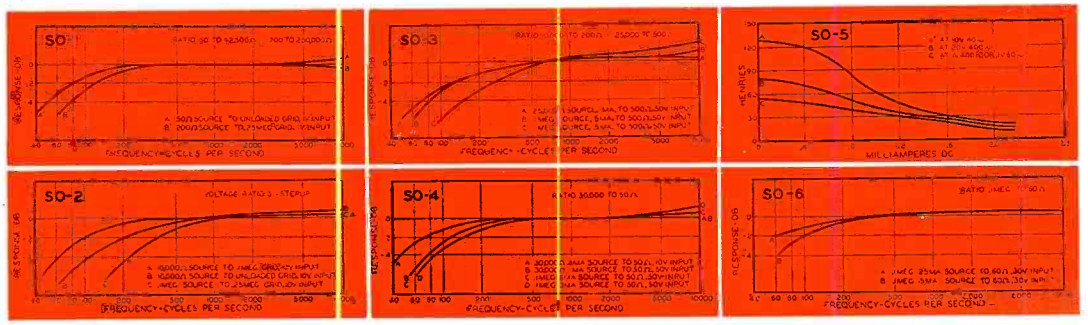
UTC Sub-Ouncer units fulfill an essential requirement for miniaturized components having relatively high efficiency and wide frequency response. Through the use of special nickel iron core materials and winding methods, these miniature units have performance and dependability characteristics far superior to any other comparable items. They are ideal for hearing aids, miniature radios, and other types of miniature electronic equipment.

The coils employ automatic layer windings of double Formex wire . . . in a molded Nylon bobbin. All insulation is of cellulose acetate. Four inch color coded flexible leads are employed, securely anchored mechanically. No mounting facilities are provided, since this would preclude maximum flexibility in location. Units are vacuum impregnated and double (water proof) sealed. The curves below indicate the excellent frequency response available. Alternate curves are shown to indicate operating characteristics in various typical applications.

Type	Application	Level	Pri. Imp.	D.C. in Pri.	Sec. Imp.	Pri. Res.	Sec. Res.	List Price
*SO-1	Input	+ 4 V.U	200 50	0	250,000 62,500	16	2650	$ 6.50
SO-2	Interstage/3:1	+ 4 V.U.	10,000	0	90,000	225	1850	6.50
*SO-3	Plate to Line	+ 20 V.U.	10,000 25,000	3 mil. 1.5 mil.	200 500	1300	30	6.50
SO-4	Output	+ 20 V.U.	30,000	1.0 mil.	50	1800	4.3	6.50
SO-5	Reactor 50 HY at 1 mil D.C. 3000 ohms D.C. Res.							5.50
SO-6	Output	+ 20 V.U	100,000	.5 mil.	60	3250	3.8	6.50

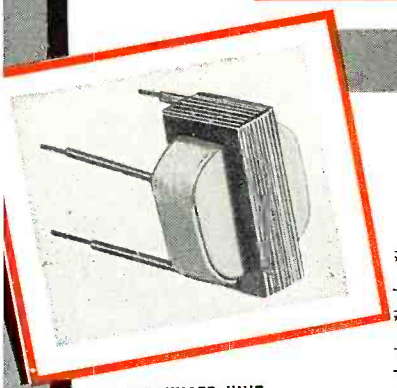
*Impedance ratio is fixed, 1250:1 for SO-1, 1:50 for SO-3. Any impedance between the values shown may be employed.

SUBOUNCER UNIT
Dimensions....9/16" x 5/8" x 7/8"
Weight ..... .03 lb.



SUB-SUBOUNCER UNITS

FOR HEARING AIDS AND ULTRA-MINIATURE EQUIPMENT

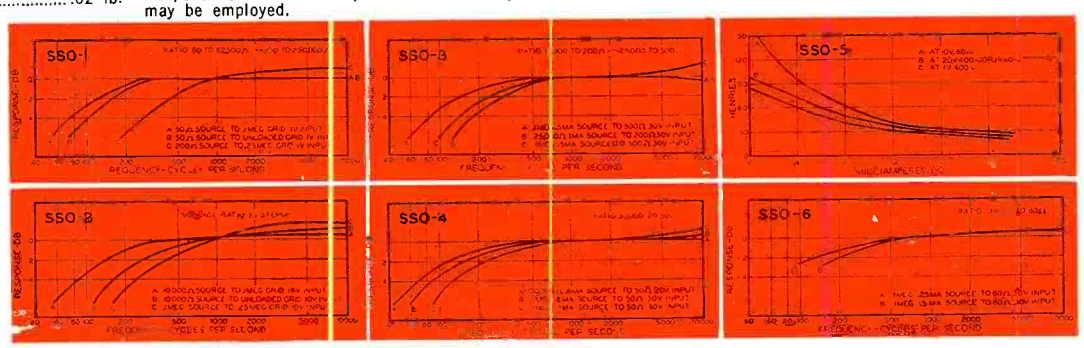


UTC Sub-SubOuncer units have exceptionally high efficiency and frequency range in their ultra-miniature size. This has been effected through the use of specially selected Hiperm-Alloy core material and special winding methods. The constructional details are identical to those of the Sub-Ouncer units described above. The curves below show actual characteristics under typical conditions of application.

Type	Application	Level	Pri. Imp.	D.C. in Pri.	Sec. Imp.	Pri. Res.	Sec. Res.	List Price
*SSO-1	Input	+ 4 V.U.	200 50	0	250,000 62,500	13.5	3700	$6.50
SSO-2	Interstage/3:1	+ 4 V.U.	10,000	0	90,000	750	3250	6.50
*SSO-3	Plate to Line	+ 20 V.U.	10,000 25,000	3 mil. 1.5 mil.	200 500	2600	35	6.50
SSO-4	Output	+ 20 V.U.	30,000	1.0 mil.	50	2875	4.6	6.50
SSO-5	Reactor 50 HY at 1 mil. D.C. 4400 ohms D.C. Res.							5.50
SSO-6	Ouptut	+ 20 V.U.	100,000	.5 mil.	60	4700	3.3	6.50

*Impedance ratio is fixed, 1250:1 for SSO-1, 1:50 for SSO-3. Any impedance between the values shown may be employed.

SUB-SUBOUNCER UNIT
Dimensions....7/16" x 3/4" x 5/8"
Weight ..... .02 lb.



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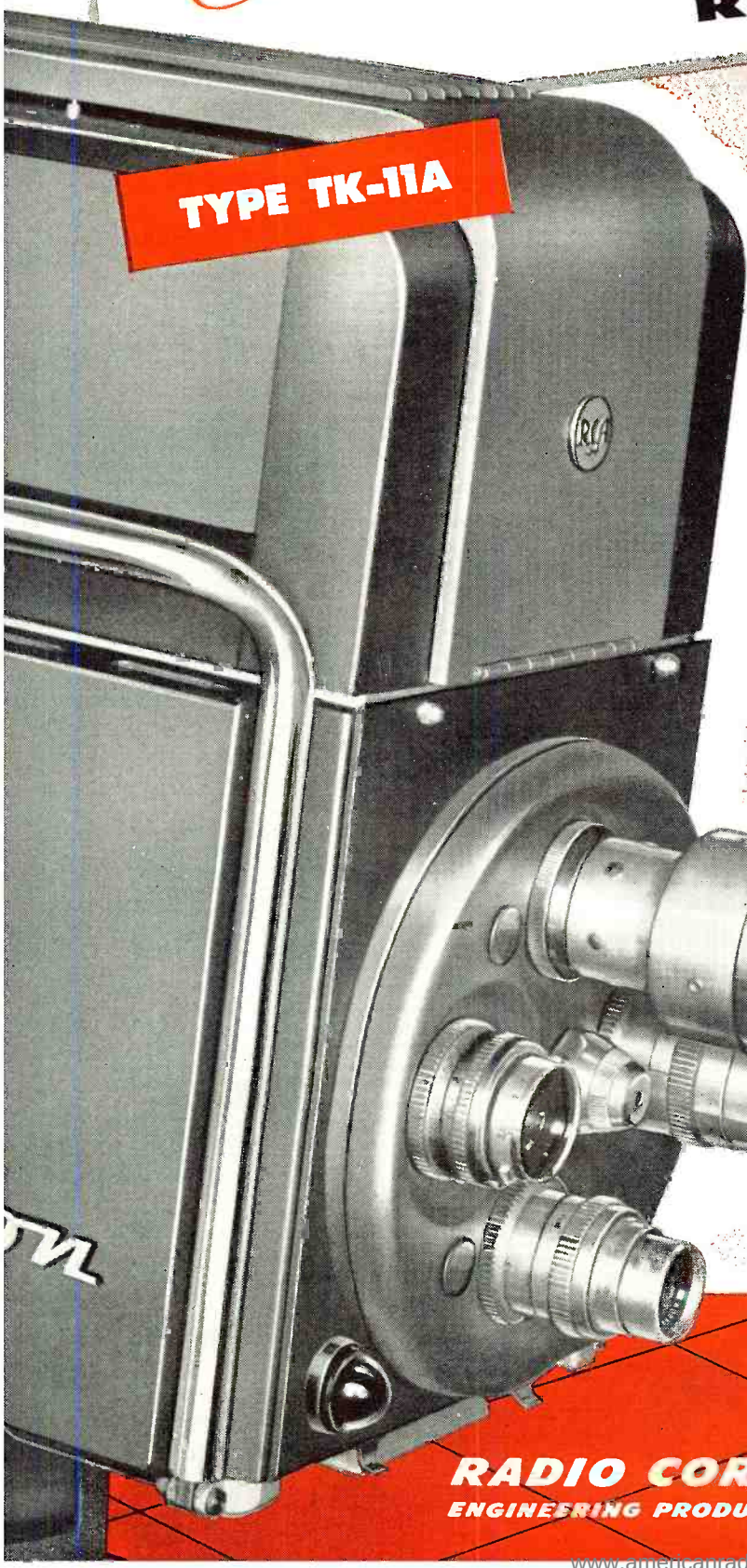

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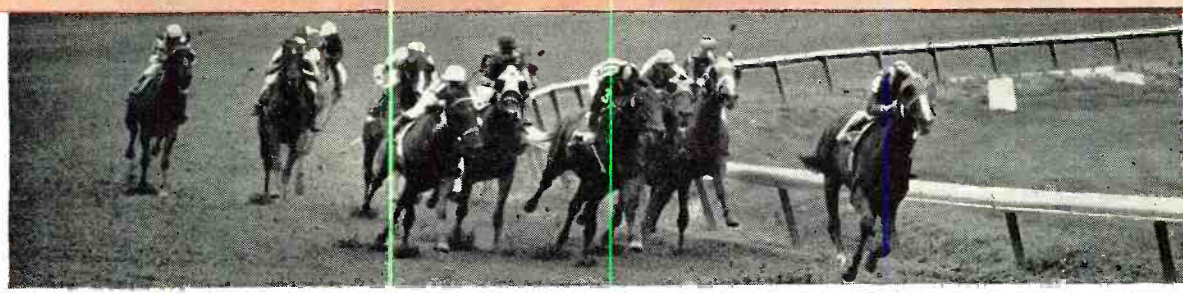

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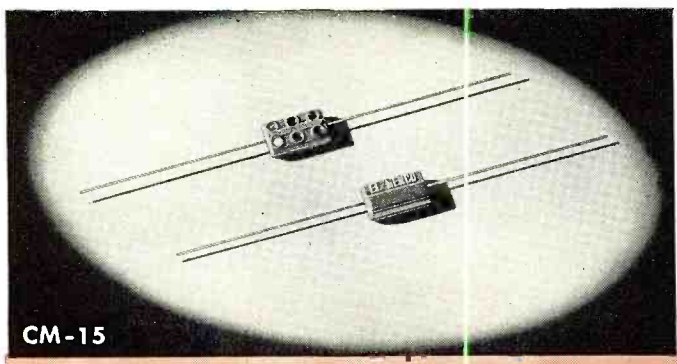

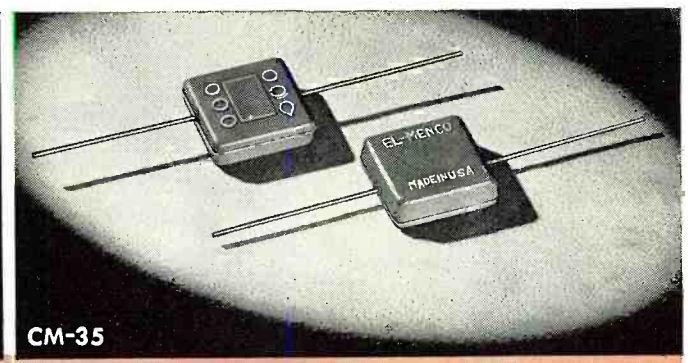

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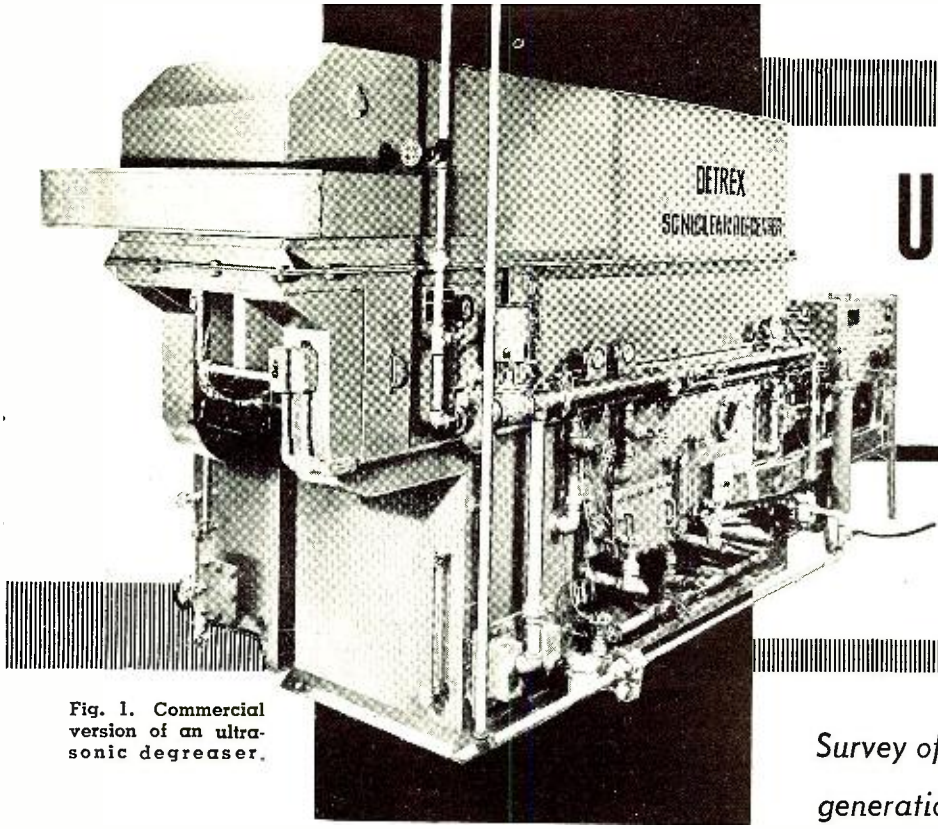


Fig. 1. Commercial version of an ultrasonic degreaser.

ULTRASONICS IN INDUSTRY*

By

OSKAR E. MATTIAT

Clevite-Brush Development Company

Survey of equipment and techniques used in generation and utilization of ultrasonics.

ULTRASONICS came into the limelight of scientific interest 25 years ago when Wood and Loomis[1] demonstrated the spectacular physical and biological feats which ultrasound is able to perform. Since then a great number of papers have been published describing new effects in physics, biology, chemistry and therapy, and suggesting their industrial application. This stimulating interest is still alive. But whereas ultrasonics has established itself as an important tool in physics, e.g., for the determination of elastic constants in materials, and for underwater communication, its present applications in industry are still rather limited.

Ultrasonic Waves

Ultrasonic waves are a form of vibratory mechanical energy. They comprise alternating compressional waves in any medium—gas, liquid, or solid—having a frequency above the audible range, i.e., above 20 kc. Experimentally, they have been produced to frequencies of 1000 mc. The basic laws of sound waves hold for ultrasonic waves.

The wavelength of sound is inversely proportional to the frequency; therefore, ultrasonic waves are very short. This means that ultrasonic energy can be easily focused, and thus extremely high intensities can be obtained. The particle displacement in an ultrasonic wave is usually very small, but its acceleration—being proportional to the square of the frequency—is extremely high and can reach a million times that of gravity.

At high ultrasonic intensities, a phenomenon called "cavitation" occurs. The mechanism involved is rather complicated and not yet clearly understood, but as cavitation plays an important role in many of the practical applications of ultrasonic energy, a somewhat simplified explanation of it may be pertinent. When an alternating sound pressure is applied to a liquid, it is under compression for one-half of each cycle and under rarefaction or negative pressure for the other half-cycle. If the pressure drops below the hydrostatic pressure of the liquid during the rarefaction half-cycle, tensile forces try to pull the liquid apart; and if the tensile strength is overcome, cavities are formed during this half-cycle. These cavities collapse with great violence during the compression half-cycle. It has been calculated that at the point of collapse pressure peaks of 30,000 atmospheres occur, and accordingly, local temperatures of several hundred degrees centigrade may be reached.

Transducers

Three different types of transducers are used to generate ultrasonic waves: mechanical, magnetostrictive, and piezoelectric. The latter two are most widely used for producing ultrasonic waves in liquids and solids.

Mechanical

Sirens

In air, high frequency sirens have been found most efficient. A stator with a great number (e.g., 100) of equally spaced holes circularly arranged, with a diameter of 6″, has immediately adjacent a coaxial rotor disc of duralumin with corresponding holes. When compressed air is blown through these holes, with a motor driving the rotor at adequate speed, high power ultrasonic waves can be produced with frequencies up to 34 kc. With compressed air at 3 atmospheres pressure, 2 kw. of acoustic power can be obtained at an efficiency of 20%. Such a siren, built by the *Ultrasonic Corporation* in Cambridge, Mass., for a frequency of 10 kc., delivers 34 kw. of acoustic power. An efficiency of 60% has been reported[2]. With this siren, sonic intensities of 10 w./cm.^{2} over an area of 100 cm.^{2} have been obtained. Such sirens have been used to agglomerate smoke particles.

Ultrasonic Whistle

For producing ultrasonic waves in liquids, a recently developed mechanical transducer[3] uses the same principle as a whistle, with liquid instead of air as the fluid. A liquid jet coming out of a narrow slit impinges on the sharp edge of a rectangular metal blade which is clamped at two nodal points. The blade is excited to flexural vibrations. If the resonant frequency of the blade coincides with the frequency of formation of vortices produced by the jet, very strong waves result. Such whistles have been built for frequencies between 4 and 32 kc. They have a treating capacity of 5-7 gpm and are deemed useful in emulsifying liquids.

Magnetostrictive

Magnetostriction, a change in dimen-

*This article is based on a paper presented at the 1953 *National Electronics Conference*, held in Chicago, Ill., Sept. 28-30.

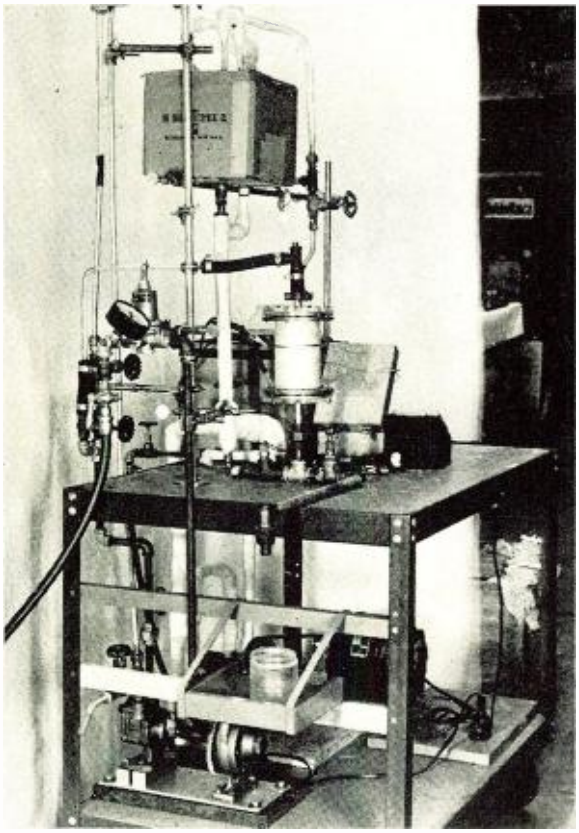


Fig. 2. Laboratory setup for use in ultrasonic depolymerization studies.

sion with a change in magnetizing force, is exhibited by certain metals and alloys like iron, nickel, cobalt and permendur. If a bar of magnetostrictive material is placed with its length parallel to a magnetic field, the bar changes its length proportionally to the square of the magnetic field. If a strong permanent field is applied and an alternating field superimposed, the vibrations are practically proportional to the a.c. field. Magnetostrictive transducers are operated at their mechanical resonant frequency. They have been built in the frequency range from 2 kc.

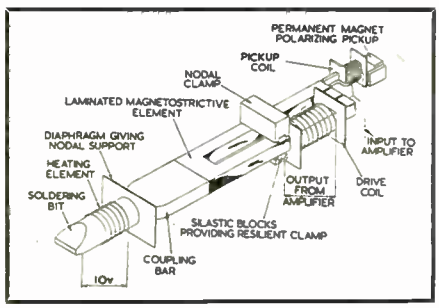


Fig. 3. Ultrasonic soldering iron.

(i.e., in the sonic range) up to 200 kc., and work best in the lower ultrasonic frequency range between 20 and 50 kc. Above 100 kc., the length of the transducer becomes rather small and therefore difficult to handle, and the eddy current losses become increasingly high. A high power magnetostrictive transducer of the *Frank Massa Laboratories*, Hingham, Mass., for example, employs a consolidated stack of thin nickel alloy laminations which resonate at 24 kc. For cooling purposes, the transducer is assembled in an oil-filled compartment and includes a finned tube through which cooling water is circulated. The power input is 1 kw. and the maximum conversion efficiency is about 60%.

Piezoelectric

Piezoelectric transducers are based on the inverse piezoelectric effect, i.e., the change of size of certain crystals when an electric field is applied to them. Quartz, tourmaline, Rochelle salt and many other crystals show this effect and have found a wide field of application in electrical communication engineering and research. Quartz is most frequently used because of its outstanding mechanical properties, such as temperature stability, high tensile strength, and hardness. Many different ways of cutting slabs, bars and other shapes out of the natural crystal are in use. The most commonly applied is the *X*-cut, in which the main faces of the slabs or discs are perpendicular to the electric or crystallographic *X*-axis. The electric charges are applied to the faces by means of metallic electrodes, and the mechanical forces and displacements are parallel to the electric field. Maximum radiation is obtained when the crystal vibrates at its mechanical resonant frequency, which is inversely proportional to the thickness of the transducer element. A resonant frequency of 100 kc. requires a crystal thickness of about 1"; 10 mc. only 1/100". Still higher frequencies are obtained by using higher harmonics of thin crystal slabs. The acoustic power of generally available equipment ranges up to about 400 watts and intensities up to about 40 w./cm.² of crystal surface, between 300 and 1000 kc.

Ceramic

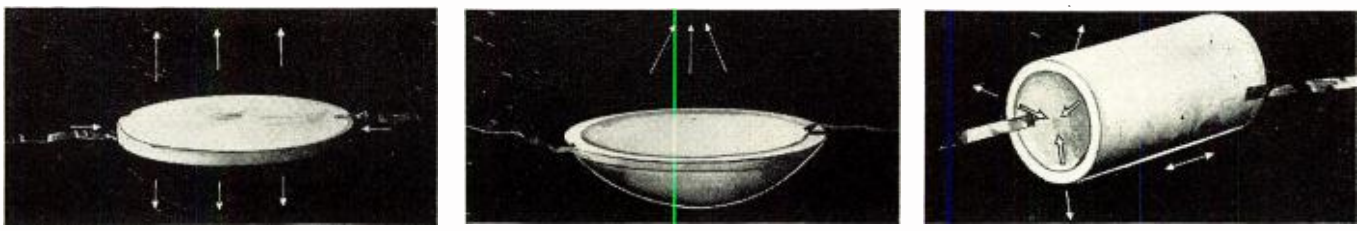
A ceramic material, barium titanate, has recently been developed which shows strong piezoelectric properties when polarized by a d.c. field of 50,000 v./inch. Bars and discs which are prepared in this way can be used as transducers in the same manner as quartz crystals, although they have different mechanical and electrical properties. An outstanding difference is the low electrical impedance of the ceramic as compared to quartz, which means that the same ultrasonic radiation into a liquid may be obtained with much lower voltage. For example: to obtain an ultrasonic intensity of 1 w./cm.² at a frequency of 100 kc. requires 10,000 volts with a quartz crystal. With a ceramic transducer, only 100 volts are needed.

The barium titanate ceramic is polycrystalline and has a great advantage in that it can be fabricated by casting, pressing, or extruding into various sizes and shapes as shown in Fig. 4. By shaping the ceramic into spherical bowls, ultrasonic waves can be focused; and thus very high acoustic intensities can be obtained. Such focusing transducers are commercially available from 400 kc. up to 5 mc. They are operated at their thickness resonant frequency. For 400 kc., the thickness of the bowl is about ¼", and its electrical impedance is about 10 ohms. With a spherically shaped transducer, acoustic intensities of more than 1000 w./cm.² can be obtained in the focus, with an input of only a few w./cm.² at the surface of the element.

Maximum power input to barium titanate transducers is limited only by the internal heating due to the losses inside the ceramic material, which loses its polarization at 120°C. Adequate cooling is therefore imperative. Lower frequencies require thicker transducers. For 100 kc., the thickness is about 1", which makes it difficult to cool the inside of the element effectively. Focusing transducers for the frequency range of 100 kc. have been built using a mosaic of hexagonal ceramic tiles. These elements are about 0.8" long and ½" across flats, and resonate along their major axis. By proper spacing of the elements, cooling is enhanced and the power input can be raised to 15 w./cm.² without depolarization.

Extremely high acoustic intensities are not always required for ultrasonic

Fig. 4. Three types of ceramic transducers. Arrows indicate the mode of vibration.



applications. In some cases, the treatment of a liquid in a continuous flow process may be desirable. Here, the tubular ceramic transducer has its field. It can be excited in its circumferential as well as in its thickness mode of vibration. For a tube of 3″ O.D. and ¼″ thickness, the resonant frequencies are about 22 kc. and 400 kc., respectively; thus, two widely different frequencies can be covered by one transducer. For a length of 6″, this transducer can be operated continuously with 500 watts of electrical power. The great variety which ceramic material offers in the field of ultrasonics may be illustrated by the fact that tubular transducers have been built with diameters ranging from 1/16″ to 18″.

Applications

Ultrasonic applications may be divided into two classes: (1) low power applications where the wave energy does not change the material through which it passes and (2) high power applications where the material is changed physically or chemically by the wave energy. In the first class, ultrasonics is used as an instrument for inspection, testing or measuring, and the energy level is usually below cavitation threshold. In the second category, the energy level is high and cavitation, in general, is essential. Only those applications which seem to be well established will be covered here.

Low Power Applications

Non-Destructive Testing

Perhaps the best known application of ultrasonics in industry is its use in nondestructive testing of metals. Ultrasonic waves can penetrate solid bodies. They will be reflected at any sudden change of acoustic impedance such as would be presented by a void or flaw. Therefore, they can be used in a manner similar to x-ray testing. Four techniques of flaw detection in metals or other sound transmitting materials are in use:

1. Through testing
2. Pulse testing
3. Resonant testing
4. Screen view testing

Usually quartz crystals are used as transducers. Ultrasonic search beams are very sharp at high frequencies, where the wavelength in the material under test is small compared to the beam width. For a crystal diameter of 1″ and a resonant frequency of 5 mc., the wavelength in steel is 3/64″, and the beam divergence is only ¼″ per foot of beam length.

In the through test technique (1), one transducer is used as a projector —sending a continuous wave train— and a second one as a receiver. For constant projector signal and flawless test piece, the receiver indicates a constant output. Any flaw reduces the received signal. This method has been advantageously used for testing gun powder uniformity. It is also being used to inspect tires that are to be recapped for the presence of internal defects, such as ply separation. An apparatus capable of detecting defects of only 1/16 sq. in. area has been used by the *Goodyear Tire and Rubber Company*, Akron, Ohio.

The pulse testing technique (2), is used in the *Sperry* "Reflectoscope," invented in 1941 by Dr. Firestone. Ultrasonic pulses of short duration (1 to 10 μsec.) are projected from a quartz crystal transducer into the test piece, reflected from the opposite surface, and received by the same crystal. Electronic switching networks similar to those in radar techniques are used to present the transmitted and reflected pulses on an oscilloscope whose time sweep is synchronized by the pulse frequency. Any flaw within the wave path will cause an additional reflection and will appear as another pip on the scope. Among the many applications of this instrument is the inspection of railroad rails, engine axles and aircraft parts.

Resonant testing (3) is used for all wall thickness measurement, detection of flaws, and lack of bond in any metal or plastic parts. A frequency-modulated ultrasonic signal is sent into the part, and the sweep frequency of an oscilloscope is synchronized in such a way that a certain part of the sweep corresponds to certain frequencies. When the test piece is resonant at a certain frequency, a pip appears on the scope at that point because the piece under test gives maximum reaction while resonating. A different pip will appear when a flaw is present because then another resonant condition is set up. This ultrasonic gauge has the advantage that the wall thickness of objects can be measured when only one side of the wall is accessible, e.g., in pipes and tanks.

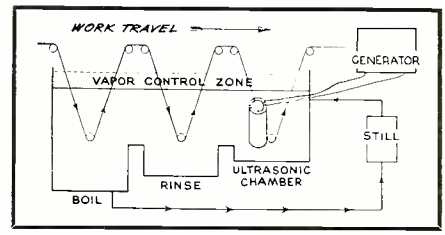
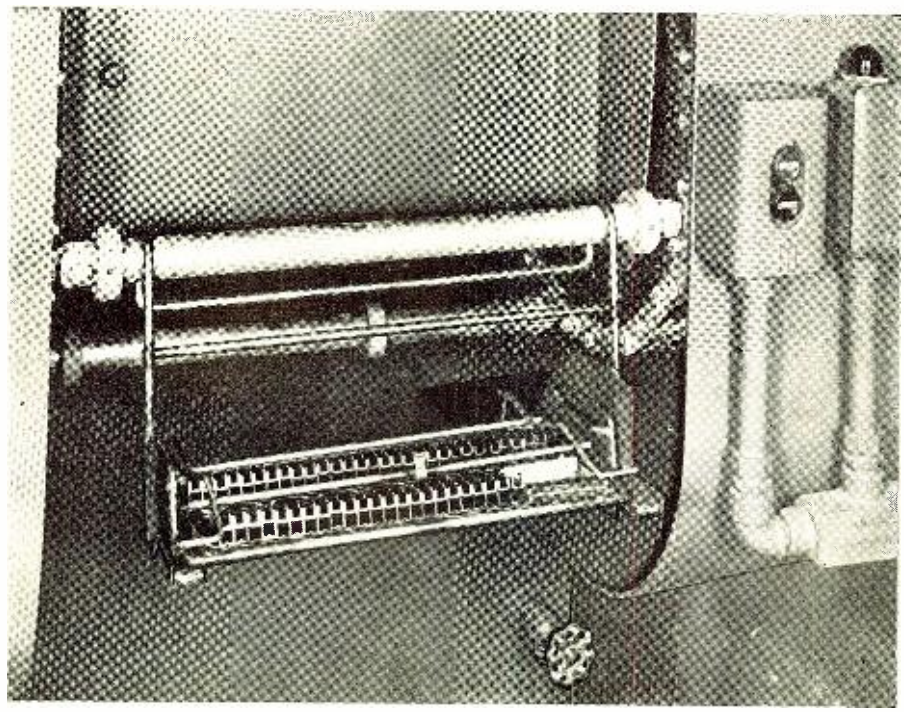


Fig. 5. Diagram of a cleaning process for electric shaver heads.

The screen view method (4) takes advantage of the phenomenon that small flat particles in a sound field have the tendency to adjust their planes parallel to the front of the sound wave. Pohlmann, in Germany, uses small aluminum particles (20 microns in diameter and 1.5 microns thick) suspended in xylol in a flat cell as an indicator. One wall consists of a thin copper foil, the other of a glass plate. If an ultrasonic beam hits the cell through the sound-transparent copper diaphragm, the aluminum particles in the sound beam will align themselves parallel to each other. If a light beam illuminates the cell through the glass window, the aligned particles will reflect light while particles not in the sound beam will give

Fig. 6. Feed-in portion of cleaning equipment sketched in Fig. 5.



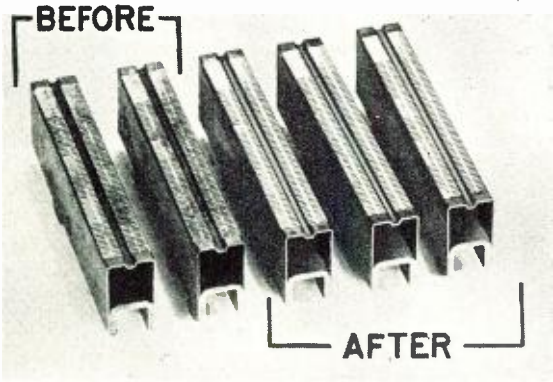


Fig. 7. Electric shaver heads before and after ultrasonic cleaning.

little reflection. When a material which is to be examined is put between the sound source and cell, flaws and fissures will cast a sound shadow on the cell, causing nonorientated particles—which in turn give a dark spot when projected as an optical picture on a screen.

Distance measurement by the evaluation of reflected ultrasonic pulses, known as "Sonar" (i.e., sound navigation and ranging), for underwater detection of submarines and the like has also found industrial applications. An example is the mapping of water-saturated sediment by the U. S. Geological Survey. In the lower ultrasonic range (15 kc.), the beam is partially reflected and partially penetrates water-saturated sediment, but is completely reflected by bedrock. In an investigation of the filling of Lake Mead above Hoover Dam, the phenomenon was used for taking bottom profiles; it revealed that 2 billion tons of sediment have already accumulated, which means that the reservoir will be completely filled in about 400 years. Another example is the detection of schools of fish by the underwater echo method; it is claimed that by examining the shape of the reflected signal on an oscilloscope, the type of fish below can be determined and fishermen can decide whether or not to cast the nets.

Fig. 8. A ceramic trough transducer immersed in a cleaning fluid.

Ultrasonic Viscosimeter

An ultrasonic instrument which measures the viscosity of fluids has recently been offered to industry by *Rich-Roth Laboratories*, East Hartford, Connecticut. A magnetostrictive probe of about 2" length is pulsed with an ultrasonic frequency of approximately 30 kc. while in contact with the liquid. The vibration is damped by the surrounding medium, and when the amplitude drops to a predetermined value, the probe is pulsed again. Therefore, the probe is pulsed at a high rate in a highly viscous medium and at a low rate in a medium of low viscosity like water. An electronic unit incorporated in the instrument relates the pulse rate to the viscosity of the medium. The instrument measures viscosities of liquids up to 50,000 centipoise and requires only a few milliliters of liquid for proper operation. It can be used to maintain uniform production of liquids by the addition of control circuitry.

Ultrasonic Flow Meter

Another instrument is the ultrasonic flow meter, which works on the principle of the Doppler effect. Ultrasonic pulses are projected through the liquid in and against the direction of flow by alternate switching of projector and receiver. In the direction of flow, the rate of flow is added to the transmission velocity; in the opposite direction, it is subtracted. Thus, the velocity of flow is made to produce a phase difference which is measured electronically to indicate the rate of flow. This flow meter does not obstruct the fluid currents and can be applied in closed systems, such as the flow of blood in the aorta or the flow of a coolant in a chain reactor.

High Power Applications

The engineering and evaluation of high power ultrasonic energy is more difficult because cavitation prevents the application of conventional acoustic measurements, and practically no engineering data exist on exactly how much acoustic power is required to produce the phenomena.

Chemical

The great variety of chemical effects produced by intense ultrasound has been summarized in a new word: Sonochemistry[4]. Among these effects are hydrolysis, addition, oxidation, molecular rearrangement, polymerization, depolymerization, and acceleration of chemical reactions. Although ultrasonics seems to have great possibilities in the chemical industry, it has not yet been established on any large scale. One reason is the relatively high cost of equipment and power per gram of material converted. Another is that suitable ultrasonic transducers for large volume applications have been developed only recently, and it usually takes years for a new chemical process to grow to industrial size. Figure 2 shows a laboratory recycling setup for ultrasonically depolymerizing a high polymer substance in a continuous flow process. A barium titanate tubular transducer of 3" diameter irradiates the solution with an electric power input of 500 watts at 22 kc. Such a unit can be expanded to industrial size by building pipelines consisting of a multitude of tubular transducers. Fifty such cylinders could absorb and process many hundreds of gallons per hour in a relatively small space.

Degassing

As previously mentioned, high ultrasonic intensity irradiation of a liquid causes cavitation. Gas present in the liquid evaporates into the cavities, the bubbles coalesce, and then rise to the surface. Thus, ultrasonics offers a means of rapid degassing, especially if a slight vacuum is applied. Dr. Thiede, of the *Atlas Werke*, Bremen, Germany, has built an ultrasonic degassing machine, having an operating frequency of 175 kc. and an acoustic power output of 500 watts, which degasses water at a rate of 10 tons per hour (2640 gph). The remaining gas content is only 1 mg./liter. Such machines have also been used to degas transformer oil.

Degassing molten metals and glass, the separation of nonmetallic impurities, and the reduction of grain size by the use of ultrasound have long been intriguing possibilities, but thus far they have not been achieved with certainty.

Soldering

The cavitation effect caused by high intensity ultrasonics in molten metals has been used to destroy the oxide layer on aluminum, thus making it possible to solder aluminum parts using tin solder without flux. Ultrasonic soldering irons are manufactured in England and Germany.

Figure 3 shows a diagram of the *Mullard* ultrasonic soldering iron. A magnetostrictive transducer transforms 55 watts of electrical power into ultrasonic power at a frequency of 22 kc. A coupling bar transmits the vibrational energy to the soldering tip, which is heated by a 100-watt heating element. As soon as the ultrasound is switched on, the molten solder on the surface of the aluminum sheet cavitates, and thereby breaks up the layer

(*Continued on page* 27)

ELECTROMECHANICAL FILTERS*

By **STANLEY P. LAPIN**
Motorola Inc.

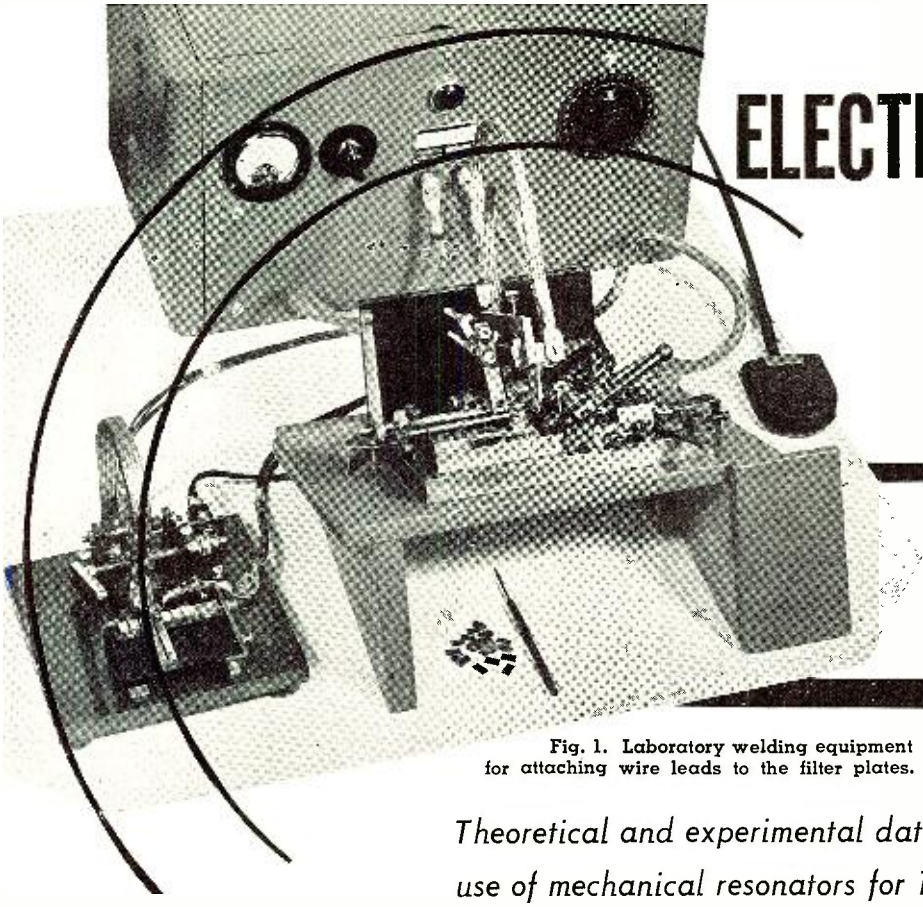


Fig. 1. Laboratory welding equipment for attaching wire leads to the filter plates.

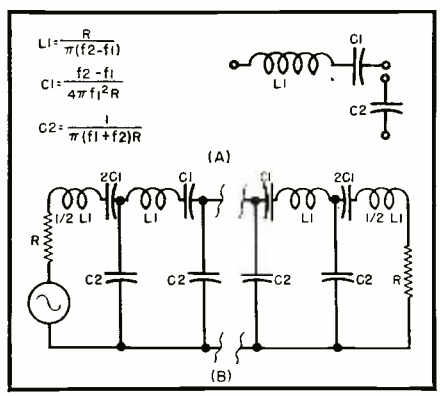
Theoretical and experimental data are presented on the use of mechanical resonators for 100-1000 kc. i.f. filters.

MOST superheterodyne receivers constructed in the past have obtained their intermediate frequency selectivity through the use of several double-tuned circuits separated by amplifier tubes. Improvement in this design is achieved through the use of inductance-capacitance filters of conventional form. These filters lump the selectivity into one package, are usually placed immediately after the last frequency converter in the receiver, and are followed by relatively wide i.f. amplifiers. The use of such a filter allows the separation of selectivity and amplification. By placing the main amplification after the selectivity, and having only enough amplification prior to the filter to maintain the desired signal-to-noise ratio, receiver performance can be considerably improved with respect to desensitizing, spurious responses, cross modulation and intermodulation[1]. These effects are generally due to overloading and to harmonic generation in the tubes preceding the selectivity, and can be minimized by keeping the gain of these tubes at as small a level as possible consistent with a good receiver noise figure.

Lumping the selective circuits together also means, generally, that fewer components can be used to obtain the same selectivity, and such lumping also allows the unit to be factory-adjusted and permanently sealed. No maintenance or adjustment is required in the field, and the selectivity will not be affected by changes in the other parts of the receiver, such as changes in tube capacity, etc. Sealing or potting also greatly increases the humidity resistance of the unit as well as preventing possible misalignment at a later time. The selectivity characteristics of the receiver can be changed, if desired, by merely replacing the filter with another unit having a different bandwidth characteristic.

Although good results have been obtained with inductance-capacitance filters, even better performance can be expected with filters using mechanical elements. The three most important attenuation characteristics of any selectivity network response are: the insertion loss at the center frequency; the bandwidth of the passband; and the steepness of the rejection slopes of the curve. From an attenuation standpoint, the ideal curve would be in the form of a rectangle, with zero attenuation from frequency f_1 to frequency f_2—the cutoff frequencies—and infinite attenuation for frequencies below f_1 and above f_2. This would allow maximum utilization of the available frequency spectrum, as adjacent bands of communication could be spaced side by side. As the steepness of the rejection slopes decreases, channels must be spaced further apart so that sufficient discrimination between them can be obtained. In addition, a non-flat—or curved—passband may result in increased channel spacing, as the rejection slopes may have to be spaced still further apart to allow a relatively flat region over which the desired frequencies will be passed. Sharp corners are not desired in the attenuation curve, however, in applications where phase shift and transient response are important.

Fig. 2. (A) Three-element m-derived bandpass section with equations. (B) Filter with mid-series termination.



Generally speaking, the higher the Q of the elements used in the filter structure, the less will be the center frequency insertion loss, the wider will be the passband, and the steeper will be the rejection or attenuation slopes of the curve. At frequencies near 450 kc., it is difficult to obtain electrical inductors with Q's above 200 while retaining a practical size. However, if mechanical elements could be used in the filter circuits to replace the electrical inductors

This article is based on a paper which was presented at the 1953 National Electronics Conference in Chicago Sept. 28-30.

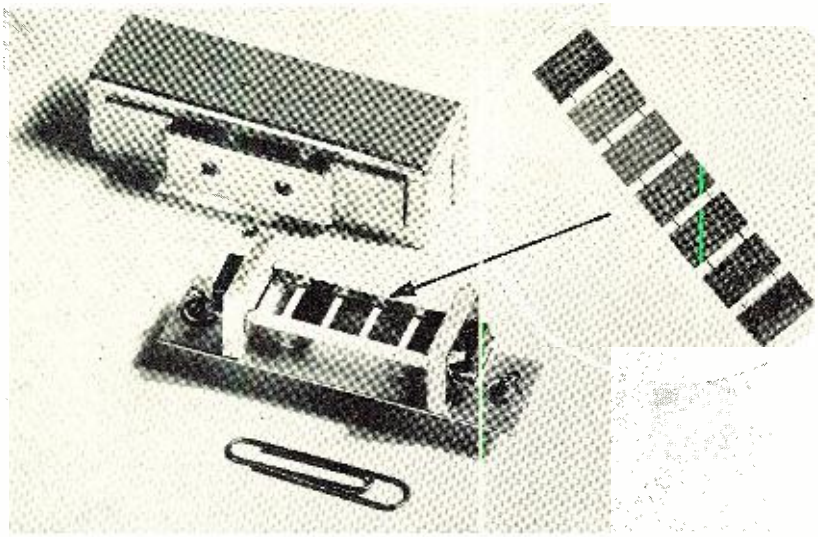


Fig. 3 (left). Assembled and disassembled views of an i.f. filter.
Fig. 4 (right). The metal plate filter used in the unit of Fig. 3.

and capacitors, much higher Q's would be expected. Mechanical resonators, in the form of stable vibrating metal plates, have been made with Q's ranging up to 2000 or 3000; quartz crystal resonators may have Q's of about 30,000 in air, and perhaps 300,000 to 400,000 in a vacuum. Use of such mechanical elements should also result in a substantial saving in size and weight, as they are generally smaller than the electrical components which would be used in their stead. The features of factory adjustment and sealing would still be retained.

With the advent of subminiature receivers, the small size of a mechanical filter becomes of increasing importance. While the emphasis in the design of the receiver is toward miniaturization, an irreducible minimum is reached in the size of an electrical inductance-capacitance filter. Any further reduction in size would, for instance, lower the Q of the inductors, thus necessitating more sections—and a consequent greater size—to achieve the same selectivity. The reverse would also be true. It is conceivable that as the receiver size is made smaller and smaller, the electrical filter might become as large as, or even larger than, the rest of the receiver. Use of a small electromechanical filter should alleviate this problem.

A mechanical filter, to perform the functions outlined above, can be constructed by utilizing a series of mechanical resonant circuits with mechanical coupling between them, and using electromechanical transducers at both ends of the structure. The transducers may or may not contribute to the selectivity.

In the frequency range under discussion, mechanical systems must be considered in terms of distributed circuits rather than lumped circuits. This is due to the much slower velocity of wave propagation in these materials as compared to electromagnetic wave velocity in air. Therefore, the usual lumped circuit concepts of analogies between mechanical and electrical elements, which consider a mass as an inductor and a spring as a capacitor, are not applicable.

Most mechanical filter configurations which utilize mechanical elastic coupling between mechanical resonators can be represented, near the resonant frequency, by the mechanical diagram shown in Fig. 6. Here M_N and K_N represent the equivalent lumped circuit mass and elastance of the resonators, with B_N representing their mechanical losses. The masses are represented as inelastic bodies moving vertically with respect to the plane of reference, with the "springs," K_N, attached between the masses and ground. X_N is the displacement of each mass, and the driving force is shown acting on M_1. K' represents the equivalent lumped circuit elastance of the coupling media, and is shown connected between successive masses.

From the mechanical diagram, a mechanical network schematic can be drawn, as shown in Fig. 5A[2]. Here, each mass-elastance-damping combination of Fig. 6 is shown with common "terminals" connected together (one side of each to ground, and the other side having displacement X_N). The coupling elastance connects each M-K-B system, and the driving force is connected to the first system.

Assuming an electromechanical analog where electrical voltage is analogous to mechanical force, the electrical analogous circuit as shown in Fig. 5B can then be drawn[3]. This circuit can be made to conform to a standard-type three-element m-derived bandpass section, as shown in Fig. 2A. A complete filter, fabricated from such sections and having a mid-series termination, would appear as shown in Fig. 2B; once the values of cutoff frequencies and impedance level are fixed, the component values can be determined, as given in any standard text on filter theory[4]. Through manipulation of these design equations, the low cutoff frequency, f_1, is determined by the resonant frequency of L_1C_1:

$$f_1 = \frac{1}{2\pi\ (L_1\ C_1)^{1/2}} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

and the ratio of bandwidth, $f_2 - f_1$, to the lower cutoff frequency, f_1, is determined approximately by the ratio of twice the series capacity to the shunt capacity:

$$\frac{f_2 - f_1}{f_1} = \frac{2\ C_1}{C_2} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

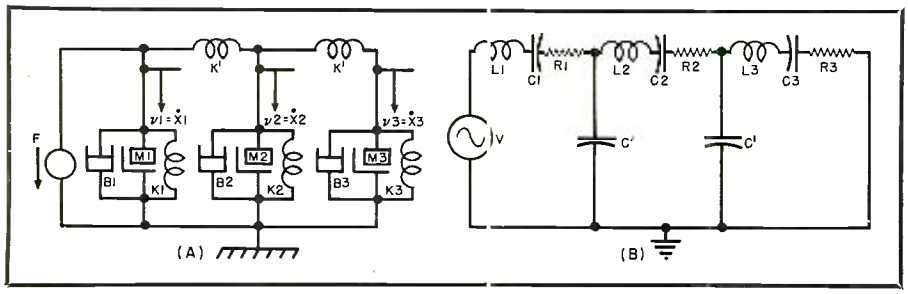
An almost unlimited number of actual mechanical designs are possible which are analogous to this type of circuit.

An approximate equivalent expression can be derived[5] to determine the bandwidth of a mechanical structure. The distributed resonant element can be equated to a lumped series inductance-capacitance circuit, $L_1 - C_1$, resonant at the same frequency. Assuming that, near its resonant frequency, the reactance curve of a series resonant circuit is the same as a tangent curve near $\theta = \pi$, the impedance of the mechanical resonator, Z_1, is determined as:

$$Z_1 = \frac{2}{\pi}\ (L_1/C_1)^{1/2} \quad . \quad . \quad . \quad . \quad . \quad (3)$$

The impedance, Z_2, of the coupling members between the resonators—if the members are ⅛ wavelength long—can be determined as the reactance of a capacitor, C_2, assuming that the capac-

Fig. 5. (A) Mechanical network diagram of filter. (B) Electrical analog of the mechanical network shown in (A).



itor's reactance curve is the same as a tangent curve near $\theta = 3\pi/4$.

$$Z_2 = \frac{1}{2\pi f_1 C_2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

From Eqts. (1), (2), (3), and (4):

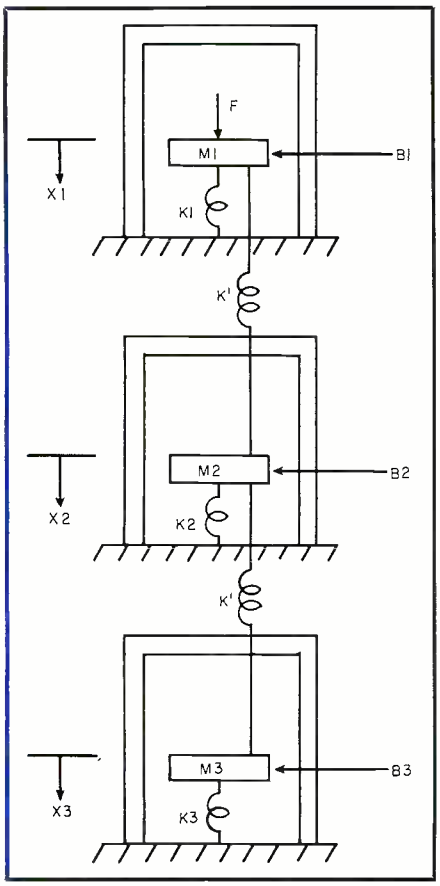
$$\frac{f_2 - f_1}{f_1} = \frac{4 Z_2}{\pi Z_1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

Assuming Z_2^2 to be much less than Z_1^2, the result in Eqt. (5) can also be derived by consideration of the structure in mechanical terms only[6].

A Practical Filter

Several distributed mechanical filters have been proposed[5, 7, 8, 9] in the literature, and a unit of this type has been the subject of considerable development at *Motorola*. This filter, shown in Fig. 4, consists of a series of flat plates interconnected with pairs of fine metal wires. The plates are resonant on the low side of the passband, and the wires serve as nonresonant couplers between these resonant "circuits." Made of a special stainless steel, the five center plates have a high Q and a very low temperature coefficient. The two end plates—if made of nickel—form part of the filter, and are also magnetostrictive converters which convert electrical into mechanical energy (and vice versa). Other units have been made with quartz end plates which drive the filter piezoelectrically.

Fig. 6. Equivalent lumped circuit diagram of a mechanical filter.



The plates vibrate in an extensional mode, but because of the large ratio of width to length, the frequency constant and the vibrating shape are not simple functions—due to mechanical coupling in various directions through Poisson's ratio. Assuming that the plates are isotropic, very thin, and that they vibrate in a free-free mode, the analytic procedure of McSkimin[10] can be followed to determine expressions for the frequency and shape. The displacement equations are:

$$u = V_1 \left\{ \cos\left[(l_1 b)\frac{y}{b}\right] + \frac{V_2}{V_1}\cos\left[(l_2 b)\frac{y}{b}\right] \right\} \cos(kx)\, e^{j\omega t} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

$$v = V_1 \left\{ -\frac{l_1 b}{k b}\sin\left[(l_1 b)\frac{y}{b}\right] + \frac{V_2}{V_1}\frac{k b}{l_2 b}\sin\left[(l_2 b)\frac{y}{b}\right] \right\} \sin(kx)\, e^{j\omega t} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

where:

$$\frac{V_2}{V_1} = \frac{-2\,(l_1 b)\,(l_2 b)\sin\left(\frac{l_1 b}{2}\right)}{[(l_2 b)^2 - (k b)^2]\sin\left(\frac{l_2 b}{2}\right)} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

$$(l_1 b)^2 = \frac{1-\sigma}{2}(\theta b)^2 - (k b)^2 \quad . \quad (9)$$

$$(l_2 b)^2 = (\theta b)^2 - (k b)^2 \quad . \quad . \quad (10)$$

$$\theta^2 = \frac{2\rho\omega^2(1+\sigma)}{E} \quad . \quad . \quad . \quad . \quad (11)$$

$$k = \frac{m\pi}{L} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

and:

ρ = density of the material
E = modulus of elasticity of the material
σ = Poisson's ratio of the material
$\omega = 2\pi f$ = angular frequency of vibration
m = an integer
L = length of plate (along the x direction)
b = height of plate (along the y direction)
u = displacement in the x direction
v = displacement in the y direction
V_1 = a constant

At the ends of the plate, $x = 0$ and $x = L$; and at the top and bottom of the plate, $y = \pm (b/2)$.

The resonant frequency of such a plate can be determined from a transcendental equation:

$$\frac{\cot\left(l_1\frac{b}{2}\right)}{\cot\left(l_2\frac{b}{2}\right)} = \frac{-2\,(l_1 b)\,(l_2 b)\,(k b)^2(1-\sigma)}{[(l_2 b)^2 - (k b)^2]\,[(l_1 b)^2 + \sigma(k b)^2]} \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

This equation cannot be solved explicitly for the frequency, but by using other techniques, two solutions are obtained; Fig. 7 shows the relation of resonant frequency times the height of the plate to the ratio of height to length. The frequencies of any given plate size can thus be easily determined from the curves. Experimental results verify these curves, with the two frequencies occurring approximately as predicted—as shown in Table 1, where $m = 1$, $E = 30 \times 10^6$ psi and $\rho = 0.295$ lb./cu. in. Since the lines on Fig. 7 are not straight, overtone operation does not result in a harmonic relation. As b is made very small, Eqt. (13) reduces to the common frequency-determining equation for a long, thin bar. This result is also indicated by the straight portion, for small width-to-length ratios, of the lower curve of Fig. 7.

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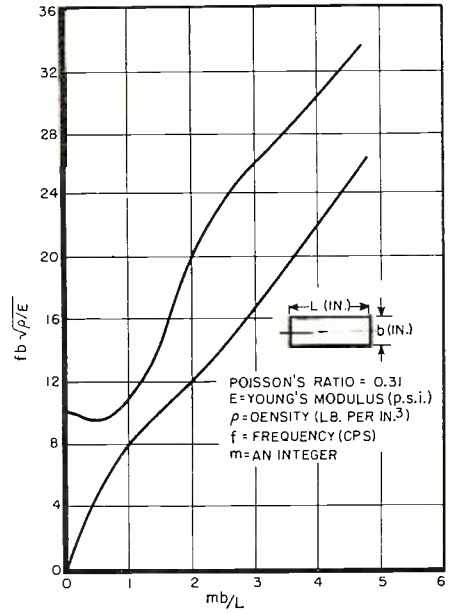
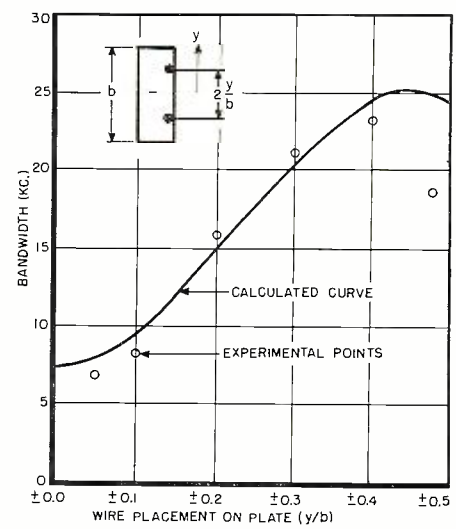
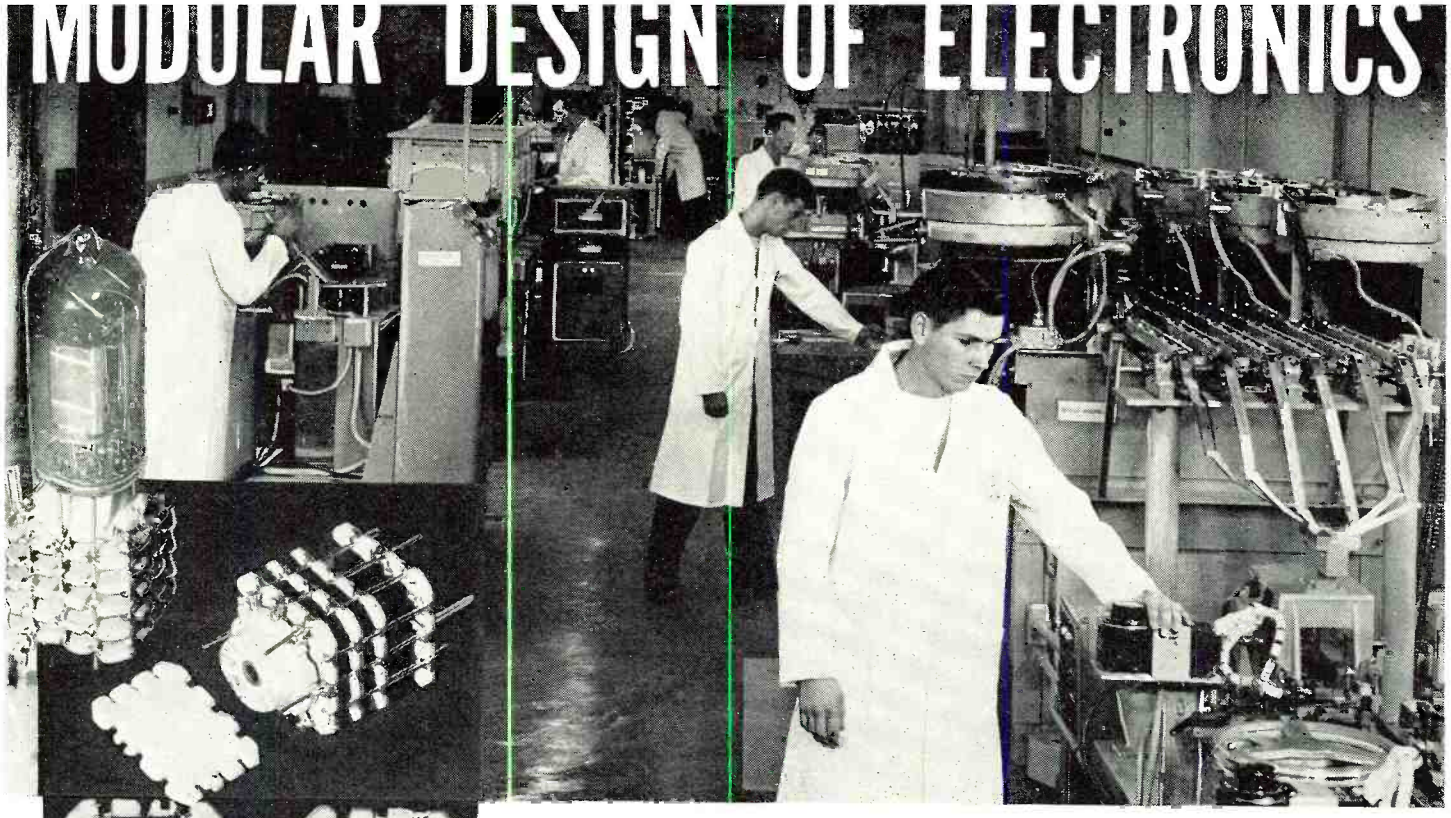


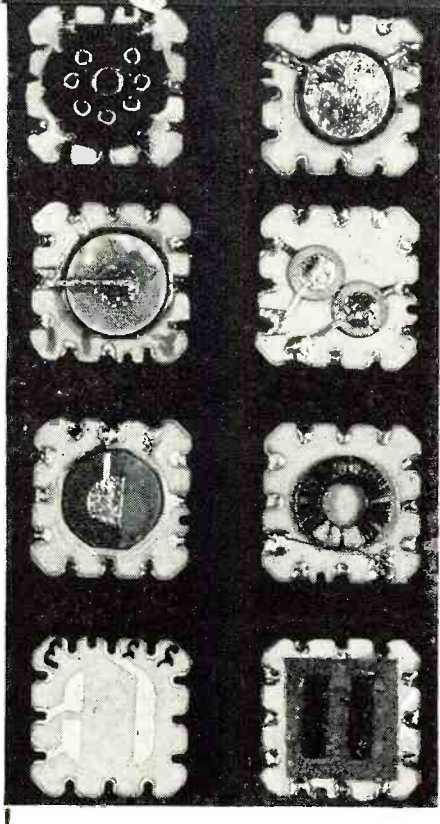
Fig. 7. Curves for determining the resonant frequency of a plate.

Fig. 8. Curve showing bandwidth as a function of wire placement.



MODULAR DESIGN OF ELECTRONICS





(Top) Interior view of the PROJECT TINKERTOY plant. (Upper left) Two modules and a blank wafer; a tube has been inserted in one of the modules. (Lower left) A group of wafers bearing various components, such as resistors and capacitors.

AN AUTOMATIC production line for the manufacture of electronic products and a novel system of electronics design which makes this possible have been developed by the National Bureau of Standards. The program, code-named PROJECT TINKERTOY, was sponsored by the Navy Bureau of Aeronautics.

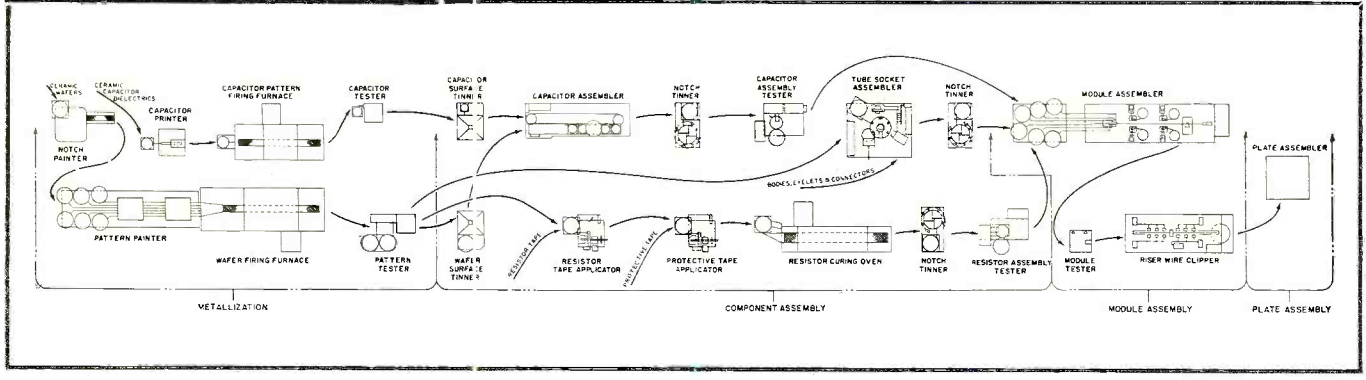
Starting from raw or semiprocessed materials, machines automatically manufacture ceramic materials and adhesive carbon resistors, print conducting circuits, and mount resistors, capacitors, and other miniaturized component parts on standard uniform steatite wafers. The wafers are stacked very much like building blocks to form a module that performs all of the functions of one or more electronic stages. Automatic inspection machines check physical and electrical characteristics of the parts-mounted wafers at numerous stations along the production line. The completed module is a standardized, interchangeable subassembly combining all of the requirements of an electronic circuit with ruggedness, reliability, and extreme compactness.

MDE Design System

The key to the automatic, mechanized production of electronic equipment in PROJECT TINKERTOY is the design system developed by NBS. Called MDE—for Modular Design of Electronics—the system establishes a series of mechanically standardized and uniform modules (or building blocks), producible with a wide range of electrical characteristics.

Each module, in general, consists of some 4 to 6 thin ceramic wafers, bearing various circuits associated with an

Schematic diagram of the PROJECT TINKERTOY mechanized assembly line.



Printed circuit techniques, machine assembly, and 100% production testing are all part of this development.

electronic stage. A number of individual modules are combined to form a major subassembly. The composition of modules into major subassemblies is possible because there is great similarity between circuits and parts of circuits in modern electronic equipment.

MPE Production System

Production of the modules and assemblies, designed in accordance with the MDE system, is achieved mechanically in PROJECT TINKERTOY. The production system is called MPE—Mechanized Production of Electronics. MPE largely utilizes noncritical raw materials. Ceramic wafers—⅞ inch square by 1/16 inch thick—are produced directly in quantity from the raw ingredients. Ceramic capacitors are produced in a similar fashion.

These and other basic parts are fed into the production line. The appropriate circuits are printed by automatic machines. The circuit configuration is achieved through photographic processing. Quality control is established by automatic inspection, directed by information prepared in punched card form. Special components, not suitable for "printing" techniques, can be incorporated into the modules. Automatic physical and electrical inspection is provided for in the production line.

The MPE system is based on the use of bulk or semiprocessed materials, and the line produces all the large-quantity parts except for the tubes. The pilot plant is designed for a production goal of 1000 modules per hour. Joining modules together to form subassemblies may also be accomplished by machines.

Circuitry

Dispensing with the conventional circuit diagram of the tested electronic model, the MDE design system places all necessary production programing information on an MDE work sheet (Fig. 2). Each work sheet contains the front and back outlines of six wafers with appropriate numbering to identify each notch in the wafer, each riser wire, and the electronic piece that is to be placed on the wafer. The engineer translates his conventional wiring diagram (Fig. 1) to an MDE diagram. He indicates the position of the piece and its proper value and tolerances. Lines are drawn to indicate how the circuits between wafers are connected.

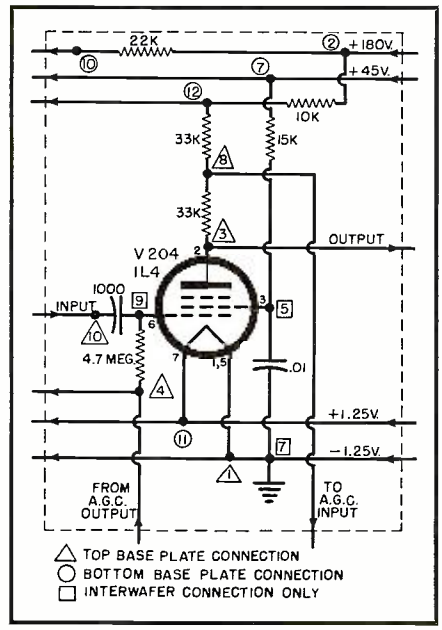


Fig. 1. Schematic diagram of a typical module, showing points at which wafer connections are made.

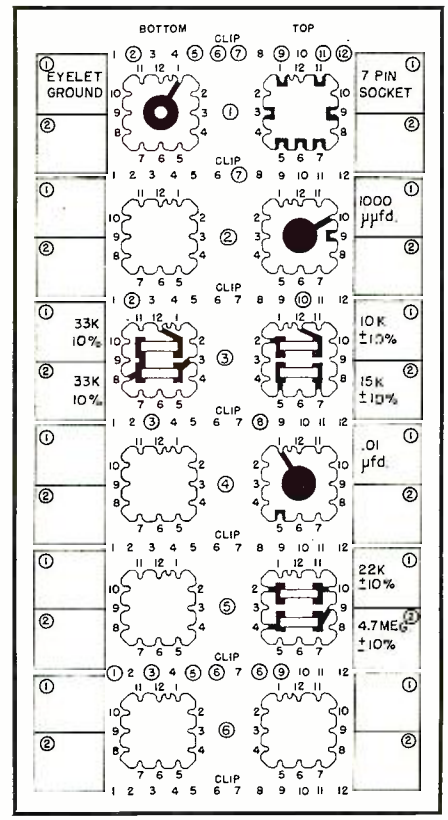


Fig. 2. Modular work sheet for the circuit of Fig. 1. Individual wafer arrangements are shown.

The engineer's MDE work sheet becomes the basic document from which a draftsman makes an ink drawing that may be reproduced in large numbers. The draftsman also prepares a larger version of the work sheet that is photographed and is subsequently used to make stencils for the circuit printing machines.

Use is made of the MDE work sheet in establishing inspection procedure; current paths on each wafer are marked on specially prepared punch cards which will accompany the wafers through all of the manufacturing processes. The sheet is also used in the construction of the standard modules or counterparts that are employed in the final testing and inspection of the module assembly.

Module Assembly

The standard wafer is pressed with twelve peripheral notches (three on a side) and a keying notch on one side. The keying notch is a medium by which individual wafers are automatically oriented for the mechanical application of component parts. Uniform wafer-mounted component parts, including wafer-mounted coils, toroids, potentiometers and crystals, are assembled as a module in a single machine. Six

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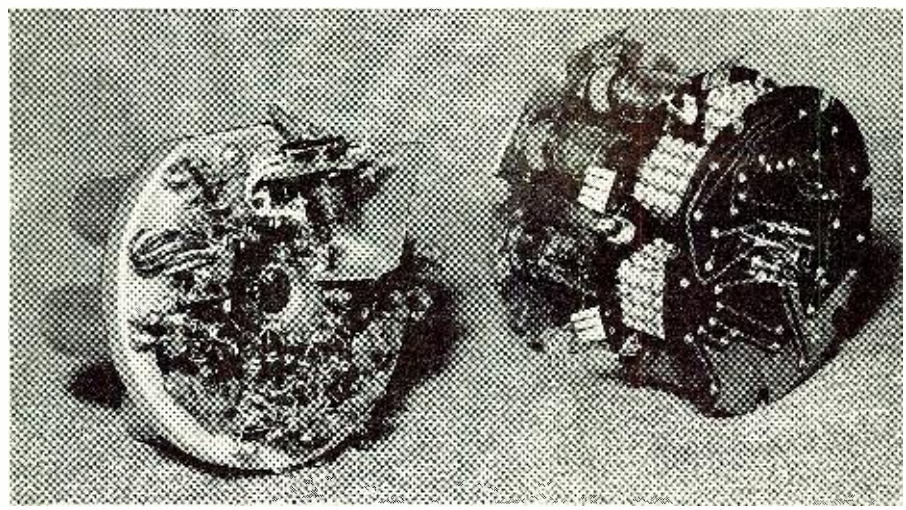
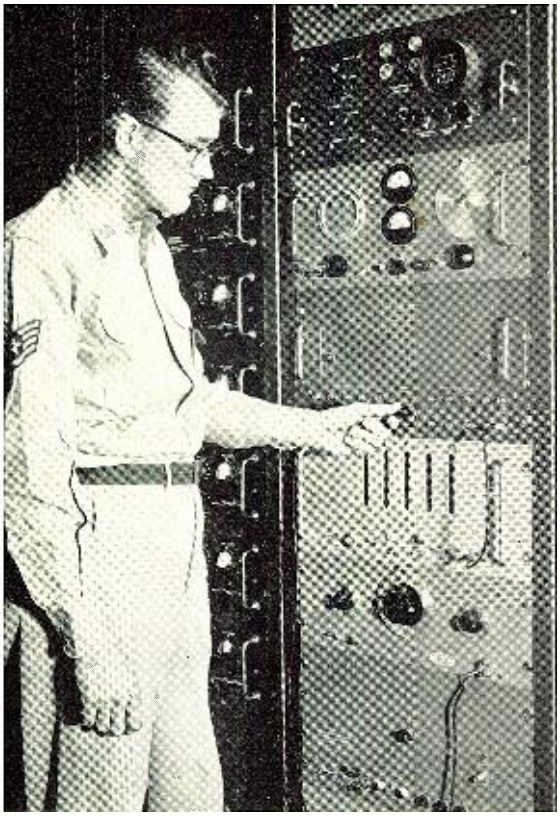
(Left) Conventional electronic equipment. (Right) Same equipment using modules.





The eight-channel signal separator and EPUT meter installed in a rack of standard telemetry receiving components.

TELEMETRY SUBCARRIER SEPARATOR

By

JAMES B. WYNN, JR.* and **SAM L. ACKERMAN****

Patrick Air Force Base, Florida

A device for separating the individual channels from the carrier frequency in an FM/FM telemetry system.

THE RADIO-telemetry system known as FM/FM (frequency-modulated subcarriers modulating a frequency-modulated radio carrier) conveys intelligence on subcarrier frequencies. This type of instrumentation is used for gathering performance data from guided missiles in flight. To recover the intelligence, each carrier frequency has to be separated from the others and demodulated.

Since the subcarrier intelligence is in the form of a varying frequency, the data is extracted by the use of discriminators. Most discriminators in radio-telemetry receiving stations contain all the circuitry required for separating one of the frequencies, limiting, and discriminating the subcarrier frequency intelligence, as well as suitable vacuum tube stages to drive various types of recording oscillographs, pen recorders or electronic digital computers.

It is the purpose of this article to describe the "channel separator"—a small, simple unit which may supplant complex and costly discriminators for many purposes. This unit is satisfactory for testing and calibration of airborne radio-telemetry missile systems and subcarrier oscillators, with or without associated transducers, and replaces a complete rack of standard telemetry receiving station equipment.

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The channel separator was first designed and fabricated for reasons of economy and because of the shortage of electronic equipment. The need for checking out a radio-telemetry guided missile installation arose, and a satisfactory method of doing so had to be devised within one week. All telemetry receiving stations available, containing the required units, were committed to other missile projects or flights. Since the basic requirement called for a means of statically calibrating and adjusting the telemetry missile installation in the hangar prior to the launching check-out, it seemed feasible that a few of the basic components would suffice in place of an elaborate ground station. It was felt that the task could be adequately performed by the use of: (1) the telemetry FM special-purpose receiver, (2) a unit for separating the desired channel from the complex signal output of the receiver or of the subcarrier oscillator mixing circuits in the missile, and (3) standard electronic precision test equipment to read the separated signal directly in terms of cycles per second, such as a frequency counter.

Most FM/FM airborne telemetry installations made in guided missiles or pilotless aircraft make use of either 6, 8, 10, or 12 subcarrier oscillator frequencies. The ground receiver stations generally contain eight subcarrier discriminators, for separation and demodulation, in each relay rack. In view of these conventional airborne and ground configurations, it was felt that the separator units should be designed for either four or eight channels. The basic design was thus limited in configuration, so that the separator would be suitable for mounting in a standard relay rack or in a cabinet for portable use, and for standardization would be approximately the same size in both the 4- and 8-channel models.

The front panel adopted for both units is 19" wide, 8" high and is constructed of ⅛" steel with an *Onslo* Gray Baked Hammeroid finish. All standard, commercially available components were used throughout. No stringent requirements were placed on size, weight, or power consumption other than that the separator should operate on 110-120 volts, 60 cycles. The chassis is 17" long, 13" deep, and 3" high in both models.

A number of improvements between the first 4-channel model and a later 8-channel model were made possible mainly through additional procurement time. Most notable, probably, is the use of the miniature vector turret tube sockets. Components associated with each tube are a part of the socket assembly, so that the circuits are prefabricated; only common filament and plate power wiring and circuit coupling need be installed on the chassis.

The controls as well as input and output receptacles are all mounted on the front panel. This permits easy operation of the unit whether it is installed in a rack as part of the telemetry installation or in the laboratory as test equipment. The a.c. power input is on the rear of the chassis. Coaxial connectors were selected for the input complex and output telemetry signals because frequencies up to about 90 kc. are employed.

For each channel, the input signal is paralleled across a 500,000-ohm input attenuator, with the center arm of the potentiometer capacitively coupled to the control grid of the cathode-follower isolation and impedance matching stage

required between the input and the bandpass filter; the cathode follower is capacitively coupled to the bandpass filter, which in turn provides the proper frequency separation. Bandpass filters may be of the type utilized in any of the telemetry subcarrier discriminators manufactured by such companies as *Raymond Rosen, Bendix, Electro-Mechanical Research,* and *Clarke Instruments Division* of *National Electric Machine Shops.* Filters of this nature have been manufactured by *Burnell, Freed* and *Hycore.* Each filter is terminated into its characteristic impedance of 2500 ohms, and direct-coupled into the grid of one-half of a dual triode. Capacity coupling is used to the second half of the triode, and high impedance capacity coupling is utilized from the triode to a selector switch. A switch is used in the output to select any one of the signals for presentation at the output coaxial connector. The output of the channel separator is connected through a coaxial cable to a *Berkeley* EPUT (events per unit time) meter Model 554, or a similar frequency counting instrument, which is normally rack-mounted adjacent to the separator. The signal level output from the separator is 20 volts maximum without distortion and is more than adequate for visual observation on an oscilloscope or electronic counter. If this circuit is duplicated, at no time should the output be above the 20-volt level as distortion may cause erroneous counting.

The power supply is of conventional full-wave, choke-input design. An adjustable wire-wound resistor in series with the load provides a means of setting the high voltage to 250 volts under normal operation. The load requirements are constant so that a single setting of the voltage level is sufficient. Power input should be 115 volts, 60 cycles, with a consumption of 40 or 60 watts for the 4- and 8-channel models respectively.

Because the bandpass filters employed are of the plug-in type of construction, considerable flexibility is provided in the use of the channel separator; the basic circuitry is not frequency-sensitive, and any filters may be plugged in so that any combination of four or eight frequencies can be separated by a unit. On the other hand, if different frequencies are occasionally

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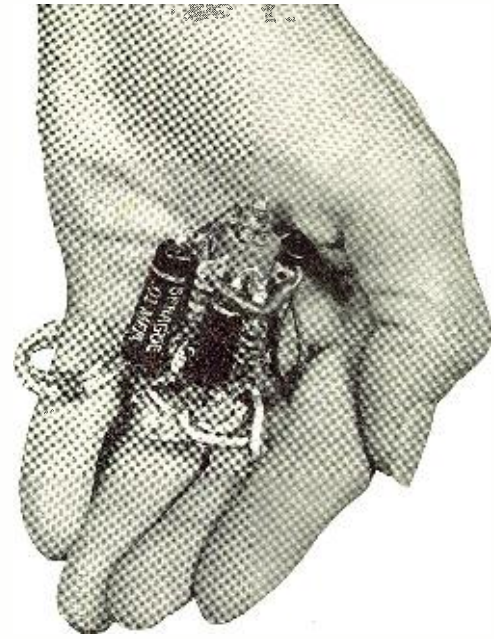
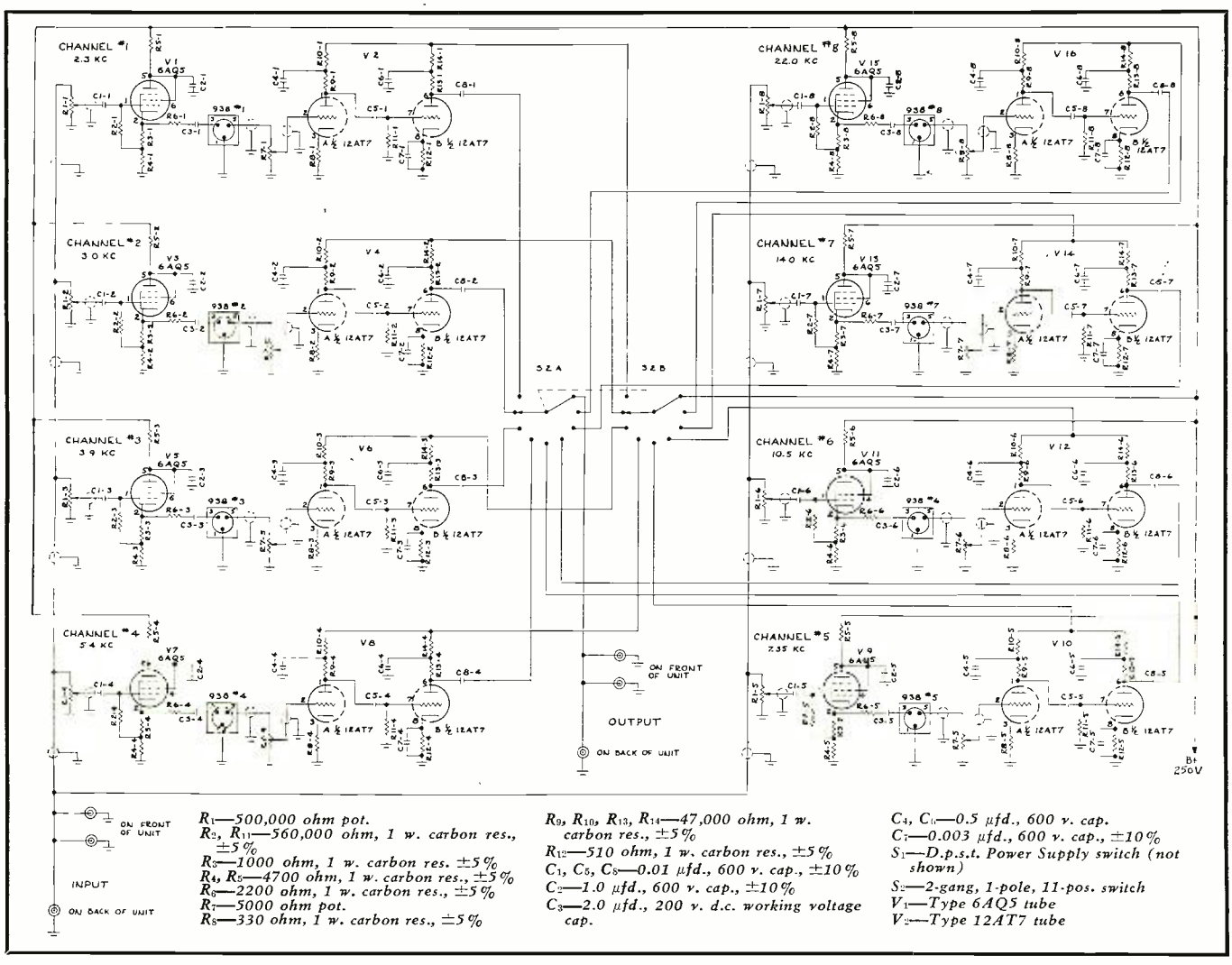


Illustration of the vector socket wiring technique employed throughout the subcarrier separator.

Fig. 1. Complete schematic and parts list of the eight-channel separator except for power supply, which is conventional.



R_1—500,000 ohm pot.
R_2, R_{11}—560,000 ohm, 1 w. carbon res., ±5%
R_3—1000 ohm, 1 w. carbon res. ±5%
R_4, R_5—4700 ohm, 1 w. carbon res., ±5%
R_6—2200 ohm, 1 w. carbon res., ±5%
R_7—5000 ohm pot.
R_8—330 ohm, 1 w. carbon res., ±5%
R_9, R_{10}, R_{13}, R_{14}—47,000 ohm, 1 w. carbon res., ±5%
R_{12}—510 ohm, 1 w. carbon res., ±5%
C_1, C_5, C_8—0.01 μfd., 600 v. cap., ±10%
C_2—1.0 μfd., 600 v. cap., ±10%
C_3—2.0 μfd., 200 v. d.c. working voltage cap.
C_4, C_6—0.5 μfd., 600 v. cap.
C_7—0.003 μfd., 600 v. cap., ±10%
S_1—D.p.s.t. Power Supply switch (not shown)
S_2—2-gang, 1-pole, 11-pos. switch
V_1—Type 6AQ5 tube
V_2—Type 12AT7 tube

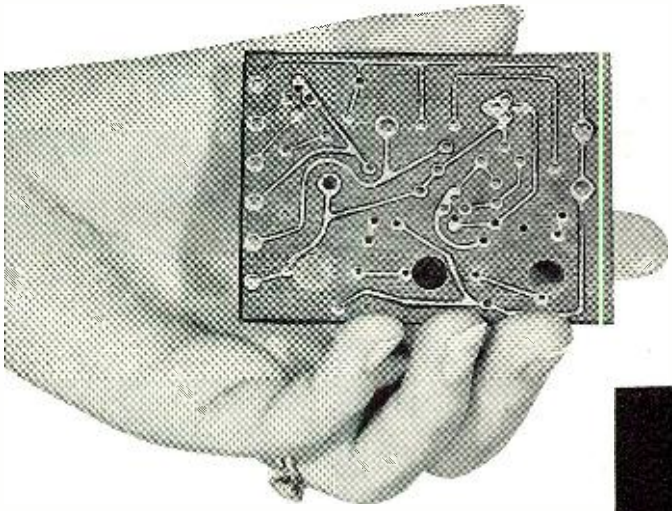


Fig. 1. Hot die-stamped circuit.

AUTOMATIC PRODUCTION

By

L. K. LEE and F. M. HOM

Stanford Research Institute

An analysis of three possible approaches to automatization of electronic equipment production.

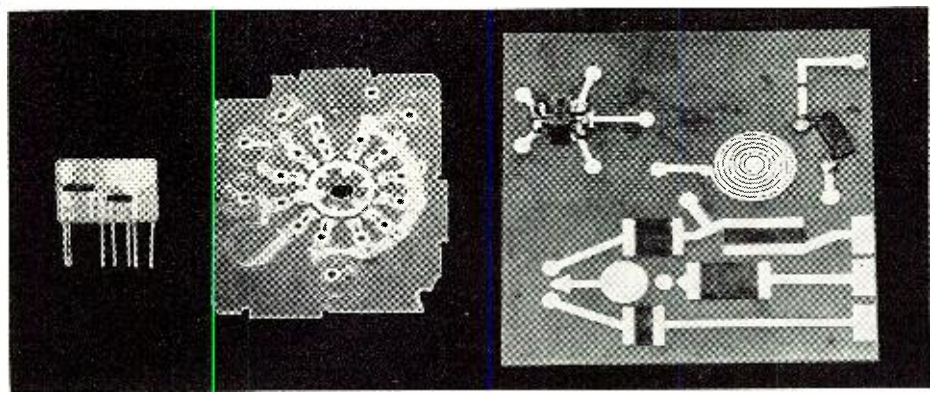


Fig. 2. Functional elements formed by printed circuit techniques.

DURING the past few years considerable effort has been spent developing new techniques to reduce labor and economize on materials in the manufacture of electronic equipment. Few trends in electronic equipment and component manufacturing have been more pronounced than the concentration of effort upon mechanized production methods, improvement of reliability, and development of miniaturization techniques.

Postwar development shows that greater quantities of electronic equipment are needed. Between 1939 and 1952 electronic equipment sales have grown from approximately 340 million dollars to almost 6 billion dollars—a twenty-fold increase. The number of factory workers in the electronics industry has jumped from 93,000 to 360,000 during the same interval. Communications, television, computers, electronic controls, and instrumentation are areas which have a tremendous growth potential. The military with its guided missiles, proximity fuses, electronic fire control, and endless other applications would create a demand in an all-out national emergency that industry could not satisfy with its present facilities. Thus, with the coming of age of the electronics industry, automatization of its production methods is not only desirable but necessary.

The problems of industry, however, are not confined merely to producing enough. Increased labor costs and a need for more efficient utilization of present plant layouts are also of much concern. Increasingly stringent requirements for reliability of performance under adverse conditions and miniaturization create additional crucial problems with respect to design and production. Electronic equipment fabrication has outgrown the early stage when it was simply a matter of designing a circuit, mounting the components and soldering their leads together. Today, fabrication requires closely integrated coordination of materials selection, mechanical and thermal design, and correct component application.

One answer to providing quantity and quality at minimum cost is automatic fabrication. Automatization of the production line would provide: (1) accelerated production, (2) uniformity of products—since all components and leads

Fig. 3. Components suitable for mechanized assembly.

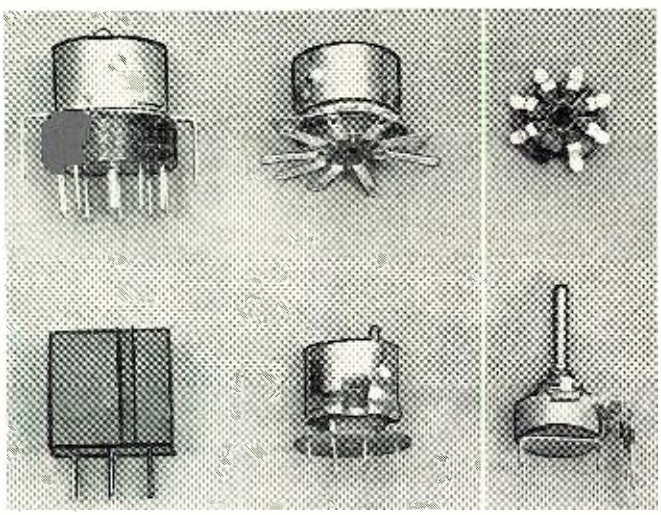
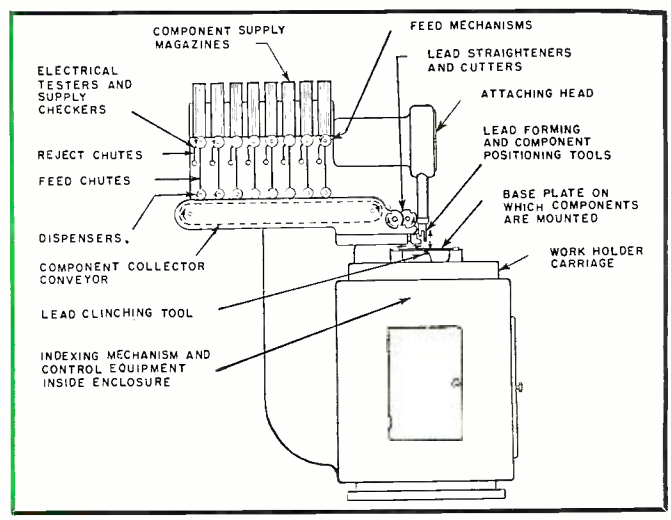
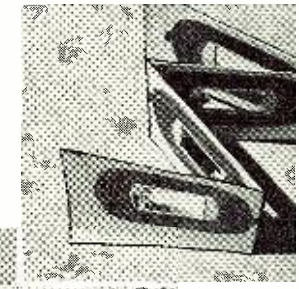


Fig. 4. Outline drawing of component-attaching machine.



AND ELECTRONIC COMPONENTS



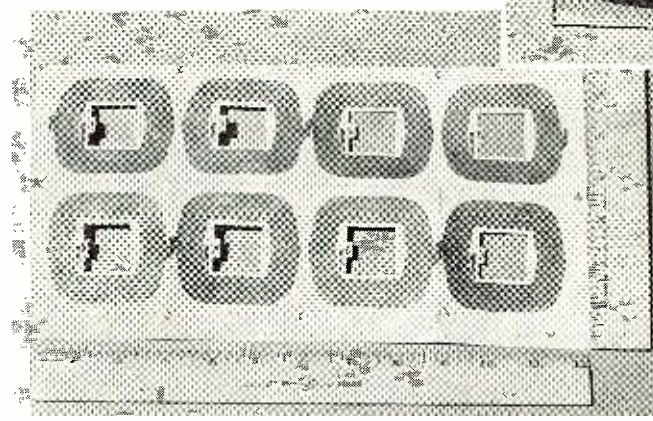


Fig. 5 (top). Folding windings to form multilayer coil.
Fig. 6 (bottom). Printed windings of coil before folding.

are in precise orientation and location, (3) simplified quality control, (4) improved reliability, (5) reduction of manpower requirements for production—particularly as concerns the skilled worker, and (6) production around-the-clock.

Three possible approaches to automatization of electronic equipment fabrication relative to its effect on component requirements are as follows:

1. The first approach is the application of prefabricated components using conventional wiring methods and designing machines to duplicate the assembly operations now performed manually.
2. The second approach makes use of prefabricated components (possibly with mechanical modifications), printed circuit wiring methods, and machines to perform the assembly and fabrication operations.
3. The third approach is the adoption of completely new concepts wherein present components, as prefabricated units, are no longer used. Instead, the separate elements performing the electrical functions, the structural support, and protection against environmental effects are fabricated in the production line as parts of a functional electronic package.

The first approach is the most direct but certainly not the simplest. Although the use of unmodified available components is a great advantage, it is too difficult to design machines that duplicate the dexterity of human hands in performing the assembly operations. As a result, this approach has not been pursued extensively and accordingly will not be discussed further.

The second approach, the one most generally followed at this time, is used principally by the assembler of electronic equipment. Circuit patterns are fabricated by one of the so-called printed circuit techniques, such as etching copper foil, stamping copper foil (Fig. 1), embossing silver powder on a plastic base (Fig. 2, large panel), or plating copper on a plastic base.

Components are used with minor modifications so that machines may automatically position and insert their leads into a base plate containing the circuit pattern. Figure 3 shows components with modified leads for mechanized insertion and dip-soldering. Some of the requirements for making these components suitable for automatic assembly are:

1. Standardized component body shapes and dimensions to specific production tolerances must be realized to make them suitable for stacking in magazines, feeding by hoppers, etc., with a minimum of handling difficulties.
2. Components must be designed to provide means for orienting polarized components, such as electrolytic capacitors and semiconductor diodes.
3. The components must be provided with suitable means for attaching. This may be primarily a requirement on materials. For example, tinned copper leads may be changed to steel leads to facilitate electric welding as a means for attaching the components to the circuit.
4. The components must be able to withstand the environmental effects and conditions imposed by the processing methods used during fabrication. For example, the components must withstand exposure to heat during dip-soldering or the curing of protective coatings, and must return within tolerance requirements. This is primarily a requirement on the stability of the electrical characteristics of materials.
5. Component body dimensions should vary in fixed increments to facilitate circuit layout and hence base plate indexing during the component inserting operation.
6. Positioning of leads with reference to the body of the component must be standardized to facilitate mechanized insertion of the component into the circuit.
7. Dimensions of the leads must be standardized so that

Fig. 7. Outline drawing of component-attaching head.

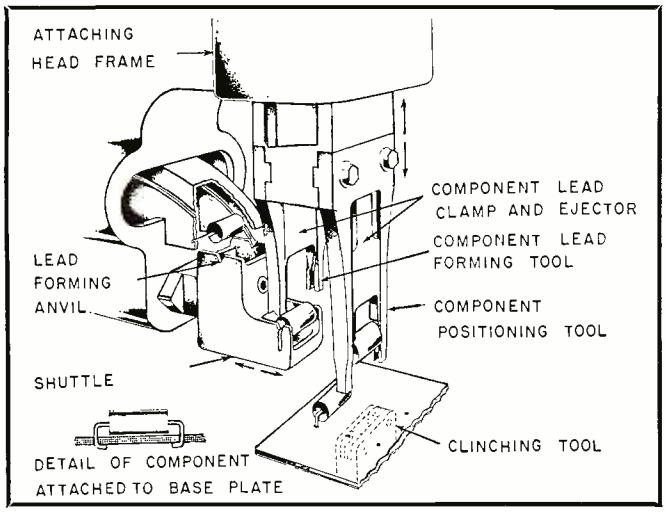
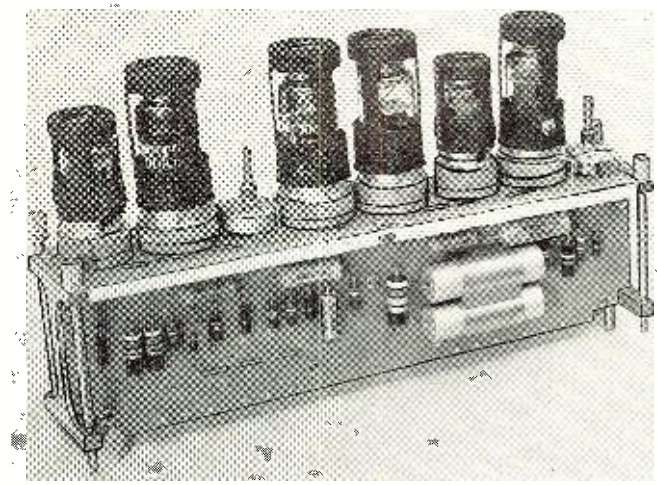


Fig. 8. Subassembly designed for mechanized production.



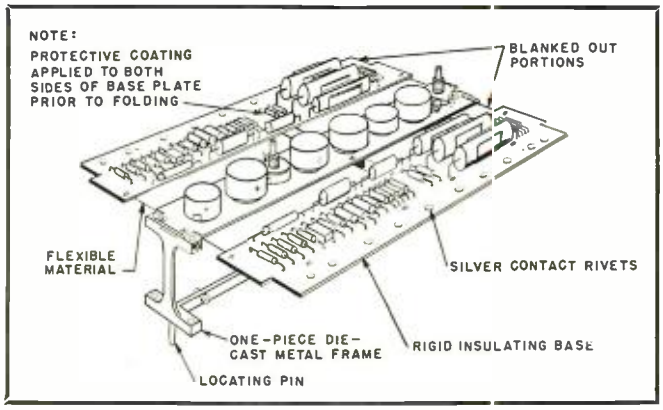


Fig. 9. Components attached to partially assembled unit.

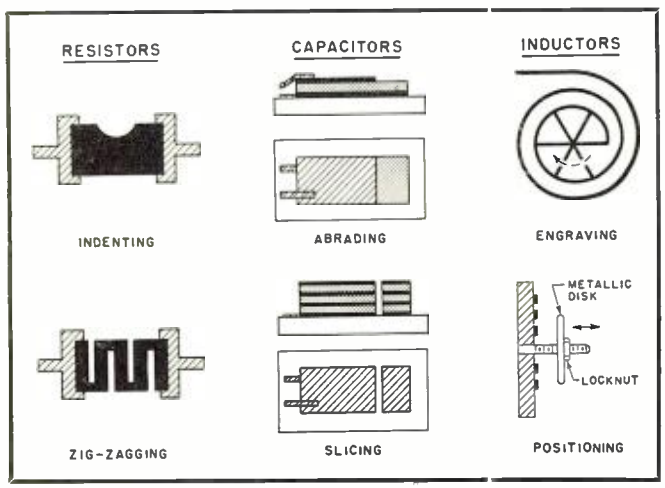
lead-handling mechanisms and standard hole sizes in the base plate may be used for attachment of the leads.

Figure 4 shows one possible machine which may assemble axial lead components such as resistors and capacitors on circuit patterns (Figs. 1 and 2). Individual values of components are loaded into the magazines as shown. Each component is checked electrically before it is allowed to descend to the feed chute. The dispensers and the conveyor mechanism are programed to deliver the proper sequence of components for the attaching head which straightens the leads, trims them to the correct length, and forms the leads so that the component body and the leads form a U-shape. Forming and positioning tools are shown in greater detail in Fig. 7. The component is inserted into a base plate which has been punched to receive the component leads. Leads are clinched to hold the component in place for eventual dip-soldering.

Shown in Fig. 9 is a subassembly specially designed to be suitable for mechanized production at an intermediate stage of completion. Components have been attached to the base plate by the component-attaching machine. The circuit pattern is formed on the under surface of the flexible laminate. Figure 8 shows the completed assembly after the base plate has been folded and attached to the supporting frame.

The third and most novel approach to automatization has in general been adopted by the component manufacturer whose familiarity with materials such as carbon, resins, and ceramics, and with processing techniques, has enabled the formation of the circuit assembly concurrently with the components. With no restraints on assembly methods imposed by past practices, the component manufacturer has started with raw materials and fabricated the circuit assemblies in any way suitable for mechanization or automatization. The forming of the components and the fabrication of the subassembly are integrated into one continuous process and may even be done by one production line.

Fig. 10. Methods of adjusting the various functional units.



The package is considered as comprising the electronic functional elements, the structural support, and protection against environment. An electronic functional element is defined as that portion of a circuit which performs primarily an electrical function. Thus, in the printing of a circuit, the resistive element is formed on a ceramic supporting body and this resistive element is protected from the environment by a coating. As another example, a conventional prefabricated resistor may be thought of as an assembly consisting of a resistive element on a supporting body, connected to conducting elements (the leads), and the entire assembly enveloped by a protective coating. This third approach not only allows much wider latitude in the use of new materials but also encourages new fabrication methods, new packaging techniques, and of course, new machines for performing the fabrication in an automatic production line. The adjustment or tailoring of the electronic functional element and the more economical use of materials by combining functions of these materials are additional advantages gained.

Some of the general requirements for the automatic fabrication of electronic subassemblies using the third method of approach are:

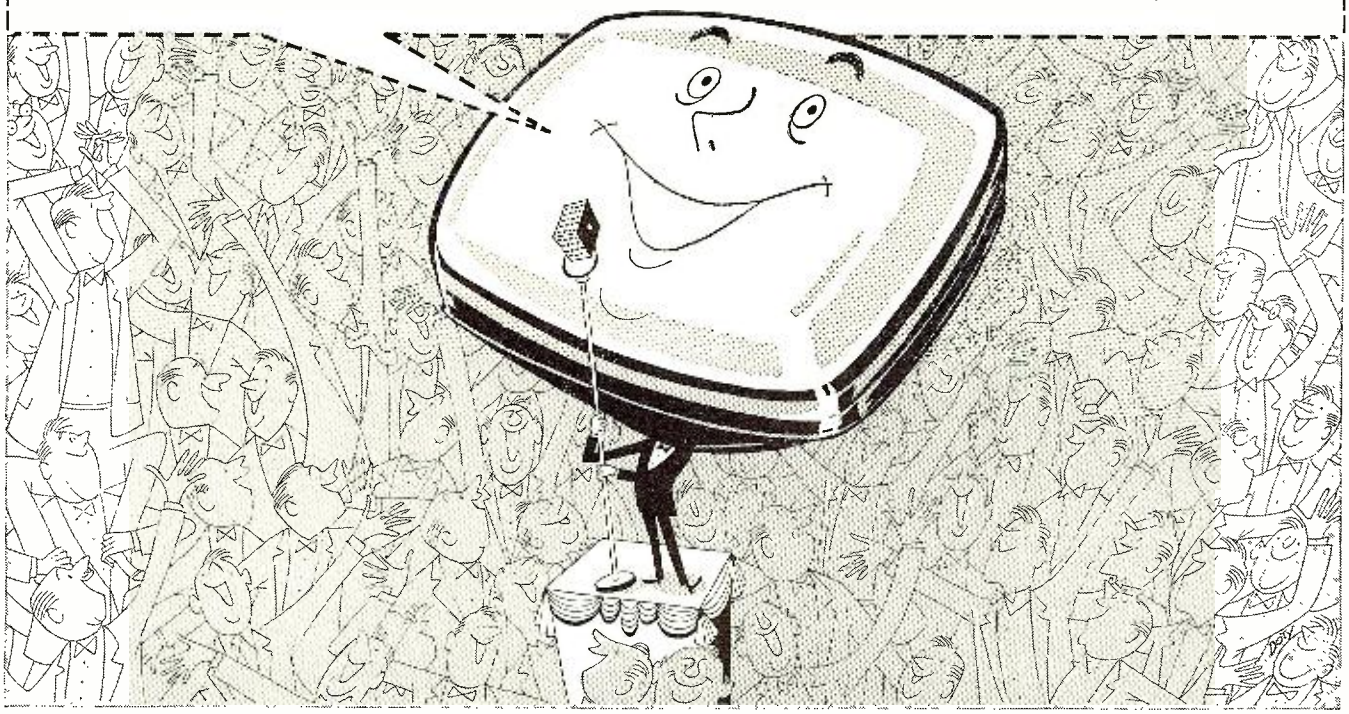
1. The functional elements should be suitable for fabrication as an integral part of the assembly fabrication processes.
2. Automatic fabrication processes used to form the assembly or the functional element should not adversely affect previously fabricated elements nor influence the elements subsequently to be formed. There must be compatibility of materials and processes used in the production line. For example, the application and curing of a protective coating should not affect the characteristics of the components beyond the allowable tolerance limits.
3. The automatic processes of fabrication must produce functional elements within the required tolerances.
4. Functional elements must have a planar configuration. An exception occurs when the functional elements are stacked, as in the fabrication of multilayer capacitors by alternate spraying of the dielectric and conductive materials.
5. Processing time for each operation in fabricating the elements of the subassembly must be approximately the same in order to maintain a balanced line requiring a minimum of storage capacity or parallel operation. For example, the time required to form an electrolytic capacitor makes it unsuitable for an automatic production line in which the time required by most operations for fabricating the assembly may be measured in seconds.

Functional elements which are fabricated during the assembly process are shown in Fig. 2. On the left is an example of resistive, conductive, and capacitive elements formed by the so-called silk screen printing process. The base material is used as the dielectric for the capacitor. At the right of Fig. 2 is an example of the pressed powder process. Conductive elements are formed with powdered silver embossed by a hot die on a base plate which may be phenolic, teflon-glass laminate, or another material of this type. Resistive elements are formed in the same manner, using carbon granules. The center example in Fig. 2 is that of a stamped circuit process in which the functional elements are formed by hot die stamping or embossing copper foil onto the plastic base material.

The materials used, and the sizes and shapes of these elements, are in general very different from the conventional prefabricated component. Another example of how mech-

(*Continued on page* 38)

NOW YOU CAN HAVE the Tungsten and Chemical Components that help make Sylvania Picture Tubes so popular



Seven out of the ten leading television set makers are today using Sylvania Picture Tubes. Why this overwhelming popularity? Much of the credit will be found in the splendid quality and scientific purity of Sylvania's Tungsten and Chemical Components. And NOW, these products, based on 15 years research and special skills, are offered to you! *For example:*

Picture Tube Phosphors by Sylvania are superior because they are carefully controlled for particle size, brightness, and uniformity of color. Sylvania offers a number of these quality phosphors for black and white television. Of special interest is the phosphor blended for maximum cross-burn resistance. Also available are phosphors for color television picture tubes and cathode ray tubes. All may be obtained in 1000 lb. lots to eliminate any color-matching problems.

Potassium Silicate is produced by Sylvania with exact control of the ratio of the two elements involved, thus assuring optimum wet-screen strength. Its high chemical purity helps maintain screen brightness and good color. Each container of this Sylvania quality chemical guaranteed to contain 28% total solids.

Stranded Tungsten Coils for Vacuum Metalizing. With Sylvania Tungsten Coils, you can depend on highest performance at lowest cost. These stranded coils provide a uniform deposit of metal where needed. They're sturdy too . . . reduce mechanical breakage in the loading of filaments. Sylvania Tungsten Coils also give you more shots from each filament, and the best heat for evaporation.

Tungsten Wire for Cathode Heaters. Sylvania controls and quality checks its tungsten wire production, from ore to finished product. With Sylvania Tungsten Wire, you can be sure of good retention of shape and other desirable characteristics after treating and coating.

Triple Carbonate Cathode Emission Coatings. These Sylvania coatings comply with the highest standards of purity. Made by Sylvania's improved methods, these coatings are offered in a range of exact chemical compositions and particle sizes to meet the requirements of any manufacturer.

New illustrated booklet, T C-5, gives detailed information concerning the quality and money-saving advantages of Sylvania's Tungsten and Chemical Components for TV Picture Tubes. For your file copy write to: Sylvania Electric Products Inc., Dept. 3T-3512, 1740 Broadway, N. Y. 19, N. Y.

SYLVANIA

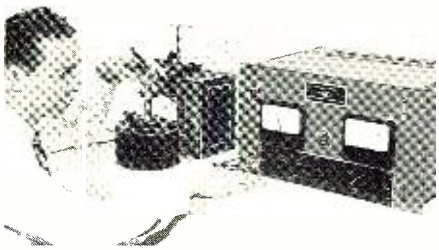
LIGHTING • RADIO • ELECTRONICS • TELEVISION

In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg., St. Catherine St., Montreal, P. Q.

NEWS BRIEFS

VIBRATION PICKUP CALIBRATOR

In recent years, the widespread use of vibration pickups for simultaneously monitoring a large number of points has introduced a serious calibration problem. To overcome deficiencies in many of the calibration techniques now in use, the National Bureau of



Standards has devised an instrument which calibrates vibration pickups and accelerometers rapidly and reliably.

The vibration-sensing element of the NBS unit is a stable noncontacting displacement transducer of the mutual-inductance type. At the left of the chassis is the transducer probe, mounted on a massive block to reduce ambient vibrations. Switch settings on the panel at the right provide measurement of four displacement ranges with full-scale readings of 0.01, 0.001, 0.0001 inches and 10 microinches, and an accuracy of 5% over a frequency range of 10 to 20,000 cps. Other switch settings permit easy, rapid standardization of the instrument.

NEW ELECTRONICS FIRM

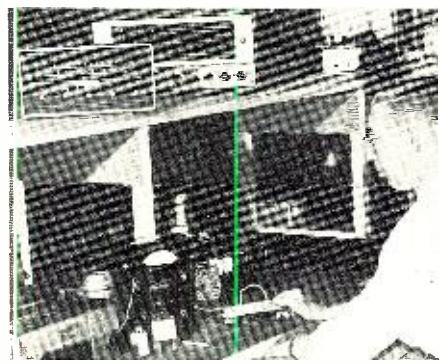
Announcement has been made of the formation of a new West Coast corporation to be devoted to research, development and manufacturing in the general field of advanced electronics and guided missiles. Known as *The Ramo-Wooldridge Corporation*, and located in Los Angeles, Calif., it will be headed by Dean E. Wooldridge as president and Simon Ramo as vice-president and executive director. Mr. Wooldridge has been vice-president in charge of research and development for *Hughes Aircraft Company* during the past two years, while Mr. Ramo recently served as vice-president for operations at the same company.

Thompson Products, Inc., manufacturer of electronic parts since 1950, will have a stock interest in the new corporation, and will be provided with consulting services by *Ramo-Wooldridge*—possibly leading to new production programs.

FLUXCOAT FOR PRINTED CIRCUITS

Through the joint efforts of *Hallicrafters Company* and the *London Chemical Company*, both of Chicago, Ill., a solution has been found to an important problem affecting the use of printed circuitry for radio and television applications—the presence of conductivity in the phenolic boards used as a base.

To fill the needs of *Hallicrafters Company*, the *London Chemical Company* has developed a fluxcoat which depends on insulating materials in its formulation for its extra activity rather than on "activation" as it is normally understood. The photograph shows the research director of *Hallicrafters Company* testing the product. When boards were coated with *Lonco*



"Fluxcote 21XR" and insulation measurements were taken after dip tinning, the boards showed readings of 50,000 megohms across their width at 350° F.

G-E APPOINTMENTS

Expansion of the *General Electric Company*'s Electronics Laboratory at Syracuse, N. Y., to triple its size has resulted in a functional reorganization and many new managerial appointments by Lloyd T. DeVore, manager of the laboratory.

Shown in the photograph, left to right are: Marlin C. Evans, manager of administration; Burton R. Lester, manager of advanced products development engineering; Walter Hausz, manager of techniques and applications development engineering; Robert N. Gillmor, manager of materials and

processes; and J. Paul Jordan, manager of components development engineering. Mr. DeVore is shown at the extreme right.

TRANSISTOR CIRCUITRY

Advances in transistor circuitry that widen the application range of transistors were outlined in a technical paper delivered by Robert M. Cohen, *RCA* transistor engineer, before the Western Electronic Convention in San Francisco's Civic Auditorium on August 20.

Mr. Cohen pointed out that the refinement of the *RCA n-p-n* junction transistor will make available to circuit engineers a long-desired device which produces output current flowing in a direction opposite to that generated by a similar but electrically opposite counterpart—in this case, the *RCA p-n-p* junction transistor. Because of this unusual characteristic, such transistors give promise of a wide variety of new circuits employing so-called "complementary symmetry" operation.

SEMICONDUCTING COMPOUNDS

Investigations by the National Bureau of Standards into the fundamental properties of semiconductors have revealed that certain intermetallic compounds show promise of extended use in solid state electronic devices. It has been found that these combinations may have equal or greater utility than the germanium and silicon semiconductors which are so difficult to manufacture.

Laboratory apparatus used by NBS to investigate the Hall effect and the conductivity of such compounds as indium antimony and aluminum antimony is shown on the cover. Data on the Hall effect and conductivity give indication of the number of charge carriers in the semiconducting compound and its charge carrier mobility.

Related phenomena, such as optical absorption spectra, photoconductivity, and rectification effects, are also under observation.

TIME PROVED

Eimac 4W20,000A gives 25 kw peak sync power output through channel 13 with only 500 watts driving power

TYPICAL OPERATION
Class-B Linear Amplifier—Television Visual Service
(Per tube, 5 mc bandwidth, 216 mc.)

Load Impedance		650 ohms
D-C Plate Voltage		7000 volts
D-C Screen Voltage		1200 volts
D-C Control-Grid Voltage		—150 volts
	Peak Sync Level	Black Level
D-C Plate Current	6	4.5 amps
D-C Screen Current	230	100 ma
D-C Grid Current	90	45 ma
Peak RF Grid Voltage	280	220 volts
Driving Power	500	300 watts
Plate Power Input	42	32 kw
Plate Dissipation	16	16.5 kw
Useful Plate Power Output	26	15.5 kw

FOR THREE YEARS THE EIMAC 4W20,000A has been proving itself an outstanding power tube in a variety of electronic applications. In VHF-TV operation it gives an easy 25 kw peak sync power output with only 500 watts driving power. This high power output with low driving power requirements is typical of Eimac radial-beam power tetrodes. Rugged 4W20,000A construction includes a ceramic envelope that minimizes losses and increases operational life. In pulse service, FM and TV operation the 4W20,000A is the only time proved tetrode in its power class.

Eimac TUBES

Information about the 4W20,000A or any of Eimac's complete line of electron power tubes can be obtained by writing our Application Engineering department.

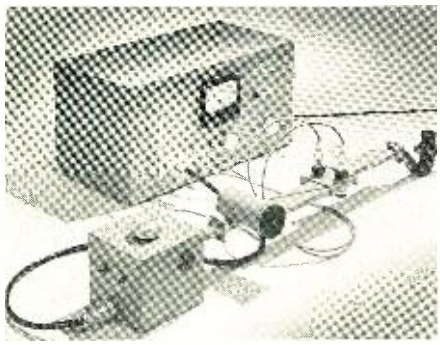
The Power for TV

EITEL-McCULLOUGH, INC., SAN BRUNO, CALIFORNIA

NEW PRODUCTS

X-BAND VSWR METER

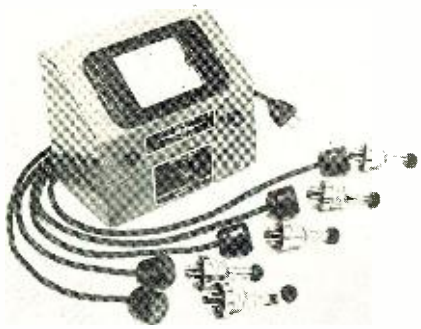
Laboratory or production line testing of wave guide components may be performed rapidly with the Model 110A *CTI* X-band VSWR indicator. Just announced by *Color Television Incorporated*, 983 E. San Carlos Avenue, San Carlos, Calif., this unit includes an oscillator, an accurate wavemeter, forward-and-reverse directional coupler, and a direct-reading ratiometer with dual scales.



Model 110A offers a number of advantages over slotted line measuring techniques. Permitting continuous coverage of a frequency band from 8500 to 9600 mc., it overcomes the difficulty of missing points inherent in point-by-point measurements. No readjustments are necessary for frequency changes, and reading is not affected by changes in r.f. power.

VACUUM GAGE

One *Hastings* vacuum gage can now monitor as many as five positions in a vacuum system. The *Hastings Instrument Company, Inc.*, of Hampton, Va., has made available a gage employing a one-knob switching unit which permits a single operator to make selective readings at any of five stations. Continuous readings may be made without changing the pressure in the system.



Because calibration is not affected by length of cable from indicator to gage tubes, this modified unit is practical for widely separated indications. Having a range of 1-1000 microns Hg, the *Hastings* gage contains noble metal thermocouples and nickel-plated gage tubes—affording freedom from system contamination and corrosion.

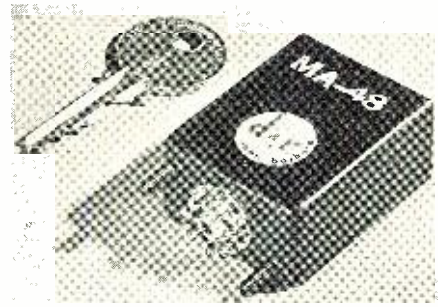
TRANSISTORIZED POWER SUPPLY

Development of a subminiature transistorized high-voltage power supply for high-voltage low-current applications has been announced by *Technical Operations Incorporated*, 6 Schouler Court, Arlington, Mass. Typical applications include use with nuclear radiation detectors, photomultiplier photometers, and infrared image converters.

Measuring only 2¾"x1¾"x1⅞", and weighing only 7½ ounces, this power supply is especially useful where small size, light weight, high d.c. energy conversion efficiency, and reliable operation over a long period are required. Battery-operated, its d.c. energy conversion efficiency ranges from 30 to 50%, depending upon the operating point and input voltage.

MAGNETIC AMPLIFIERS

Rapid response time and high power-handling capability have been attained in miniaturized lightweight magnetic amplifiers through the use of special core materials, winding techniques and mountings, coupled with high frequency a.c. power. Model MA-48, one of a line of 4000-cycle and 2000-cycle units now being manufactured by *D & R, Ltd.*, 402 E. Gutierrez Street, Santa Barbara, Calif., is shown in the photograph; it weighs only 3 ounces, yet delivers a power output conservatively rated at 25 watts.



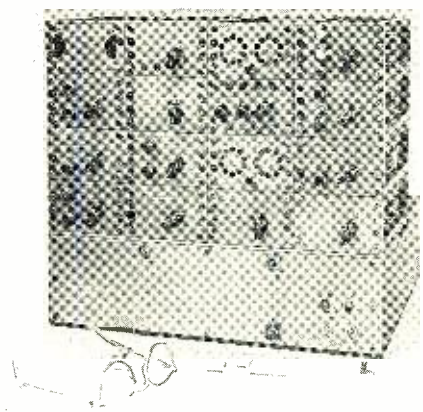
SOLID DELAY LINES

LFE solid ultrasonic delay lines utilize fused quartz as a delay medium. Frequency range specifications are 5-100 mc., and 1-3000 μsec. delay time can be provided with a high degree of accuracy. Spurious response is up to 60 db below desired signal.

Of minimum size and weight, these delay lines offer many advantages in obtaining precise delay intervals for pulse or modulated signals. They are intended for use in video integration, computers and time markers. For further information, write to Specialties Division, *Laboratory for Electronics, Inc.*, 75-4 Pitts Street, Boston 14, Mass.

DIGITAL PULSE SYSTEM

A basic electronic tool for information transmission, storage and computation has been announced by *Audio Products Corporation*. Called the "Modular System" of digital pulse units, it consists of 16 electrically and mechanically compatible "modulars" which perform all the basic functions of digital pulse operations, such as gating, pulse forming, counting, coincidence mark-



(*Continued on page* 37)

NEW LITERATURE

VARIABLE RESISTORS

Data Sheet 166, now available from *Chicago Telephone Supply Corporation*, Elkhart, Ind., illustrates and describes a new line of variable resistors designed primarily for mass production radio or TV printed circuit applications. Diagrams show how ample spacing between printed circuit terminal openings provides adequate clearance for circuit paths, and complete technical data are given.

MICROWAVE HANDBOOK

Microwave apparatus, components and accessories are described in an "Introductory Catalog and Microwave Handbook" issued by *Sightmaster of California Co.*, Gillespie Airport, Santee, Calif. Among the subjects covered are microwave calorimeters, "Sightmaster-Mold" wave guides, and "Chemalloy" welding or soldering material. A discussion of introductory microwave concepts is included.

TESTING INSTRUMENTS

Bulletin GEA-5469B, a buyer's guide of electrical testing instruments, has been announced as available from the *General Electric Company*, Schenectady 5, N. Y. This 16-page bulletin provides data on such instruments as: hook-on voltammeters, wattmeters and power-factor meters; portable recorders; voltmeters and ammeters; phase-sequence indicators; hand pyrometers; surface roughness scales; insulation-resistance meters; and others.

ECS PROCEEDINGS

The complete text of some 30 papers presented by recognized authorities in the electronics industry is contained in the proceedings of the 1953 Electronic Components Symposium which has been placed on public sale at the Los Angeles Division of Stanford Research Institute, Suite 1011, 621 South Hope Street, Los Angeles 17, Calif., at $4.50 per copy. Also included are the major addresses presented during the luncheon and dinner meetings.

POINT-CONTACT TRANSISTORS

A four-page bulletin covering two types of hermetically sealed point-contact transistors has just been released by *Texas Instruments Incorporated*. Mechanical specifications and electrical data are given for Types 102 and 103, and there is a section on the theory and application of point-contact transistors complete with formulas, equivalent circuits, and characteristic curves.

Ask for Point-Contact Transistor Bulletin No. DL-S 312, free on request from *Texas Instruments Incorporated*, 6000 Lemmon Avenue, Dallas 9, Texas.

GLASS SEALS

Various types of *Stupakoff* Kovar hermetic glass seals are detailed in a new 36-page catalog; these metal-to-glass seals are permanently bonded by chemical interaction of the oxide of Kovar fused with hard borosilicate glass. Featured in the catalog is a section which gives engineering information helpful in designing seals to meet specific applications.

Copies of Catalog No. 453 may be obtained on request from *Stupakoff Ceramic & Manufacturing Company*, Latrobe, Pa.

ELECTRICAL CONTROL COMPONENTS

Here is a complete, comprehensive catalog covering "telephone type" electrical control components for industrial use. Illustrated with scores of photographs and diagrams, it contains specifications and general data on key switches, impulsing devices, switchboard lamps, jacks and caps, and other control devices.

Copies will be supplied on request to the manufacturer: *Automatic Electric Company*, 1033 W. Van Buren Street, Chicago 7, Ill.

ENGINES

Six new sizes of compact *Caterpillar* engines are described in a booklet available from the *Caterpillar Tractor Co.*, Peoria, Ill. Entitled "More Power at Less Cost," the eight-page booklet contains 14 photographs illustrating applications of industrial and marine engines and diesel electric sets, and explains how *Caterpillar* designs these units to fit specific needs.

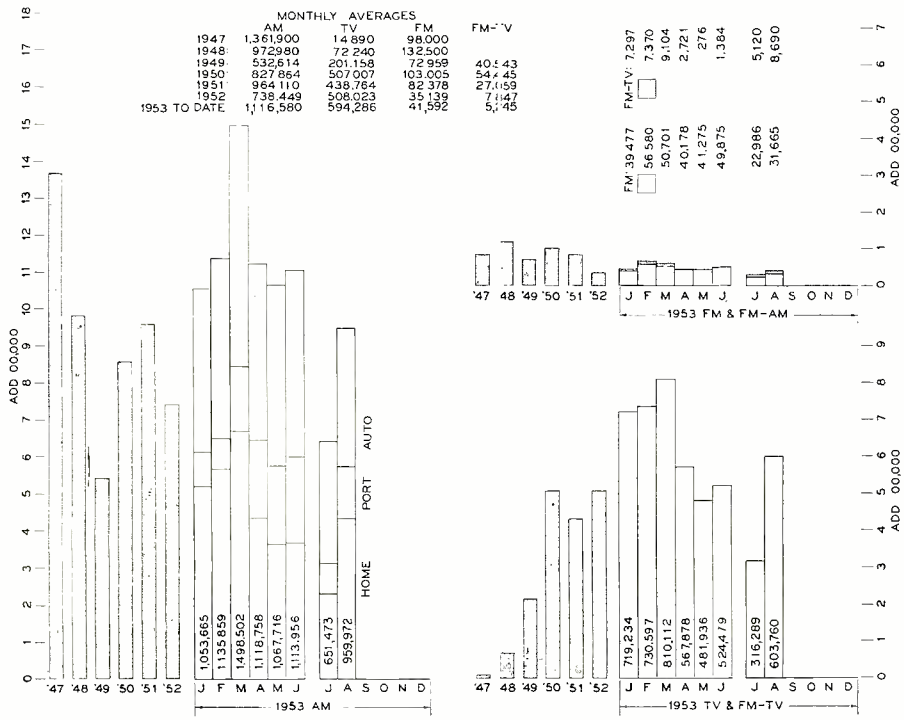
OTS PUBLICATIONS

The following two reports on research developments are available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., for 50 cents a copy:

PB 111109, "A Technique for Measuring the Effectiveness of Various Shielding Materials," Naval Research Laboratory, January, 1953, 14 pages, with charts and photographs. This is

TV-AM-FM SET PRODUCTION

Information based on latest reports from RETMA.



a report on how to determine successfully the shielding effectiveness of a given type of enclosure against high or low impedance electromagnetic fields.

PB 111131, "Stability Specification for Voltage Regulators," Naval Research Laboratory, April, 1948, 13 pages. Difficulties encountered in the operation of electrical systems due to the instability of generator voltage regulators have been studied.

RCA SUPPLIERS

"Teamwork in Industry" is the title of an attractive 32-page book which has been published by the *RCA Victor Division* of *Radio Corporation of America*, Camden, N. J. It describes in simple terms the relationship between *RCA* and its suppliers—what the relationship is, what it has accomplished, and how it works.

MAGNETS

Latest information on the uses, design, properties and manufacture of Alnico permanent magnets, cast grade 7, is available in the four-page technical report PM-112 issued by the Carboloy Department of *General Electric Company*, Detroit 22, Mich.

In addition to graphs and tables explaining magnetic and physical characteristics of the magnets, the report includes a detailed discussion of design considerations, test information, and a general comparison of cast grade 7 with other magnetic materials.

TEFLON PRODUCTS

High tensile molded rods, tubes and sheets, extruded rod, extruded tubing, electronisized rod, custom moldings, machined parts and shaved tape are some of the Teflon products discussed in a new eight-page catalog. Issued by *Ethylene Chemical Corporation*, Summit, N. J., it describes techniques for machining Teflon, and lists applications and properties.

ELECTRIC GENERATING PLANTS

D. W. Onan & Sons Inc., Minneapolis, Minn., has issued a "Blue Book" of general information concerning the selection of engine-driven electric generating plants. This pocket-sized booklet traces the history of electric plant development from early stages where storage batteries were necessary to today's modern single-unit engine-generator power plants.

Plant operation for each of the three general types of electric plants is thoroughly discussed; the three types of prime movers which furnish the mechanical power for driving the generator are reviewed in detail.

NEW TUBES

CATHODE-RAY TUBES

One of three cathode-ray tubes announced by *Vacuum Tube Products*, the VTP 5AJ is an electrostatic deflection and focus type for general oscillographic and other applications requiring relatively large screen size with a minimum over-all length. It was previously manufactured by this company under the designation 5ESP.

The VTP 7L and 16AF are electromagnetic deflection and electrostatic-focus tubes which provide high definition and intensity. The VTP 7L is a round tube, 7" in diameter, with an approximate deflection angle of 53°, while the VTP 16AF is a rectangular tube with a 16" diagonal and an approximate deflection angle of 65°. Both are available in a variety of phosphors.

Data sheets on all of these tubes may be secured from *Vacuum Tube Products*, 506 South Cleveland Street, Oceanside, Calif.

RCA TUBES

Among the latest tubes to be announced by the Tube Department of *Radio Corporation of America*, Harrison, N. J., are two "premium" medium-μ miniature twin triodes, a full-

wave rectifier, a beam power amplifier, and a series of oscillograph tubes.

Twin Triodes

Of the heater-cathode type, the RCA-5814 (left) is intended for use in mixers, oscillators, multivibrators, synchronizing amplifiers, and numerous industrial control devices. Special attention has been given to structural details to provide increased mount strength against shock and vibration.

Of the 7-pin miniature type, the RCA-6101 (right) is for use as a class A amplifier and control tube in mobile and aircraft equipment. It is constructed and processed to meet military requirements. Developed from the type 6J6, the 6101 incorporates many unique structural features.

Full-Wave Vacuum Rectifier

The RCA-12X4 is a 7-pin miniature-type tube for use in vibrator-type power supplies of automobile radio receivers operating from a 12-volt storage battery. Rated to withstand a maximum peak inverse plate voltage of 1250 volts, the 12X4 can supply a maximum peak plate current per plate of 210 ma. When operated in a full-wave circuit with capacitor input to filter, and an a.c. plate-to-plate supply voltage of 650 volts, it can deliver about 300 volts d.c. to filter at a load current of 70 ma.

Beam Power Amplifier

Small in size for its power-output capability, the RCA-6293 is a sturdy tube intended for pulse modulator service in both fixed and mobile equipment. Rated for service with duty factors up to 1.0, together with a maximum averaging time of 10,000 μsec. in any interval, the 6293 offers the equipment designer a wide choice of operating conditions.

Oscillograph Tubes

The 5ABP1, 5ABP7, and 5ABP11 constitute a new *RCA* series of 5", flat-face, cathode-ray tubes utilizing electrostatic focus, electrostatic deflection, and postdeflection acceleration. They differ one from the other only in the spectral-energy emission and persistence characteristics of their respective phosphors: P1, P7, and P11. Outstanding among the features of the 5AB types are the exceptionally high sensitivity and low capacitance of the deflecting electrodes.

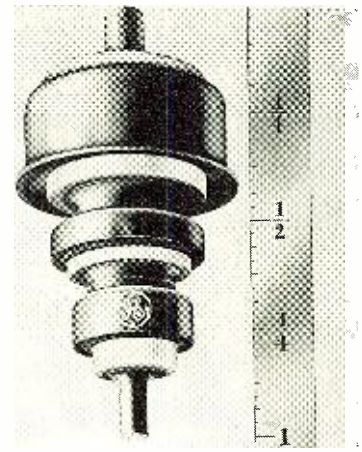
TEMPERATURE-CONTROLLED IGNITRONS

Three new types of temperature-controlled ignitron tubes for welding control have been introduced by the Tube Department of the *General Electric Company*, Schenectady, N. Y. The temperature-control feature is designed to effect cooling water savings up to 95%, as well as to protect the tubes and the welding transformer and electrodes against overloading and overheating.

Designated as GL-6346, GL-6347, and GL-6348, they are basically standard mercury-pool, stainless-steel-jacketed ignitrons, and directly replace all corresponding ignitrons in welding control operations. Type GL-6346 (Size B) is identical in ratings and characteristics to the GL-5551/FG-271, and is equivalent to a 300-ampere magnetic contactor; Type GL-6347 (Size C) is identical to the GL-5552/FG-235-A, and is equivalent to a 600-ampere magnetic contactor; and the GL-6348 (Size D) is identical to the GL-5553/FG-238-A and is equivalent to a 1200-ampere magnetic contactor.

COPLANAR TRIODE

A metal-and-ceramic receiving tube having a noise figure of 8.5 db or better



and a power gain of 16 db at 1200 mc. was displayed at the National Electronics Conference in Chicago by the *General Electric Company's* Tube Department. The GL-6299 is a coplanar triode for use as a low-level class A r.f. amplifier operating at frequencies as high as 3000 mc. One inch long and weighing one-sixth of an ounce, it is gold-plated to improve conductivity and resist corrosion.

Developed for use in lower frequency radar equipment, the GL-6299 features inherently rigid electrode construction to withstand shock and vibration, large metallic areas relative to its size for good electrical and thermal contact, and adaptability to coaxial circuitry.

CRYSTAL DIODE CHART

The Commercial Engineering Division of *National Union Radio Corporation* has prepared an interchangeability chart for germanium type diode crystals to aid service engineers and technicians in determining what diode types may be used as replacements or as substitutions in various television and electronic equipment. It is available on request from the *National Union Radio Corporation*, Hatboro, Pa.

Ultrasonics

(*Continued from page* 8)

of aluminum oxide. The solder can then wet the bare aluminum surface. Once the metal has been tinned, normal soldering methods may be employed to join two surfaces together. Elimination of fluxes during the tinning process is very advantageous.

Ultrasonic soldering irons are being used in foundries that manufacture aluminum castings for the repair of surface defects, such as scratches, cracks and pores. These can readily be covered by use of the ultrasonic soldering method, and thus casting recovery can be enhanced.

Descaling

The hammering action of cavitation can be used for the descaling of metal strips. A pilot plant is being built by the *Atlas Werke* to verify laboratory experiments which showed that pickling acid can be saved and the rate of descaling increased by factor of 5. Scale is broken away from the metal surface in small chunks and collects as sludge on the bottom of the vat, from which it is easily removed.

Drilling

Ultrasonic energy has been used successfully as a drilling tool. Soft steel, shaped to the cross section of the hole to be drilled, is brazed to the small end of a truncated metallic cone which is driven by an ultrasonic magnetostrictive transducer at 27 kc. The cone has the effect of mechanically stepping up the amplitude of vibration to about 0.001″. An abrasive, boron carbide, is washed across the face of the vibrating tool and the work piece in a liquid carrier. The ultrasonic tool delivers the high frequency motion to the abrasive, which transmits it to the work. Since the abrasive does the cutting, very hard or very abrasive materials—such as glass, ceramics, alnico, cemented tungsten carbide, and hardened dies—may be readily cut. Furthermore, since the motion of the tool is axial, odd or complicated holes may be drilled—a result which cannot be easily achieved by any other means.

It takes about two minutes to drill a hole of 32/1000″ diameter through ½″ of aluminum oxide. Commercial equipment of this kind is available from *Cavitron Equipment Corp.*, New York, N. Y., and *Raytheon Manufacturing Company*, Waltham, Massachusetts.

Dispersion

The terrific pressures released by the collapse of ultrasonic cavitation bubbles are able to break up agglomerates in a liquid vehicle and to produce very fine, uniform dispersion. Finely powdered metals like lead, iron and silver

have been dispersed in aqueous solutions. Claus[5] applied ultrasonic irradiation during electrolysis and obtained extremely fine dispersion of mercury and silver.

There are prospects for applying ultrasonics in the rayon and cellulose industry for dispersing dyes and other substances to increase waterproofness and washability of colored cloth. Recently, efforts have been made to apply ultrasonics in the paint industry. Laboratory experiments have shown that at least the same fineness and gloss can be achieved by ultrasonic paint mixing as in roll mill grinding. However, more development work is required to make these new processes economically feasible.

Extraction

Ultrasonic extraction methods have found industrial application at several large breweries in Germany. The brewing of beer is still an art and parts of the process are kept a secret, but some details have been revealed where ultrasonic processing has been established[6]. Ultrasonic treatment enables a better extraction of certain bitter contents from the hops; the efficiency is increased from 65 to 85 or 90%. This means a saving of the expensive hops of from 20 to 30%.

Cleaning

Another field of industrial application is ultrasonic cleaning. The removal of dust particles which stick to small metal or glass parts by adhesion or because of thin oil or grease films can be quite a problem. Sometimes careful cleaning of each part by hand is necessary. In this case, ultrasonic cleaning can be more economical. The parts are subjected to high intensity ultrasonic irradiation in the cleaning liquid, and the explosive forces of cavitation lift the adhering foreign particles from the surface. Several installations of ultrasonic cleaning of small parts have been established in industry and work very satisfactorily. Examples are the cleaning of lapping compound and metal chips from electric razor heads, the removal of foreign particles from quartz crystals and from optical glass, and the cleaning of small ball bearings.

In Germany, the accumulation of precipitates on the glass parts of production equipment caused frequent stoppages for removal. By irradiating these parts with ultrasound, such accumulation has been eliminated and operation is continuous.

MAGNETIZER FOR PERMANENT MAGNETS

THE MAGNETIZER for permanent magnets that has recently been constructed at the National Bureau of Standards is unusually compact, portable, and low in cost. Devised by George M. Orr, of the NBS Electromechanical Ordnance Laboratories, this magnetizer requires only a few simple and relatively inexpensive parts and weighs only 21 pounds. It normally operates from 110 volts, a.c., drawing only about 30 watts yet giving peak magnetomotive forces as high as 20,000 ampere-turns.

Two methods are in general use at present for "charging" (magnetizing) permanent magnets. In one of these, a current pulse of the order of 50,000 amperes and having a duration of a few microseconds is passed through a single turn of heavy copper strap that circles the magnet. Equipment for this pulse method is relatively expensive, often bulky, and not always satisfactory. In another method, often used when 110-volt d.c. power is available, a coil of several thousand turns wound on a soft-iron yoke is connected across the line for a few seconds; the permanent magnet to be charged is placed between the pole pieces of the iron yoke. With the latter method, disconnection of the highly inductive load may present a problem, and flux density is limited by magnetic saturation of the iron yoke and by heating of the coil.

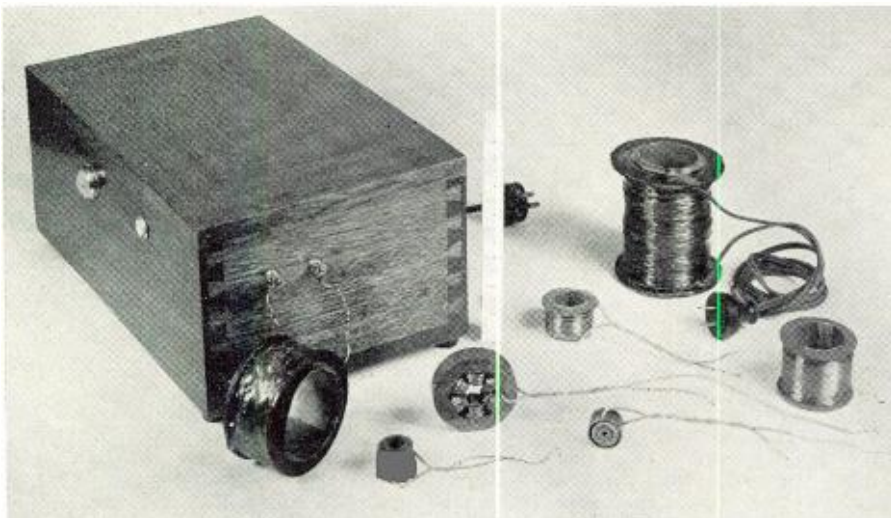
The Bureau's device is a form of "flash" magnetizer in which a large capacitor is quickly discharged through the magnetizing coil. Although flash-magnetizing may not be fully effective for large magnets (the short duration of the magnetizing pulse does not always permit the magnetizing flux to reach full value below the surface of the magnet), it is often quite satisfactory for smaller ones.

In the newly constructed unit, a 6500-μfd. capacitor bank is charged to about 125 volts by selenium rectification of the a.c. line voltage. Energy stored in the capacitor is transferred to the magnetizing coil by a heavy-duty 24-volt 70-ampere motor-starting relay. The relay coil is actuated by a push-button switch. Since the relay gets its operating power from the capacitor bank, it opens shortly before the capacitor voltage has fallen to zero. Because the relay contacts open at a time when the current through them is low, high current-interrupting capability is not required.

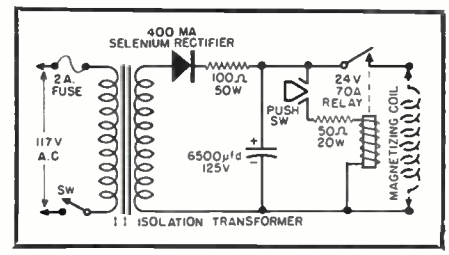
The unit was built at a total cost of less than $50, using mostly war surplus parts. Capacitors rated at 650 μfd., 80 volts, d.c., were obtained; after a forming period, they operated satisfactorily at 125 volts. Power consumption varies between 70 watts (capacitor discharged) and 10 watts (capacitor charged); at the normal rate of magnet charging—one pulse every 15 seconds—the average line power drain is no more than 30 watts. Because of this low power requirement, the unit could easily be designed to operate from batteries for portable use.

Several magnetizing coils have been constructed for the magnetizer, of designs that varied with the shape of the object to be magnetized. Although iron yokes are necessary for multipolar or radial magnetizing, simple layer-wound solenoids have been found quite satisfactory for general use. Optimum coils have from 150 to 200 turns, a d.c. resistance in the range of 0.3 to 1.0 ohm, and an inside diameter no larger than necessary to accommodate the magnet to be charged. In typical operation with such a coil, the peak current has an amplitude of the order of 150 amperes and a duration of roughly 2 milliseconds.

Inside the box are the isolation transformer, selenium rectifier, capacitor bank and relay. Magnetizing coils are shown in front of the box.



Circuit diagram of the simple, portable and economical NBS magnetizer.



Ultrasonic cleaning machines have also been developed in this country. *General Electric Company*, for example, has installed an ultrasonic quartz unit for cleaning Schick electric razor heads. And quite recently another ultrasonic cleaning instrument for industrial use was developed by the *Detrex Corporation*, Detroit, Michigan. This latter fully conveyorized unit is the largest piece of commercial ultrasonic cleaning equipment ever built. It employs *Brush* ceramic trough transducers. Illustrations of the new equipment, which has been installed at *Remington Rand* Electric Shaver Division, Bridgeport, Conn., have been made available through the courtesy of the *Detrex Corporation*. Figure 5 shows the cleaning process schematically. Baskets carrying 50 shaver heads each pass over the ceramic transducers. These focus high intensity ultrasonic waves onto the work and thoroughly clean it. Figure 1 is a picture of the ultrasonic cleaning unit, Fig. 6 shows the feed-in portion, and Fig. 7 shows electric razor heads before and after cleaning. Figure 8 is a side view of a transducer in action. Millions of gas bubbles caused by strong cavitation give a picture of the high frequency sound field.

Summary

There are two fields of activity for ultrasonics in industry: (1) low power applications, and (2) high power applications. In the first field, ultrasonics is used for measuring fluid flow, viscosity, thickness, displacement, or soundness. The material is not changed; cavitation is detrimental. There is a great variety of possible applications, and steady progress is being made.

In high power applications, ultrasonic energy is used to bring about material change of the work. Cavitation occurring at high sound intensities appears essential. Real progress in this field has been made only recently, with the advent of a transducer capable of radiating large amounts of energy and of such shape that continuous processing is practical.

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4. *Weissler, A., "Sono Chemistry: The Production of Chemical Changes with Sound Waves," Acoust. Soc. Am., Vol.* 25, *July*, 1953, *pp.* 651-657.
5. *Claus, B., "Uber Eine Neue Methode zur Erzeugung Hochdisperser Zustande," Z. Techn. Phys., Vol.* 16, 1935, *p.* 80.
6. *Specht, W., "Bitterstoffextraktion durch Ultraschall, Ein Verfahren zur Rationellen Hopfung des Bieres," Brauereiwelt H.* 40. *Oct.* 4, 1951, *p.* 902-908.

Personals

MAURICE L. ALEXANDER has been appointed plant manager of the Batavia, Ill., tube plant of *Avco Manufacturing Corporation's* Appliance and Electronics Division. With the *Crosley* Division since 1951 as assistant production manager and manager for television and radio, Mr. Alexander has been serving as acting plant manager for some time. For six years prior to joining *Crosley*, he was an executive in engineering for *Capehart-Farnsworth*.

DR. GEORGE T. CROFT, who received his Ph. D. at the University of Pennsylvania earlier this year, has now joined the physics research group of the *Edison Laboratory* of *Thomas A. Edison, Inc.*, West Orange, N. J.; his principal interest will be research in fundamental solid state physics as concerned with semiconducting materials. Dr. Croft has done some development work at the Naval Research Laboratory and at the Frankford Arsenal.

DR. WILLIAM L. EVERITT, renowned radio authority, will receive the highest technical award of the radio engineering profession—the Institute of Radio Engineers' Medal of Honor for 1954. An author of textbooks and scientific articles in the radio field, Dr. Everitt has had a distinguished career as engineer, educator, and consultant. He has been serving as Dean of the College of Engineering, University of Illinois, since 1949.

DR. GEORGE CHENEY NEWTON, JR., Associate Director of the Servomechanism Laboratory, M.I.T., has been awarded the Louis E. Levy Medal by The Franklin Institute of the State of Pennsylvania for his outstanding paper "Compensation of Feedback-Control Systems." Dr. Newton, who received his Sc. D. degree in electrical engineering in 1950, has been with M.I.T. since 1946 as instructor, assistant professor, and—as of 1952—associate professor.

EDWARD W. STONE comes to his new assignment as sales engineering district manager for the *Standard Electronics Corporation*, Newark, N. J., after serving for seven years in the Atlanta office of the *Graybar Electric Company* as district manager of electronics sales. Active in the broadcasting and electronics fields since 1932, Mr. Stone has also held positions with *Maguire Industries, Fairchild Aircraft*, and the *Columbia Broadcasting System*.

WALTER V. TYMINSKI, as commercial product design engineer for *Industrial Television, Inc.*, 369 Lexington Avenue, Clifton, N. J., will be in charge of *ITI*'s expanding line of television products sold through the parts jobber. Prior to his present appointment, Mr. Tyminski was connected with the Research Division of the *Allen B. Du Mont Laboratories*, where he was engaged in the study of a.g.c. systems, u.h.f. receivers, tuners and converters.

Modular Design

(*Continued from page* 13)

vibratory feeders issue the wafers to a loading device that holds the wafers in an upright position between specially designed jaws. A chain drive carries the jig to a soldering position at which six riser wires are guided into appropriate notches, three on a side.

Automatic Inspection

During each stage in the mechanized production, provision is made for 100% automatic inspection. This is both a physical gaging and an electrical comparison. Printed circuits, resistors, and capacitors are compared with their electronic equivalents both before and after assembly. This is accomplished by use of electronic computers, bridge circuits, and other comparison devices. The inspection "code" is contained on the punched cards.

Final Assembly

The final assembly operation need not necessarily be considered a part of MPE. Normally, a set of modules (as many as ten) is mounted on or between copper-clad base plates. Circuits have been etched into the copper surface and connect the riser wires of the several modules to form a complete electronic circuit. Several such plate assemblies form a complete unit. One base plate with six modules, for instance, contains all the necessary circuits to make a six-tube radio receiver function properly.

Acknowledgments

Basic conception and development—as well as early background research—were contributed by the National Bureau of Standards, including solution of new process and materials handling problems, design of the pilot plant and much of its equipment, and technical direction of all phases of the program. While some of the plant machines were designed and contructed by NBS, the major part of the design and construction of the production equipment was done by the *Kaiser Electronics Division* of *Willys Motor Company*. Some special machines were designed and built by the *Doughnut Corp. of America* (Ellicott City, Md.). Specially designed automatic production test equipment was obtained principally from *Communication Measurements Laboratory, Inc.* (of Plainfield, N.J.), and major engineering applications to equipment were made by *Sanders Associates, Inc.* (of Nashua, N.H.)—including environmental studies of MDE units. The *Davies Laboratories* (Riverdale, Md.) and the Navy Post Graduate School (Monterey, Calif.) also rendered assistance in some phases of the work.

TECHNICAL BOOKS

"MICROWAVE THEORY AND TECHNIQUES" by Herbert J. Reich, Philip F. Ordung, Herbert L. Krauss and John G. Skalnik. Published by *D. Van Nostrand Company, Inc.*, 250 Fourth Ave., New York 3, N. Y. 901 pages. $12.50.

While this book is intended primarily as a textbook for a senior or graduate course in microwaves, it may also be useful to research workers and practicing engineers as a reference book. Chapters have been included on the theory of static and dynamic electromagnetic fields, a knowledge of which is essential to the analysis of wave guides and traveling-wave tubes; and emphasis has been placed upon the physical principles underlying the operation of microwave amplifiers and oscillators, since these principles may be helpful in suggesting new microwave devices.

Other subjects covered are transmission lines, impedance matching and baluns, wave guide and coaxial line components, antennas, measurements, microwave resonators, klystrons, magnetrons, and double-beam tubes. Most of the chapters contain problems that help to emphasize fundamental principles, and standard symbols have been used whenever possible.

"ULTRA HIGH FREQUENCY PROPAGATION" by Henry R. Reed, Ph. D., and Carl M. Russell, M. S. Published by *John Wiley & Sons, Inc.*, 440 Fourth Avenue, New York 16, N. Y. 562 pages. $9.50.

An outgrowth of intensive experimental research carried on at the U. S. Naval Air Test Center, this book makes available to the general field of electrical engineering the most recent information on new developments in u.h.f. radio wave propagation—the most important single parameter of a u.h.f. communications system. It also reviews all related system parameters, emphasizing the system concept which considers the effect produced on the entire system by a variation of any one of its parts.

Through presentation of theory and illustrative examples, this book shows how to determine operational ranges when using u.h.f. communications systems; much material is devoted to dynamic system performance characteristics. As very little information on air-to-air and air-to-ground u.h.f. propagation has heretofore been published in usable form, the authors have attempted to include all such information as is presently available.

By **WILFRID B. WHALLEY**
Adjunct Professor of Electrical Engineering
Brooklyn Polytechnic Institute

A brief history of the development of phototubes.

PHOTOTUBES have been under continuous development during the past 30 years. Their first important uses were in television and facsimile transmission. Now, a vast number of industrial processes—ranging from material-sorting to registration control of multicolor printing presses—depend upon various types of phototubes. Control of many precise mechanical operations would not be possible without the use of phototubes, and almost all experimental work in color television depends upon phototubes associated with flying-spot cathode-ray tube scanners.

Transfer devices from light energy to electron flow make use of the photovoltaic effect, photoconductivity, or photoelectron emission. Photovoltaic cells made with cuprous oxide on copper or iron selenide on iron, for example, each covered with a thin film of silver, provide sensitive pickup devices for photographic light measurement. Other cells which use metallic selenides or sulphides increase in conductivity with light. However, both the photovoltaic and photoconductive devices have the basic disadvantage of slow operation.

By far the most important is the emission of electrons from the surface of certain metals under bombardment by light. The time delay of emission has been found to be less than 3×10^{-8} μsec. Hence, there is no practical limit to the speed of operation. Also, the emission of electrons from a surface makes it possible to use special methods of current multiplication which are not feasible with the photovoltaic and photoconductive devices.

Early Types

After preliminary measurements of electron emission from the common metals such as copper and iron, with the ultraviolet light from a spark discharge, many experiments were undertaken to obtain sensitivity to visible light. It was found that amalgams of potassium and sodium would produce useful electron currents from blue light; amalgams were used because of the chemical activity of the alkali metals when exposed to air. Then a process was devised for obtaining films of potassium. Potassium was first refined at suitable temperatures in a vacuum, the container cooled in liquid air and then sealed into the exhaust system employed in evacuating phototubes.

The first phototubes were made of spherical soft glass bulbs, with a metal rod—usually of nickel—placed at the center. After evacuation and heat treatment, potassium vapor was allowed to condense on the inner surface. Hydrogen gas was introduced and a glow discharge was produced from a spark coil, which formed potassium hydride on the inner surface. After removing the hydrogen, the bulb was filled with argon at a low pressure. It was necessary that the gas remaining in the cell be inert to avoid possible interaction with the potassium. By heating a portion of the glass with a soft flame, part of the film was removed, forming a window.

In operation, a d.c. voltage of about 90 volts was applied through an external resistor, between the nickel rod and the bulb coating. As light was focused through the window, it released electrons from the potassium hydride. The electrons were accelerated toward the center rod, ionizing some of the gas molecules and causing an increased current—due to ionization—of from seven to ten times. Some of these early tubes had currents as high as 2 μamp. While relatively simple in construction, these tubes were limited in frequency response by the rate of ionization and deionization of the gas. The speed was satisfactory for early facsimile transmission.

An improved vacuum tube having greater sensitivity in the red region used cesium. A metal ring, to which small pieces of magnesium ribbon were welded and which was then painted with a thin coating of cesium trinitride, was supported in the center of the spherical bulb. After the usual processing, the ring was heated by a high frequency field, thereby evaporating the magnesium and decomposing the trinitride. The magnesium formed a deposit on the inside of the bulb, and also combined chemically with the nitrogen. Through careful control of the temperature of the ring, the cesium could be evaporated to form a critically thin inner coating on the surface of the magnesium.

Further work led to phototubes of cylindrical shape having a half cylinder of metal coated with a sensitive film. The anode was again a thin rod placed at the center of the half cylinder.

Careful measurements made with various phototubes revealed that the number of electrons emitted per second was directly proportional to the intensity of the light. Also, the rate of emission varied with the frequency of the light, and with the surface material. Ordinary metals were insensitive to visible light, and therefore were only used for ultraviolet measurements. It was shown that the frequency of maximum emission decreased with surface films having lower work functions.

Rare earth metals have low work functions, and cesium has the lowest. The most sensitive surface condition is obtained when the active material is deposited as a film one atom thick, and on top of suitable oxides of other metals. The combination of atomic layers of cesium, silver and cesium oxide on a silver base is particularly good.

Photomultipliers

Single-unit phototubes using cesium-activated surfaces still require high light levels. It was early discovered that electrons moving above a critical velocity could, upon striking a certain type of surface, release one or more secondary electrons. By suitable choice of surface and velocity, several secondary electrons could be released for each photoelectron.

The first multiplier type tubes contained a series of wire mesh grids at increasingly positive voltages; as the electrons struck the treated wires, secondary electrons were emitted and accelerated to the next screen. Another design contained a series of slotted metal plates having the appearance of small venetian blinds. One disadvantage of both types was that a proportion of the electrons passed through the screens, and therefore missed some of the stages of multiplication. Such operation affected the signal output waveform, since the final collector current was made up of electrons having different passage times through the multiplier.

Most valuable of the multiplier tubes is the focused electrostatic photomultiplier. In this type, the successive electrodes have the shape of a modified cylinder, with each one overlapping the next, and so positioned that all of the secondary electrons emitted from the convex side of one cylinder will be collected by the next. The shape of each section is carefully chosen to give the same path time for each secondary electron, providing as closely as possible the same time delay for all electron paths through the multiplier. This focusing of electrons affords the maximum efficiency known, and also the highest frequency

response. Very high frequency response may not be as important for photomultipliers as for r.f. secondary electron multiplier tubes. Yet it is necessary for photomultiplier tubes used with flying spot scanners to operate up to 8 mc. A typical present-day photomultiplier is the 1P21; operating with 100 volts per stage; the nine stages provide a sensitivity of 40 μamp./lumen, with a gain of two million.

In present photomultipliers, the active materials are introduced by small pellets which contain cesium dichromate and a reducing element—either silicon or aluminum and tantalum. When the completed tube has been evacuated and heat-treated, each pellet is heated by radio frequency to vaporize the cesium. Fortunately, the same surface films which furnish maximum sensitivity for light in general provide high secondary emission ratios. Cesium oxide silver films give secondary emission ratios of 6 to 8 at 140 volts.

Color TV Phototubes

Phototubes, which first made television possible, may soon be providing all television film reproduction, both monochrome and color. As discussed in earlier articles, motion picture film reproduction is not entirely satisfactory with television pickup tubes. To increase resolution and contrast, and reduce the undesired signals such as in "shading," several scanning methods using high voltage cathode-ray tubes and one or more phototubes have been developed.

Three of the experimental methods for flying-spot scanning of color film, respectively, employ: (1) rapid pull-down of the film in a time less than the vertical blanking period of the television system, and a stationary raster on the face of the cathode-ray tube, (2) continuous motion of the film, while the light from the cathode-ray tube passes through a group of rotating prisms to the phototubes, and (3) movement of the film at a steady speed, while the raster on the face of the cathode-ray tube moves progressively down and then back. By the addition of other voltages to the vertical deflection, the latter method compensates for the motion of the film and also for the necessary change in frame rate from the usual motion picture rate of 24.

Editor's Note: The above article completes the series on "Looking at Tubes" which has been running regularly since August, 1952, and has presented historical and practical information on vacuum tubes. This department, or a similar one, will be resumed when it is felt that there is a further need for such material.

Telemetry Separator

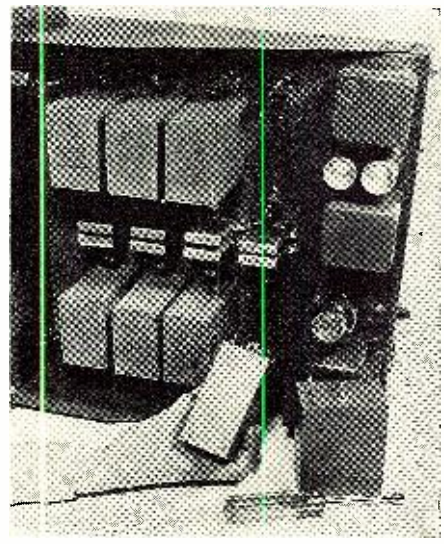
(*Continued from page* 15)

used, it is a simple process to remove and plug in different filters instead of obtaining additional units.

The versatility of the basic design permits wide application when the separator is integrated into present telemetry stations, and also when it is used as an instrument to work with some of the very recently marketed printers. With the separation of frequencies immediately following the receiver, it is felt that better signal-to-noise ratios and less roll-off of the higher frequencies will be experienced. These improvements will result from the transmission of frequencies at higher levels over low impedance lines which are properly matched and terminated, and from the fact that considerably less cable footage is needed directly at the receiver output stage. Direct-reading, printed readouts for electronic counters are now becoming available; this automatic means of permanently recording sequential counted information in numerical form will permit the preliminary setup and calibration of many of the airborne missile channels simultaneously. The innovations discussed above call for the simultaneous output of each channel of the "signal separator." Since all the circuitry is already provided, it will only require the slight modification of adding additional output receptacles on the rear of the chassis.

Acknowledgment is made to M/Sgt. D. C. Taylor and S/Sgt. J. R. Servais for their assistance in the design, development, and compilation of technical material on the channel separator.

Illustration of the simple plug-in feature which permits this unit to be adapted to any eight of the 16 RDB approved channels.



Electromechanical Filters

(*Continued from page* 11)

The impedance of the coupling wires, Z_2, can be determined as the product of their cross-sectional area, density, and velocity of propagation. Therefore, assuming that both wires are the same:

$$Z_2 = 2\,\frac{\pi\, d^2}{4}\,(E_2\,\rho_2)^{1/2}. \quad . \quad . \quad . \quad (14)$$

where d is the diameter of a wire, E_2 is the elastic modulus of the wire, and ρ_2 is the density of the wire. The impedance, Z_1, of the plates can be determined in a similar manner, except that the difference in velocity, $\delta u/\delta t$, at various points along the height of the plate must be taken into account. From (6):

$$Z_1 = \frac{b\ t\ (E_1\,\rho_1)^{1/2}}{\cos\left[(l_1\ b)\,\frac{y}{b}\right] + \frac{V_2}{V_1}\cos\left[(l_2\ b)\,\frac{y}{b}\right]} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

where t is the thickness of the plate, E_1 and ρ_1 refer to the plate, and $\pm\ y/b$ are the points where the wires are attached. Computing the bandwidth from Eqt. (5):

$$\frac{f_2 - f_1}{f_1} = \frac{d^2}{b\ t}\left\{\cos\left[(l_1\ b)\,\frac{y}{b}\right] + \frac{V_2}{V_1}\cos\left[(l_2\ b)\,\frac{y}{b}\right]\right\}\left\{\frac{E_2\,\rho_2}{E_1\,\rho_1}\right\} \quad . \quad (16)$$

Figure 8 shows a curve of bandwidth, computed from Eqt. (16), for a value of $f_1 = 455$ kc. at various symmetrical positions of the coupling wires along the height of the plate, together with some measured observations. The departure of the experimental points from the calculated curve near $(y/b) = 0$ and $(y/b) = \pm\ 0.5$ is due to inaccuracies in construction near these points. Therefore, if it is desired to change the bandwidth of a filter, three options are available: (1) change the plate size or material; (2) change the wire size or material; and (3) change the positions at which the wires attach to the plates.

In summary, the plate resonant frequency and impedance are determined by its three dimensions, the material used, and the location of the wires to be attached. The analogous circuit of the wires is determined by their diameter and length, and by the material used. The half impedance sections at the ends of the filter, as shown in Fig. 2B, are the

Table 1. Calculated and measured frequencies of 0.005"-thick nickel plate.

"b" Plate Height (in.)	"L" Plate Length (in.)	Frequency (kc.)	
		Calculated	Measured
0.388	0.222	462.0	462.0
0.347	0.222	466.1	465.0
0.265	0.222	478.0	477.5
0.222	0.222	497.9	497.0
0.250	0.200	382.0 527.0	381.7 525.5

electromechanical transducer plates, the sizes of which are adjusted to have the proper impedance levels. It should be noted that the different material of these end plates must be considered in making this adjustment. The terminating resistors at the ends of the filter consist of losses due to the Q of the end plates, and of reflected resistance through the electromechanical transducers.

Fabrication and Assembly

In fabricating plates for use in these filters, extreme precision must be maintained, especially in the dimensions which determine the resonant frequency. The plates are made from standard cold-rolled sheet stock, and strips the width of the plates are first cut from the sheets in a precision shear. The strips are then cut into plates in a micrometer shear; this second shear cuts the plates to within one-ten-thousandth of an inch—a desirable accuracy since this cut determines the length of the plate, which is the main frequency-determining dimension. Plates cut in these shears fall within about ± 50 cycles of the desired frequency. The cut plates are then heat-treated, in a reducing atmosphere, as desired.

Wires are attached to the plates by a spot-welding technique. Shown on the right of Fig. 1 is the laboratory equipment which positions and holds each plate. The two wires are then positioned at the proper places on the plate, with a slight overlap, and are spotwelded to the plate at the same time. They are then cut to the proper length, and the plate is removed. The jig to the left in Fig. 1 is used to position the several plates and to weld the other ends of the wires to the next plate. When quartz driving plates are used, a cold soldering technique is used to join the coupling wires to the quartz. The adhesive used consists of a thermosetting ethoxylene resin mixed with asbestos fiber powder.

The complete plate and wire unit is assembled in a holder, as shown in Fig. 3. To minimize friction, the plates rest on a smooth, fiberglass surface. The coils and permanent magnets, shown at both ends of the filter, drive the nickel end plates, with the permanent magnets furnishing the magnetic bias necessary with magnetostrictive drive, and the coils providing the alternating magnetic field. If piezoelectric drive is used, no bias is necessary, and an electric field replaces the magnetic field. The piezoelectric plates used consist of $-18\frac{1}{2}°$ X-cuts [(x,y,t)—$18\frac{1}{2}°$ in standard IRE notation] with plating on the X faces. No conductive connection is made between the plating and the mechanical coupling wires. Provision is made to seal the entire filter hermetically in an inert gas which has been carefully dried.

Operating Results

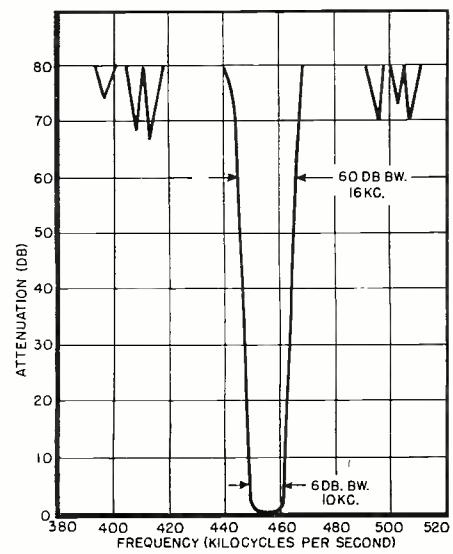
An attenuation curve of the completed filter is shown in Fig. 9. As can be noted, the 6-db bandwidth is 10 kc. and the 60-db bandwidth is 16 kc., giving a rejection slope of 18 db per kc. A still greater rejection slope could be obtained with more midplates. All spurious responses are higher than 68 db, and the closest responses are 43 kc. from center frequency, where they usually will be of no consequence. Other bandwidths are easily obtained in filters of this type by changing the plate or the wire sizes. Only minor changes in characteristic are noted with change in temperature. The theoretical analogous section, previously shown in Fig. 2A, is a nonsymmetrical one and has a steeper attenuation above the passband than below it. This is slightly in evidence between 70 and 80 db on the experimental curve.

Insertion loss of the filter runs from about 8 to 15 db, depending on the type of transducer (17 db is the approximate insertion loss of an electrical inductance-capacitance filter of comparable bandwidth). Characteristic impedance of the filter with magnetostrictive drive is about 1500 ohms; with the piezoelectric converters, it is about 100,000 ohms. The insertion loss with magnetostrictive drive might be reduced somewhat through the use of a material having lower eddy current loss and higher Q for the transducer elements. One possible material for this use would be nickel ferrite[11], but investigation of this material has not been completed as yet. Other materials will undoubtedly be investigated in the near future.

Several experimental units, similar to the one shown, have been in operation in the field in *Motorola* communication equipment for over two and a half years. Units with a 10-kc. bandwidth are particularly suitable for split-channel operation in the mobile two-way FM communication bands, thereby making possible more communication channels and a consequent definite frequency spectrum conservation.

The author wishes to acknowledge the help received from members of the Advanced Circuit Engineering Department of the Communications and Electronics Division of *Motorola, Inc.*, and

Fig. 9. Bandpass characteristics of seven-plate electromechanical filter.



in particular to Mr. B. Niederman, head of this department.

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New Products

(*Continued from page* 22)

ing, etc., as well as simpler electronic tasks like amplification, signal inversion, and impedance matching.

Since each unit performs a multiplicity of independent functions selectively, a complete system consisting of 16 modular units and a regulated power supply has a capability of 72 separate functions, with as many as 31 functions simultaneously available. Simple digital instruments, such as events-per-unit-time meters, time-interval meters, complex high-speed electronic switches, and stylized pulse generators, can be quickly patched up by using the "Modular System."

For additional information, write to *Audio Products Corporation,* 2265 Westwood Boulevard, Los Angeles 64, Calif.

DUAL-HEAD WINDER

British Industries Corporation has added a new AVO coil-winding machine to the more than 30 models already available in the United States. The AVO "Douglas" and "Macadie" dual-head coil winders are designed for the winding of coils when the setup time is long compared to the actual winding time. While one coil is being wound, the other can be finished and replaced by a new bobbin ready to start another coil.

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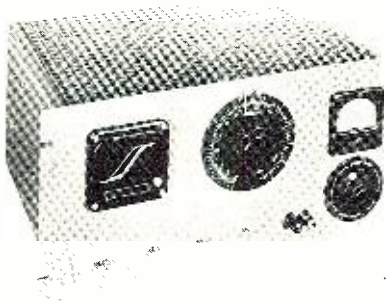
to *British Industries Corporation*, Dept. REE, 164 Duane Street, New York 13, N. Y.

INDUCTANCE BRIDGE

Completely self-contained, the *Waters* Type 1002-A incremental inductance bridge is a small, compact instrument which obsoletes the complicated test



equipment assemblies formerly required to measure inductance of iron-cored inductors when a d.c. component of current is present. No accessories are needed; the instrument is ready for operation as soon as it is connected to the power line.

Values obtainable with the Type 1002-A range from 1 to 200 henrys, at ± 3% accuracy. To operate the unit, adjustment of only one balance control is necessary; d.c. current values of 1 to 500 ma. can be selected by the operator. Write to *Waters Manufacturing, Inc.*, 4 Gordon Street, Waltham 54, Mass., for a catalog giving complete information on this inductance bridge.

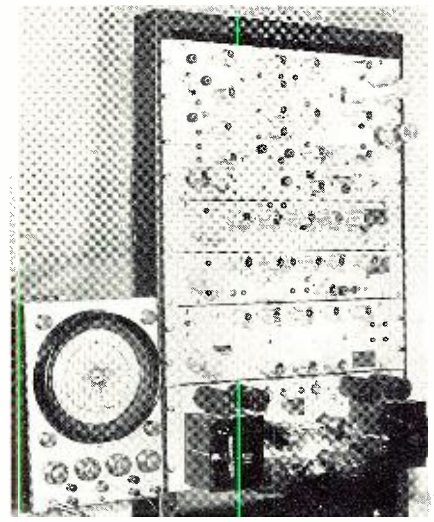
DIRECTIONAL COUPLERS

Wideband directional couplers for power, impedance or match measurements between 30 and 1500 mc. are being offered in four different models by *Sierra Electronic Corporation*. Model 137, for use with 51.5-ohm coaxial line, incorporates a coupling factor of 70 to 85 db and full-range directivity better than 46 db. Model 138, of similar design, provides a coupling factor of 59 to 24 db. Models 137A and 138A are designed for use with 50-ohm cable. All are built in solid, anodized duraluminum blocks with Type N fittings.

The broad power and frequency range of these couplers permit their use in a wide variety of laboratory measuring problems. Because the units are small in size, inexpensive, and ruggedly constructed, they are also practical as components in v.h.f.-u.h.f. transmitters. Bulletin 104 describing the couplers and their applications may be secured from *Sierra Electronic Corporation*, 1050 Brittan Avenue, San Carlos, Calif.

COLOR "CHROMASCOPE"

Use of the *Telechrome* Model 1601-AR "Chromascope" (NTSC signal certification and monitoring equipment)



greatly facilitates alignment of encoders, transmitters, and checking of phase errors in color signals. Designed by *Telechrome, Inc.*, 88 Merrick Road, Amityville, L. I., N. Y., for receiver manufacturers, TV broadcasters, and research laboratories, the equipment is self-standardizing and self-checking by means of a built-in quadrature checker.

Operating from a composite NTSC signal, presentation is in the form of an instantaneous vector plot of the colors and their amplitudes. The display is on a 7" cathode-ray tube which has a transparent overlay calibrated in degrees and amplitude.

Automatic Production

(*Continued from page* 18)

anized production may affect the design and fabrication of a multilayer transformer coil design is shown by Fig. 6. Coils for this transformer are etched in the form of spirals and then folded, as shown by Fig. 5, to form the multilayer coil.

One outstanding advantage of fabricating the circuit elements as part of the assembly process is the possibility of adjusting the values of these elements during the various stages of fabrication of the circuit assembly. Resistive films may be adjusted by abrading or rubbing the surface of the resistive element deposited. Another method of changing the resistive value is by changing the aspect ratio or the ratio of length to width of the element.

Figure 10 shows some of the methods being used for making adjustments. One method used in production is that of indenting along one dimension by sand blasting; the adjustment is made by automatic machinery consisting of a sand-blasting nozzle controlled by a resistance bridge. Another method used is that of increasing the length of the path by zigzagging across the surface of the element. Figure 10 also illustrates two methods used to adjust capacitive elements; the first consists of removing a portion of the conductive pattern, thus reducing the area of the conductor (top, center), while the second consists of slicing the capacitor (bottom, center).

Integration of materials processing, mechanical and thermal design, and component and circuitry application required in mechanized fabrication today has initiated a trend which is gradually removing the distinction between many component manufacturers and equipment assemblers. This is a natural consequence since the closest working har-

CALENDAR of Coming Events

DECEMBER 8-10—AIEE-IRE-ACM Joint Computer Conference and Exhibition, Statler Hotel, Washington, D. C.

FEBRUARY 4-6, 1954—Sixth Southwestern Conference and Electronics Show, Tulsa, Okla.

MARCH 22-25, 1954—Radio Engineering Show and IRE National Convention, Kingsbridge Armory and Waldorf-Astoria Hotel, New York, N. Y.

mony between component and equipment design groups is necessary during this period when concepts regarding equipment construction are being so drastically revised. Even during the interim period, when components are merely being modified for mechanized installation, the correct specification of such characteristics of the components as form factor, protective coating, and thermal rating can hardly proceed without references to certain standards in the practice of assembly and use of these components.

Processing raw materials to form the circuit elements integral with the packaged functional assemblies will open up many new uses of materials and make radical changes in characteristics such as stability and thermal ratings of the elements. In addition, the form factor will be changed beyond recognition. At present it has been estimated that 50% of all components used in an electronic assembly can be fabricated in situs. As more experience is gained in production techniques, the precision electronic components will also be fabricated as part of the package assembly process.

The trend toward mechanization in electronic assembly is gathering momentum. The equipment designer and the processing engineer working together as a team can develop functional packages resulting from a close integration of materials, processing techniques and mechanized assembly operations. Although complete automatization of fabrication is a possibility for the future, a great step forward in mechanization is practical today if industry gives thought to applying the technology now available.

Acknowledgment

The authors are indebted to all those participating in the program on the development of automatic fabrication of electronic equipment at Stanford Research Institute and to the sponsors, Electronic Components Laboratory, Wright Air Development Center, Dayton, Ohio.

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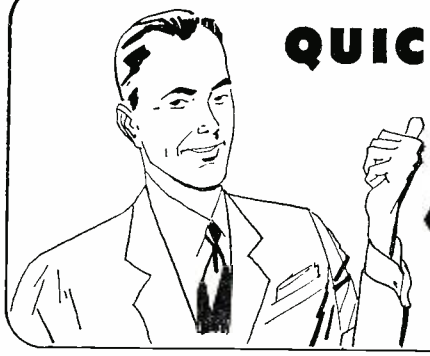
1953 INDEX



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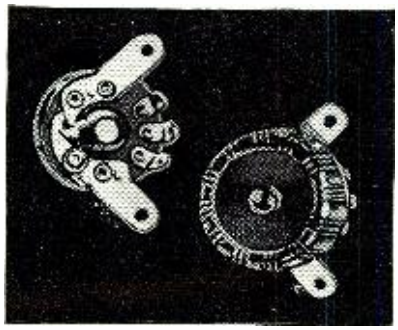

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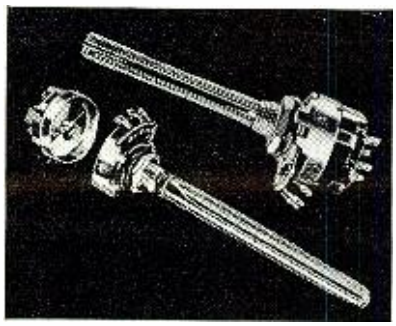

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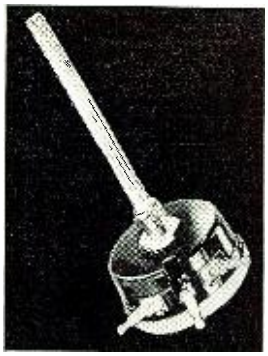
16 standard twins and a complete line of custom dual controls. Twins consist of two tandem mounted Model B Controls (Blue Shaft) operated by a single shaft. Front resistance 10,000 ohms to 5 meg. Rear resistance 25,000 to 5 meg. Universal, fluted mill, full length shafts. Duals are factory assembled custom units made exactly to original set manufacturer's specifications, complete and ready to install. Only factory assembled, factory tested complete units can be absolutely guarteed for performance by any control manufacturer. That's why Centralabs are guaranteed safest for servicing.



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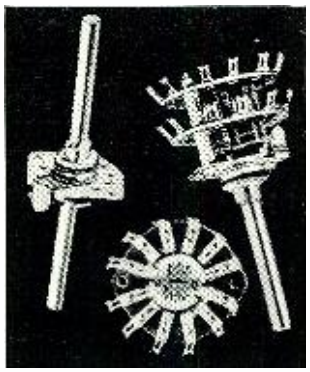

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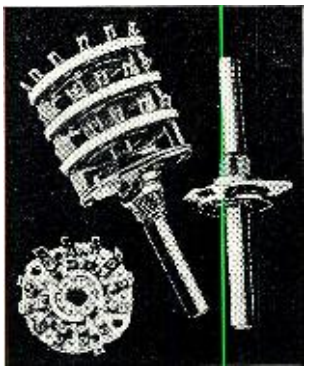

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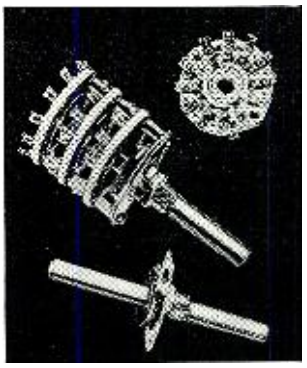

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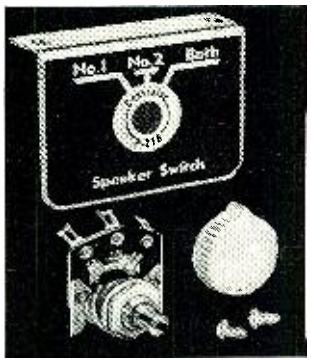

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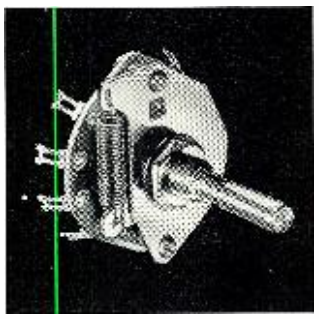
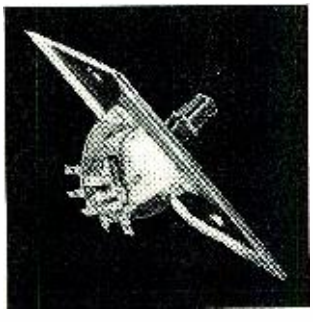


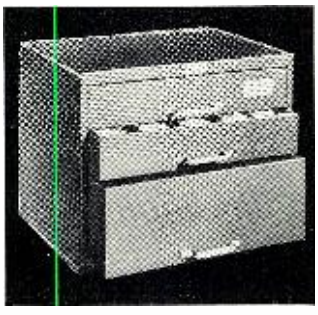
Spring Return Switches

Type 1448-49 — "Universal type" PA and intercom switch with listen position. Available with spring return one or both sides to center, non-shorting, 30° index. Index spring is tested for a minimum life of 150,000 cycles. Will replace any unit from 2 pole, 2 position to 6 pole, 3 position.



Lever Switches

For smoother action, positive indexing on speech input equipment, etc. Tested for minimum 150,000 switching cycles. 8 basic indexing combinations. Available in positive, spring return, or combination. Shorting and non-shorting types, 2 to 4 poles, 2 and 3 positions. Mounting plates optional.



Complete Switch Kits

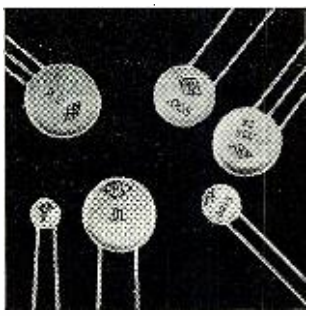
Afford a convenient, readily available source of stock sections, indexes and hardware for assembling any standard or practically any special rotary switching arrangement. 4 standard switch kits: Kit No. 414 for phenolic; Kit No. 419 for steatite; Kit No. 1500, rotary selector standard phenolic; Kit No. 2000, miniature steatite.

All parts included are standard stock items and may be ordered separately from your CRL distributor.

3 CAPACITORS— closer tolerances, more values to choose from

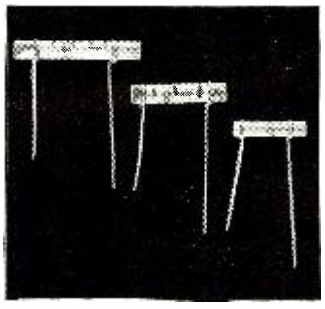
BC Tubular

Ideal for use in by-pass, audio coupling applications and general circuit use. Available from 1 mmf to 10,000 mmf. Centralab's own Ceramic-X body withstands temperatures to 2200° F ...makes capacitor impervious to moisture and low power factor. Keep plenty on hand.



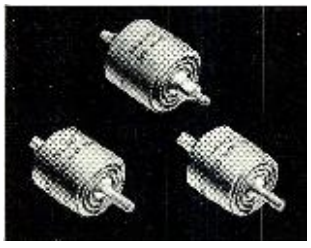
BC Discs

Ultra-compact — designed specifically to solve high-capacity, low-inductance, and small space requirements. 4 sizes: ¼", ⅜", 9/16", ⅝". Available in single, non-shielded dual and shielded dual types. ± 20% and CMV.



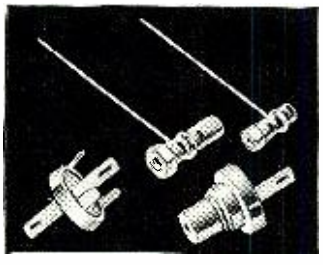
TC Tubular

Temperature compensating tubulars, type TCZ show no capacitance change over wide range of temperatures. Type TCN have special ceramic body to vary capacitance negatively to temperature changes. Comply to preferred values as set up by RTMA and JAN-C-20A.



HI-VO-KAPS®

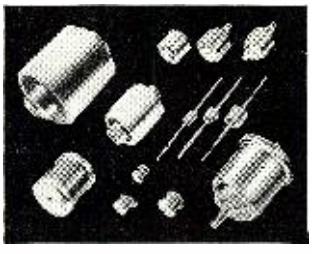
Fastest — for servicing, safest high-voltage capacitor available. Centralab's TV Hi-Vo Kaps are the standard for the TV industry, including UHF. Capacitance 500 mmf; 10 KV, 20 KV and 30 KV d-c. Will withstand continuous overload up to twice rated working voltage. Small diameter 1" to 1.4" maximum. 7 terminal combinations. (Also available in attachable terminal style).



Stand-Off and Button-Style

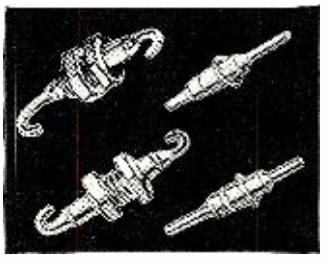
Type S1 Tubular Stand-Off (50 to 2500 mmf) by-passes r.f. to ground in many HF, UHF and VHF circuits. Type S2 (5,000 to 10,000mmf). One end threaded for panel mounting.

Button-style "Zippers"(†) — a long-life replacement for old-style mica "Buttons." Available in 5 different types. Used for by-passing in low-power, high-frequency applications.



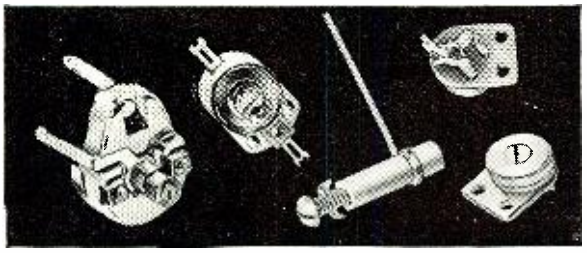
Transmitting and High Voltage

Ideal for equipment requiring close-held oscillator frequencies and prime or secondary standards. Extremely low power factor and stable retrace characteristics. Eleven terminal styles. Capacitance: 3 to 1000 mmf; 5 KV to 40 KV d-c. For high-frequency, high-voltage uses.



Feed-Thru (FT) and Miniature Feed-Thru (MFT)

Designed for single-hole mounting with ground to chassis or shield. Type FT (500 to 2300 mmf) has .050" hooked terminals for easy soldering. Bushing mounted. Type MFT (50 to 1000 mmf) eyelet-mounted. Smallest available in the widest capacitance range. Both types voltage-rated 500 v d-c.



Ceramic and Steatite Trimmers

Four types designed for greater stability to shock or vibration. Smaller, lighter, easier to mount in any position.

Type 827 Molded Ceramic Trimmer
Miniature Size. Four capacity ranges: 2.5 to 50 mmf max.

Type 822 Ceramic Trimmer
Medium weight steatite base. Five capacity ranges: 1.5 to 50 mmf max. (Jan Type CV11).

Type 823 Ceramic Trimmer
Medium-heavy steatite base. Eight capacity ranges: 5 to 125 mmf max. (Jan Type CV12).

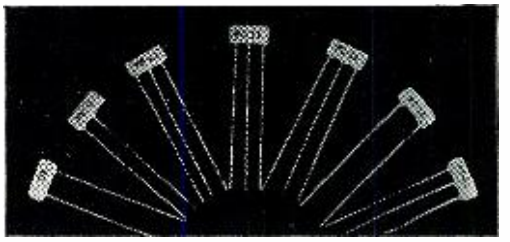
Type 829 Tubular Ceramic Trimmer
Special for TV and VHF applications. Body only .215" dia. Lock-nut mounted. Five capacity ranges: .5 to 10 mmf max.

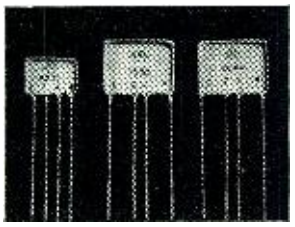
4 PRI TED ELECTRONIC CIRCUITS — pioneered by Centralab, more than 30,000,000 in use

(Available singly or in kits)

Small Plate Components

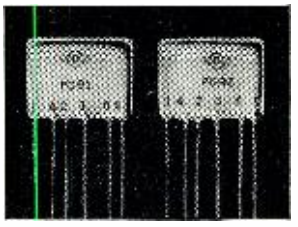
Smallest standard PEC's made by Centralab — excellent for miniature use. Minimum dimensions $1\frac{7}{32}$" x $\frac{7}{32}$" x $\frac{7}{64}$". Capacitors 50 v d-c w. Resistors $\frac{1}{5}$ watt. Plates available: single capacitors; dual capacitors; single resistors; dual resistors — in combinations; resistor-capacitor in series; resistor-capacitor in parallel. "Filpec," balanced diode load filter — has two capacitors and one resistor.





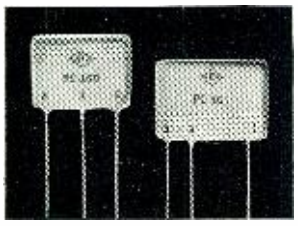
Triode Couplates

Require only 4 soldered connections. Replace 5 components normally used in audio circuits. Are complete midget assemblies of 3 capacitors and 2 resistors bonded to a dielectric ceramic plate. Available in four standard values. Resistors—$\frac{1}{5}$ watt; Capacitors — 400 v d-c w.



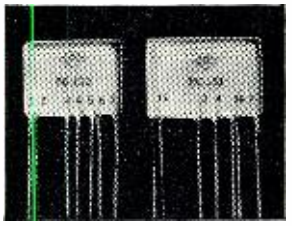
Pentode Couplates

Require only 6 soldered connections. Completely new interstage coupling circuits of 3 capacitors and 3 resistors and a small 6-load ceramic base. Compared with predecessors they actually reduce soldered connections 50%. Only $1\frac{3}{32}$" x $1\frac{3}{16}$" x $1\frac{1}{64}$". Three standard values available.



Vertical Integrators

Over 7 million in use in vertical integrator networks of TV sets produced by over 50 different set manufacturers. Two types available. Either type has *only three* external leads. Packaged one per envelope, five envelopes per carton.

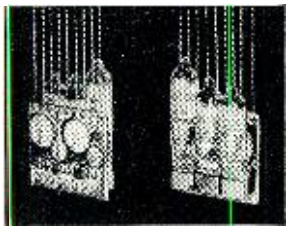


AUDET®

Extremely popular for miniature use. Furnish all values of all components generally found in output stage of a-c, d-c radio receivers. Provide 4 capacitors and 3 resistors — with only 7 leads. Available in two standard values. Resistors $\frac{1}{5}$ watt; capacitors, 400 v d-c w.

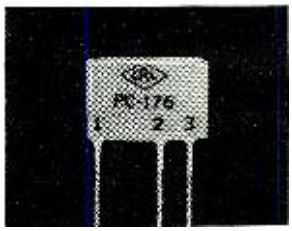
PENDET®

Another Centralab "first" in Printed Electronic Circuits. Consists of 5 capacitors and 4 resistors in a single plate with only 9 leads. Similar to the popular Audet. Couples the diodetriode and pentode tubes in output stage of a-c, d-c sets. Available in two standard values.



Ampec® Amplifiers

Outgrowth of Centralab's constant research in PEC development. Excellent for sub-miniature high gain audio use. 3-stage speech amplifier smaller than cover of ordinary book matches. Size: $1\frac{1}{32}$" x $\frac{15}{16}$" x $1\frac{1}{32}$". Capacitors, 100 v d-c w. Resistors, $\frac{1}{5}$ watt.



Special Plates

Many popular, non-standard plates used by radio and TV manufacturers are furnished as "special replacements" for servicing.

5 FINE CERAMICS — engineered to give you excellent electrical and physical properties

STEATITE CERAMIC INSULATORS

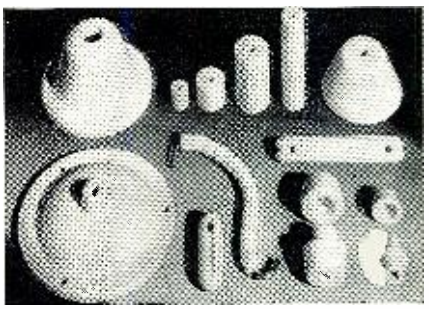
— 57 stock types packaged

Standard line includes: spreaders — strain insulators; standoff or pillar insulators; feed-through insulators; fish spine beads; through-panel bushings. All items are grade L-5 steatite, approved without limitation for Army and Navy use. Centralab Steatite Ceramic is to the ceramic field what "Lenox" china is to the fine china field.

JAN-TYPE CERAMIC STANDOFFS —

Complete line as per JAN-1-8 and JAN-1-10 in stock for immediate delivery. Five styles, 79 JAN-types available in quantities. Bulletin 42-181A has complete data . . . send for your free copy.

You can buy all these Centralab *"safest for guaranteed servicing"* components from your authorized CRL distributor. See him often for all your industrial electronics, TV and radio servicing needs. In the meantime, make sure you have a copy of Catalog No. 28, containing newest revised data on hundreds of available combinations. Ask your distributor for your copy, or write direct.



Centralab

CRL ®

A division of Globe-Union Inc.
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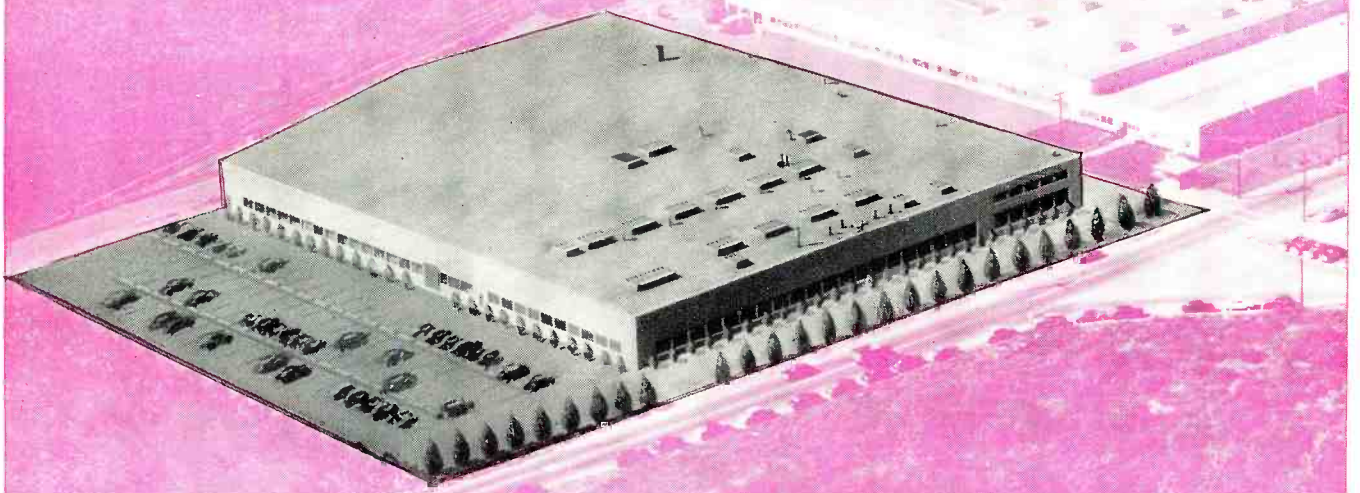
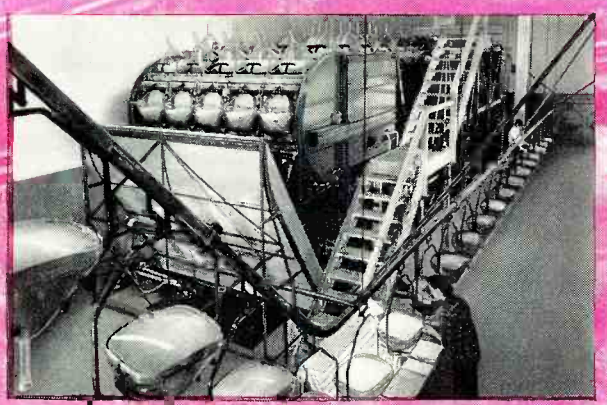
In Canada, 804 Mt. Pleasant Road, Toronto 12, Ontario

It takes the WORLD'S Newest PICTURE TUBE PLANT...

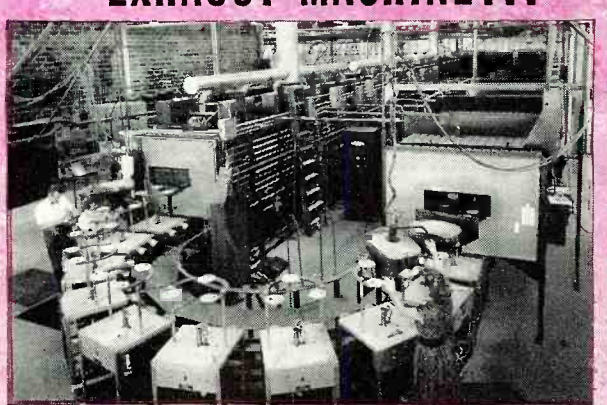


Equipped with the WORLD'S LARGEST SETTLING MACHINE...



A BAKE OVEN as Big as They Come...

And the WORLD'S LARGEST EXHAUST MACHINE...



to make the WORLD'S Finest TELEVISION PICTURE TUBES...

RAYTHEON  **PICTURE TUBES**

The only way to make large screen (21", 24" and 27") TV Picture Tubes of unsurpassed quality is to make them with equipment especially designed to handle and produce them. That's why Raytheon built and has in operation this miracle of a picture tube plant, which houses the world's finest, largest and most advanced equipment and methods for making large size Picture Tubes. This magnificent new plant is one more indication of Raytheon's dedication to a single ideal — to continue to supply you with the finest quality Television and Radio Tubes the world has ever known.

RAYTHEON®

Excellence in Electronics

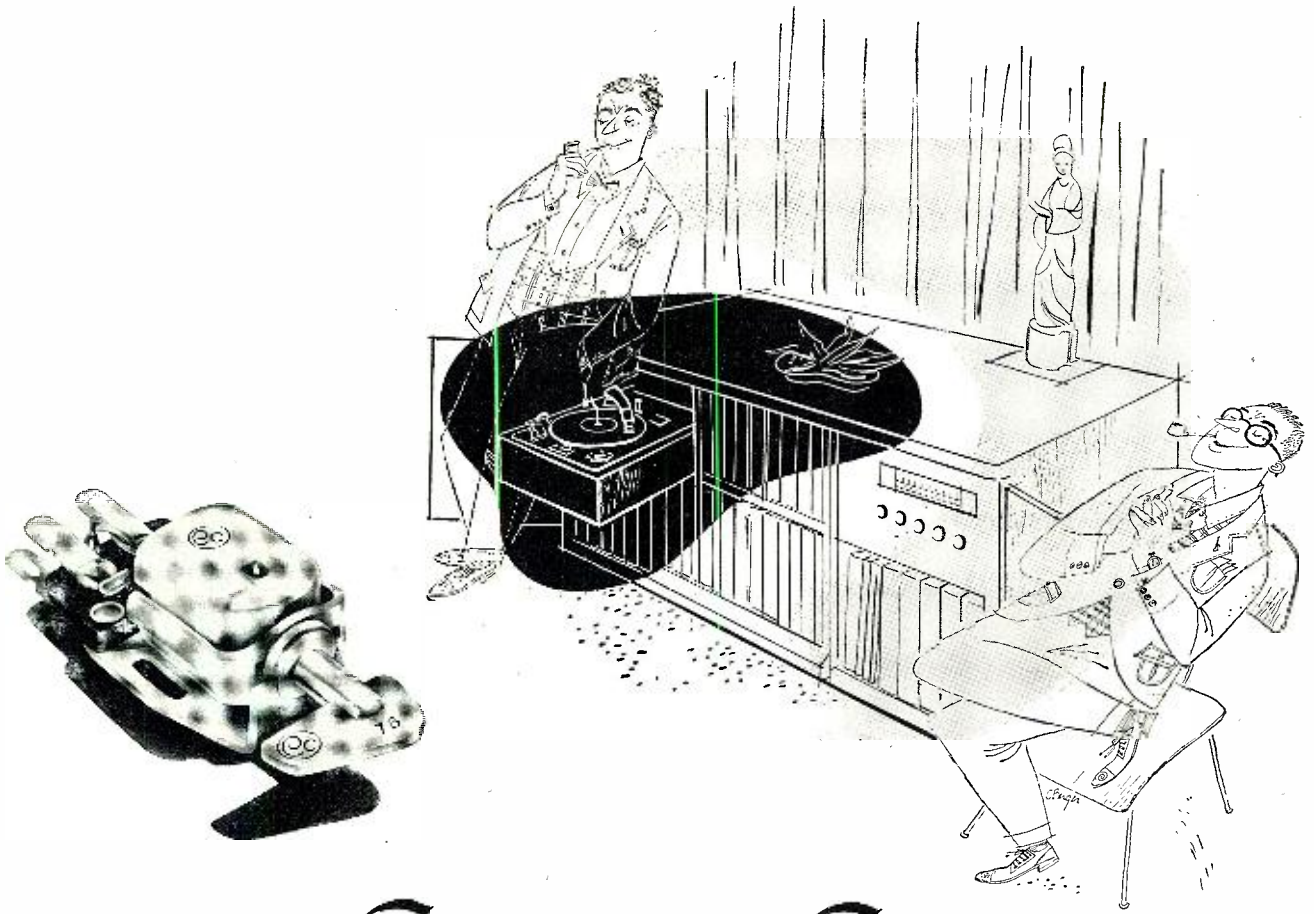
RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division

Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Cal.

RAYTHEON MAKES ALL THESE

RECEIVING AND PICTURE TUBES • RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES



"I'm glad I waited..."

Here's how I solved a problem that bothered me . . . and may be bothering you.

Many of my favorite recordings happen to be 78's. They mean as much to me as any of my newer LP's or 45's. Changing pickups was often a real nuisance—and yet I wasn't willing to give up the superior quality of my two Pickering cartridges.

Last fall my dealer offered a suggestion. "Wait a little longer," he said. "You'll be glad you did."

He was right. I now have Pickering's new turn-over cartridge. A simple flip of the handy lever and I'm ready to play any favorite that fits my mood—whether it's standard or microgroove. *More than that,* I'd swear my recordings sound better than ever.

I'm glad I waited . . . but you won't have to.

Ask your dealer to show you this convenient new turn-over cartridge. Have him demonstrate it. See if you, too, don't hear the difference!

PICKERING ***and company incorporated • Oceanside, L. I., New York***

PICKERING PROFESSIONAL AUDIO COMPONENTS

"For those who can hear the difference"

...Demonstrated and sold by Leading Radio Parts Distributors everywhere.
For the one nearest you and for detailed literature, write Dept. C-3

MY GRADUATES ARE EARNING GOOD PAY!

"I'll always be grateful to your training which helped me get my present fine position as Assistant Parts Manager."
—Norman Weston

"Thanks to your training, I qualified for a good job as a Receiver Tester."
—Paul Frank Seier

"Your excellent instruction helped me get my present job as an airport radio mechanic."
—Eugene E. Basko

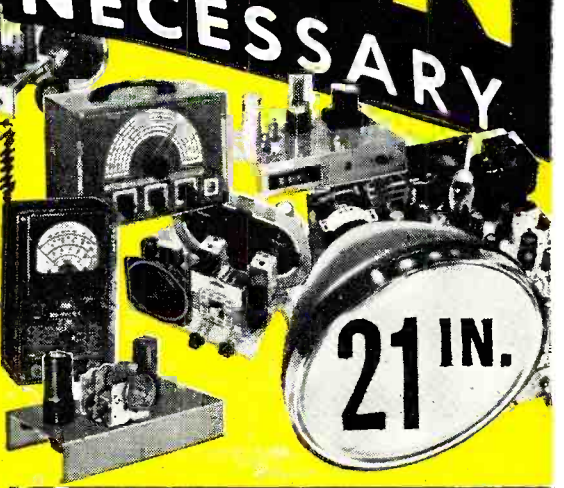
"I'm making good money in my own business, repairing and installing radio and TV sets — thanks to your training."—Irwin Polansky

YOU, TOO, CAN MAKE BIG PAY IN TELEVISION

NO EXPERIENCE NECESSARY

L. C. Lane, B.S., M.A.
President: Radio-Television Training Association
Executive Director: Pierce School of Radio & Television

ENOUGH EQUIPMENT TO SET UP YOUR HOME LABORATORY! As part of your training, I give you ALL the above equipment you need and more to prepare for a BETTER PAY TV job. You build and keep a professional GIANT SCREEN TV RECEIVER complete with big picture tube, takes any size up to 21-inch . . . also a Super-Het Radio Receiver, RF Signal Generator, Combination Voltmeter-Ammeter, Ohmmeter, C-W Telephone Transmitter, Public Address System, AC-DC Power Supply. Everything supplied including all tubes!



MORE MONEY AND A CAREER ARE WAITING FOR YOU HERE!

EXPERT FM-TV TECHNICIAN TRAINING! SAVE VALUABLE TIME! My FM-TV Technician Course can save you months of training if you have previous Armed Forces or civilian radio experience! Train at home with kits of parts, plus equipment to build BIG SCREEN TV RECEIVER, and FREE FCC Coaching Course! ALL FURNISHED AT NO EXTRA COST!

FREE FCC COACHING COURSE! Important for BETTER PAY JOBS requiring FCC License. You get this training AT HOME and AT NO EXTRA COST Top TV jobs go to FCC licensed technicians.

GOOD SPARE TIME EARNINGS! Almost from the very start you can earn extra money while learning, repairing Radio-TV sets for friends and neighbors. Many of my students earn up to $25 a week . . . pay their entire training from spare time earnings . . . start their own profitable service business. *Act now!*

OPTIONAL: TWO WEEKS TRAINING IN NEW YORK CITY AT NO EXTRA COST! You get two weeks, 50 hours, of intensive Laboratory work on modern electronic equipment at our associated school in New York City —Pierce School of Radio and Television. And I give you all this AT NO EXTRA COST whatsoever, after you finish your home study training in the Radio-FM-TV Technician course and FM-TV Technician Course.

NEW PRACTICAL TV CAMERAMAN & STUDIO COURSE! (For men with previous radio and TV training) I train you at home for a big pay job as the man behind the TV camera. Work with TV stars in TV studios or "on location" at remote pick-ups! A special one-week course of practical work on TV studio equipment at Pierce School of Radio & TV, our associate resident school in New York City, is offered upon your graduation.

CIVILIANS! VETERANS! PREPARE FOR A BRIGHTER FUTURE AS A TRAINED TV TECHNICIAN! Thousands of new jobs in TV are opening up in every state as new stations go on the air. You too can take your place in America's booming TELEVISION and Electronics industries . . . enjoy the success and happiness you always wanted. Keep your present job while I prepare you at home for a life-time career as a trained TV Technician. You "learn-by-doing" with the actual parts and equipment I send you . . . the same successful methods that have helped hundreds of men—*many with no more than grammar school training*—master television!

LEARN ALL ABOUT COLOR TV. I give you the latest principles and practical training in TV COLOR!

NO SALESMAN WILL CALL!

MAIL COUPON FOR 4 FREE AIDS!
NO OBLIGATION WHATSOEVER!

VETERANS!

My schools fully approved to train veterans under new G.I. Bill! If discharged after June 27, 1950 — CHECK COUPON! Also approved for RESIDENT TRAINING in New York City at Pierce School of Radio and Television . . . qualifies you for full subsistence allowance up to $160 per month. Write for details.

RADIO-TELEVISION TRAINING ASSOCIATION
52 EAST 19th STREET, NEW YORK 3, N. Y.
Licensed by the State of New York Approved by the VA

Dept. 12-A

Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSOCIATION
52 East 19th Street, New York 3, N. Y.

Dear Mr Lane: Mail me your NEW FREE BOOK, FREE SAMPLE LESSON, and FREE aids that will show me how I can make BIG MONEY IN TELEVISION. I understand I am under no obligation and no salesman will call.

(PLEASE PRINT PLAINLY)

NAME_____ AGE_____

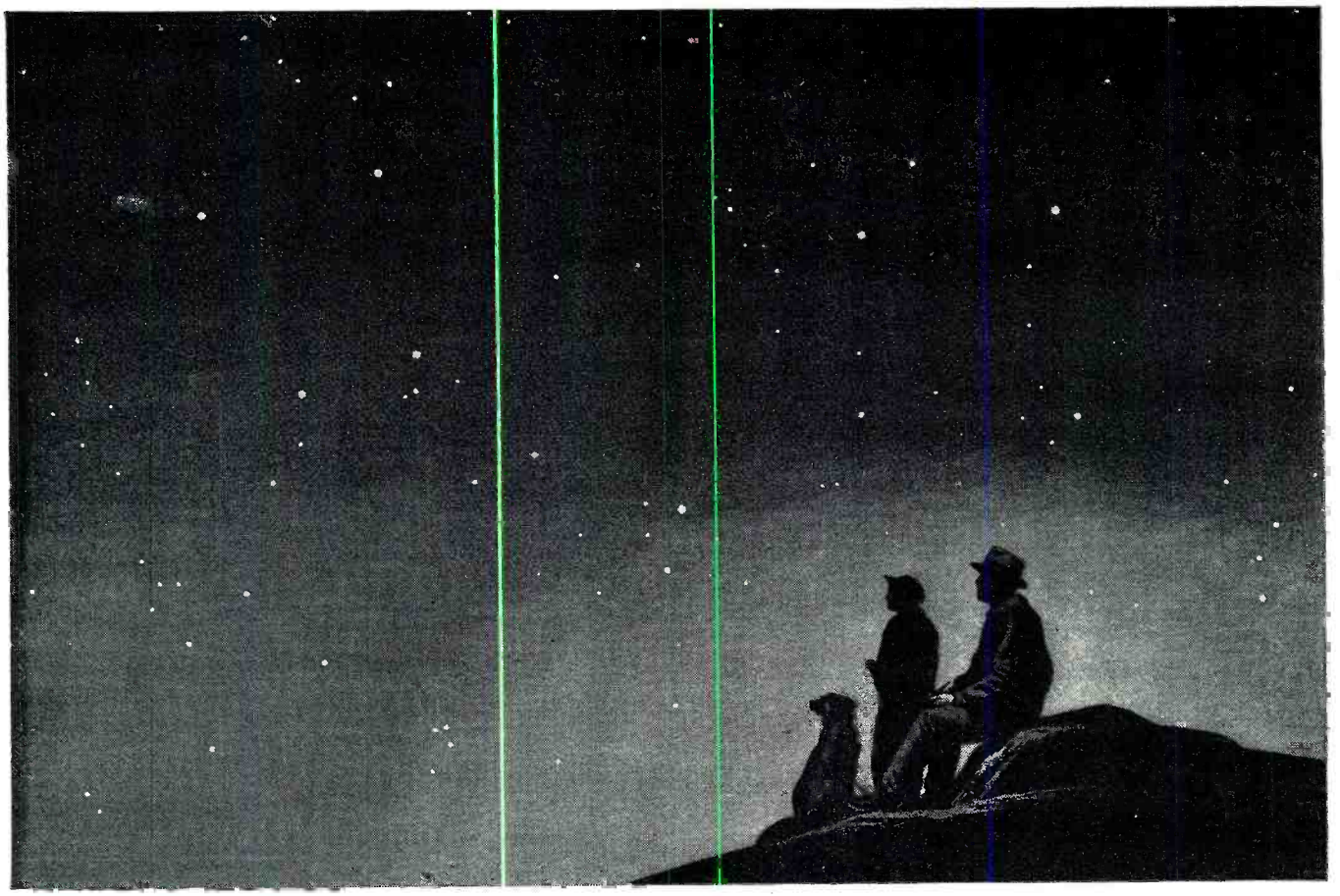
ADDRESS_____

CITY_____ ZONE____ STATE_____

I AM INTERESTED IN:

- ☐ Radio-FM-TV Technician Course
- ☐ FM-TV Technician Course
- ☐ TV Cameraman & Studio Course

VETERANS! Check here for Training under NEW G.I. Bill ☐

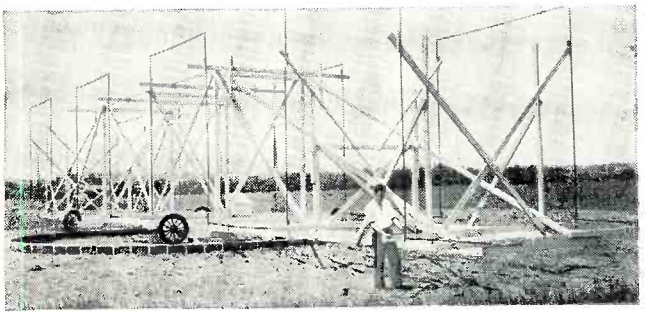


How silent is the night?

Watching the serenity of Christmas skies, we are conscious of deep silence. Yet the stars are talking to us all the while—talking in radio waves that are full of meaning to scientists probing the depths of space.

The important discovery that some stars produce radio waves was made by a Bell Laboratories scientist while exploring atmospheric disturbances which might interfere with transoceanic telephone service.

His discovery marked the birth of the fast-growing science of radio astronomy. It is telling us of mysterious lightless stars that broadcast radio waves, and it promises new and exciting revelations about the vast regions of space concealed by clouds of cosmic dust.

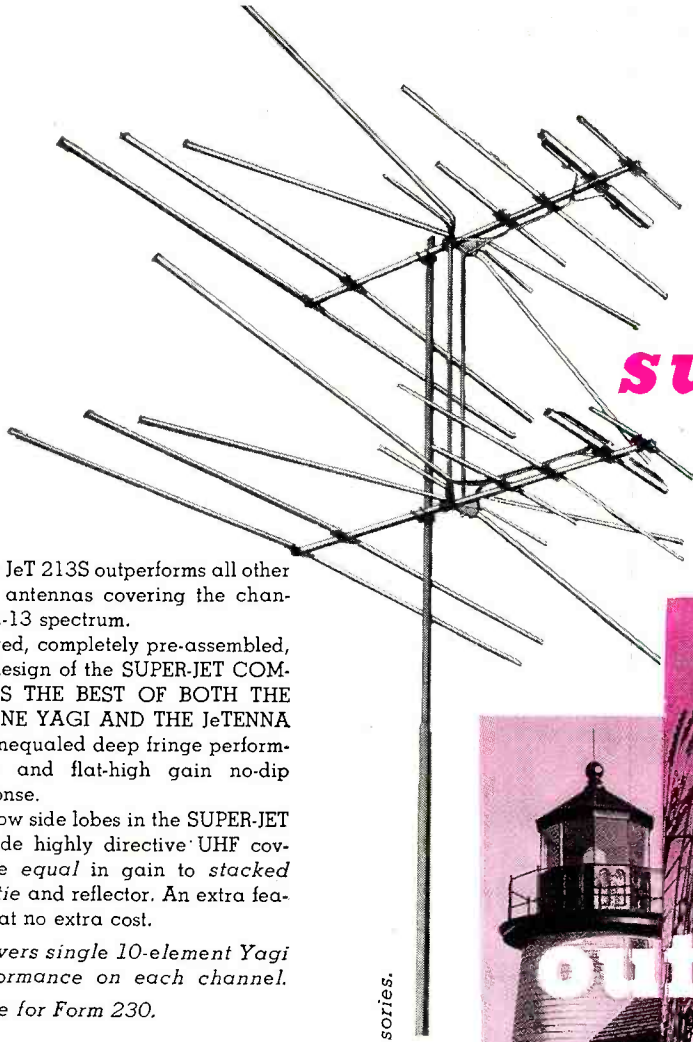


Directional radio antenna used by Karl G. Jansky, in the discovery of stellar radio signals at the Holmdel, New Jersey, branch of Bell Telephone Laboratories. In 1932 he detected waves of 14.6 meters coming from the direction of Sagittarius in the Milky Way.

It is another example of how Bell Telephone Laboratories scientists make broad and important discoveries as they seek ways to make your telephone serve you better.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE.



THE JFD super-jet outperforms across the nation

JFD's JeT 213S outperforms all other VHF antennas covering the channel 2-13 spectrum.

Rugged, completely pre-assembled, the design of the SUPER-JET COMBINES THE BEST OF BOTH THE BALINE YAGI AND THE JeTENNA for unequaled deep fringe performance and flat-high gain no-dip response.

Narrow side lobes in the SUPER-JET provide highly directive UHF coverage *equal* in gain to *stacked bowtie* and reflector. An extra feature at no extra cost.

Delivers single 10-element Yagi performance on each channel.

Write for Form 230.

Worlds' largest manufacturer of TV antennas and accessories.

HERE ARE THE FACTS— COMPARE FOR YOURSELF.

JFD JeT 213 S	Competitor D CHS 2-13 YAGI	Competitor C RADAR SCREEN TYPE B	Competitor B RADAR SCREEN TYPE A	Competitor A MATTRESS (4 STACK)	CHANNELS
6.5	4.50	0.75	0.0	4.0	2
7.5	5.00	3.25	3.0	5.0	3
9.5	5.75	4.5	4.0	7.0	4
8.5	3.00	3.5	3.25	6.25	5
8.5	2.50	3.5	3.0	5.0	6
11.0	3.50	6.0	4.5	5.25	7
11.0	1.00	7.0	7.0	6.0	8
12.0	0.0	6.5	7.0	5.25	9
12.0	.875	7.75	8.0	7.25	10
11.25	.875	8.0	10.0	9.25	11
12.75	.50	7.5	10.0	6.5	12
12.0	7.5	6.0	9.0	7.0	13
DB GAIN					
YES	NO	NO	NO	NO	1" Square Cross Arm Completely Pre-Assembled
YES	NO	NO	NO	YES	
$42.50	$65.90	$47.50	$34.95	$55.00	LIST PRICE

Model JeT 213 • single • $20.75 list

Model JeT 213S* • stacked • $42.50 list

*Complete with stacking transformers.

JFD MFG. CO.

JFD Electronics

BROOKLYN 4, N. Y.

Burton browne adv.

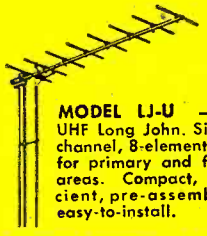
15 reasons why VEE-D-X IS YOUR BEST CHOICE

UHF ANTENNAS

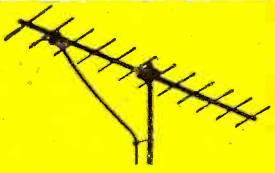
MODEL BT-U — The aristocrat of Bow-Tie antennas. Superior in both construction and performance. Can be stacked for extra gain. Compare!

MODEL CA-U — Famous Co-linear that has highest gain of all broad band fringe area UHF antennas. Also available in Dual Jr. models for specific area requirements.

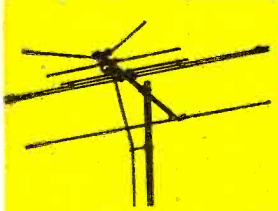
MODEL COR-U — The Corner Reflector has 40% higher gain than a single Bow-Tie. Finest construction with rugged Fiberglas boom and solid aluminum elements. Minimizes prob-ing.



MODEL LJ-U — The UHF Long John. Single-channel, 8-element yagi for primary and fringe areas. Compact, effi-cient, pre-assembled, easy-to-install.



MODEL LLJ-U —The most pow-erful of all single channel UHF antennas. Has rugged Fiberglas boom and solid aluminum ele-ments.

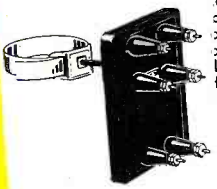


MODEL UQT — Famous Ultra Q-Tee all-channel (2-83) UHF-VHF antenna. Has printed cir-cuit filters — ideal for primary areas.

**Lic. A.A.K. Pats. 2,422,458; 2,282,292; 2,611,086; others pending.*

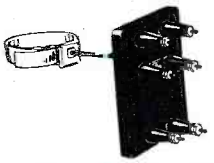
3 NEW IMPROVED MODELS OF THE FAMOUS VEE-D-X MIGHTY MATCH

Finest Most Efficient Cross-over Network Filters Ever Perfected



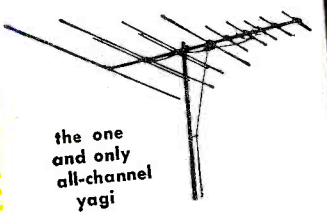
NEW MM-40 —(Yel-low case) (For com-bining separate UHF and VHF antennas to a single transmission line.) New, more ef-ficient patented* printed circuit. Amazingly low in-sertion loss. New type terminals. New moisture-resistant case.

NEW MM-40A — The ideal single line termination filter for use at set or con-verter having sepa-rate terminals for UHF and VHF. Pat-ented* printed cir-cuit.



NEW MM-25 (green case) — Permits the use of a single transmission line between sepa-rate high and low channel VHF antennas. New improved pat-ented* printed circuit. Amaz-ingly low insertion loss. New type terminals. New moisture-resistant case.

VEE-D-X tra Special



the one and only all-channel yagi

Model SP

HIGH GAIN FRONT-TO-BACK DIRECTIVITY

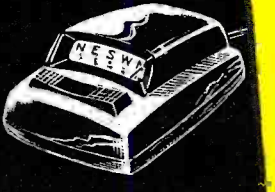
Think of it — all the desir-able features of a yagi — yet with all-channel per-formance in a single, easy-to-install antenna. Technically, the VEE-D-X-tra Special is a 9-element hi-low yagi (5-elements on high channel — 4 on low) "T" matched. The hi-low sections are phas-ed together with a new isolation filter MM-25. The ideal antenna for all-channel power—for direc-tivity—and for eliminating interference from unwant-ed stations. A honey for use with VEE-D-X Rotator.

NEW VEE-D-X UNIVERSAL LIGHTNING ARRESTER

For UHF — VHF — AM — FM

Takes all popular transmission lines flat, tubular, oval, round, open wire

MODEL ULA is the finest, most efficient lightning arrester ever perfected. Com-pletely eliminates the need for separate lightning arresters for each type of transmission line. This one arrester takes 'em all. Com-pact, clean-cut, inexpensive and employs newly devel-oped printed circuits. It literally obsoletes all other lightning arresters.



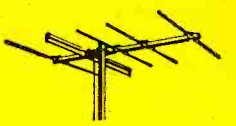
NEW VEE-D-X ANTENNA ROTATOR

Acclaimed the finest in de-sign, construction and per-formance. Clean-cut, in-line styling. Fast and easy to in-stall. Beautifully styled Con-trol Console operates with convenient downward pres-sure. Choice of two colors.

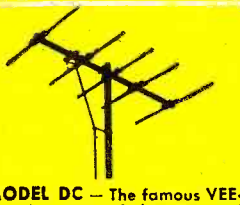
FREE

Write for your copy of this complete new 36 page pocket guide to the world's finest antenna systems.

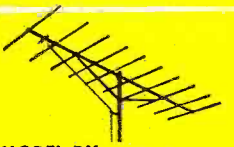
VHF ANTENNAS



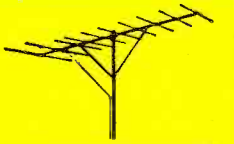
MODEL JC — For the most powerful single channel per-formance. A popular 5-element yagi. Easy-to-install.



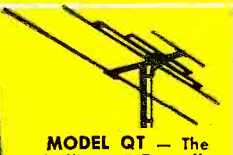
MODEL DC — The famous VEE-D-X low cost 5-element yagi with original VEE-D-X Delta Match construction.



MODEL DX — The famous economy super power yagi. Has 30% higher gain on high channels than any other 10-element yagi. Delta Match and boom braced.



NEW BROAD BAND YAGIS — Finest of all. Available in both 10-element "X" series and 5-6 element "V" series, each in 3 cuttings, cover entire VHF channel range.



MODEL QT — The brilliant Q-Tee all-channel VHF antenna with patented* printed circuit chan-nel separators. New improved construc-tion and perform-ance. Can be stack-ed for additional gain.

La Pointe ELECTRONICS INC.

ROCKVILLE, CONNECTICUT N-12

Send .....copies of your new complete antenna booklet.

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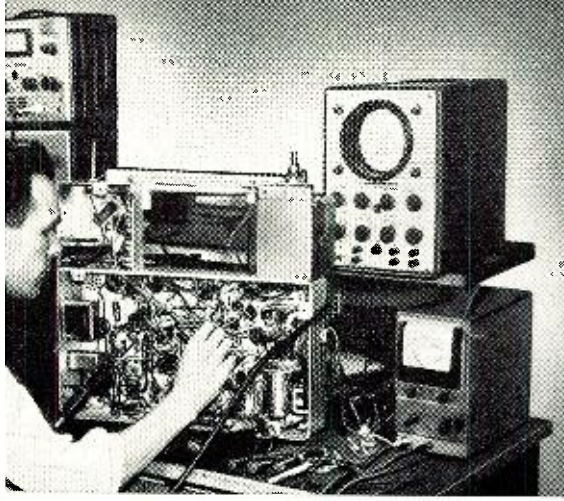
For opportunities within your reach



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Good-pay jobs. A business of your own.

OPPORTUNITIES FOR GOOD-PAY JOBS in Television are within your reach when you study TV Servicing by the RCA Institutes Home Study Method. Or perhaps you would like to start a TV Service business of your own.

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The entire course is divided into ten units of several individual lessons. You study them at home in your spare time. Lesson-by-lesson you learn the theory and step-by-step procedures of installing TV antennas, of servicing and trouble-shooting TV receivers. Hundreds of pictures and diagrams help you understand the how-it-works information and the how-to-do-it techniques. You will be amazed how easily you absorb the knowledge of each lesson, how quickly you train yourself to become an experienced technician.

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The RCA Institutes course was written and planned by instructors with years of specialized experience in training men by home-study and resident-school methods. The course embodies RCA's background of television experience plus knowledge gained in training several thousand technicians. A study of the course parallels an apprentice's training. Your lessons are carefully examined and accurately graded by friendly teachers who are interested in helping you to succeed.

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

CHANNEL MASTER

introduces a

basically new type of VHF antenna

CHAMPION*

the highest gain all-channel VHF antenna ever developed!

Featuring the unique new "Tri-Pole"

TRIPLE-POWERED DIPOLE

The "Tri-Pole" is a new antenna system in which the Low Band folded dipole also functions as three folded dipoles tied together in phase on the High Band. This is the heart of the Champion, the secret of its phenomenal performance on all 12 VHF channels.

The **CHAMPION** is another great development of the world famous Channel Master laboratories.

*Pat. Pending

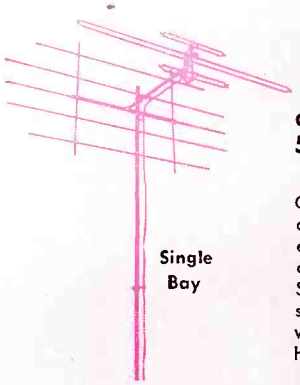
he CHAMPION is the most sensitive all-channel VHF antenna ever designed!

Stacked *CHAMPION* provides:
11-13 D B High Band gain
6½-7½ D B Low Band gain

Here is a totally NEW kind of antenna, completely different — in principal and performance — from any VHF antenna you've ever seen! Since the lifting of the TV freeze means a gradual disappearance of the single-channel VHF area, the VHF antenna of the future will be a *multi-channel* antenna. Prepare now for outstanding reception on *all* VHF channels — present and future — with Channel Master's super-sensitive CHAMPION! Outperforms every all-channel VHF antenna made today — and many Yagis, too!

COMPARE these features with the antenna you are now using:

- Folded dipoles throughout — give close to 300 ohms impedance across the entire band.
- Screen-type reflector provides high uniform gain on every channel, 2 through 13. *Not* frequency sensitive — this reflector provides more than twice as much extra gain as straight bar reflectors.
- Phase-correcting harness is built-in and fully assembled; the only wiring you do is to attach the lead-in.
- All-aluminum construction . . . lightweight, durable, non-corrosive.



MARVEL OF PRE-ASSEMBLY

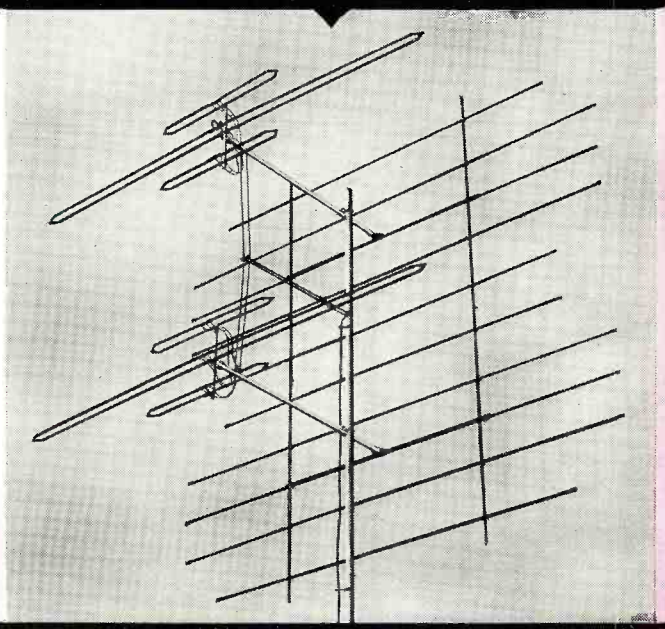
assembles faster than a 5-element yagi!

Collapsed "Pop-Up" screen opens instantly — no loose rods, elements or hardware. "Tri-Pole" assembly features automatic Spring Lock Action — all dipoles snap permanently into place without wing nuts or any other hardware.

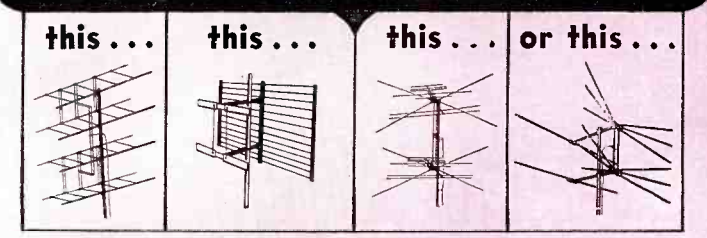
It's a *CHAMPION* in any area!

1-bay—*local areas*
2-bay—*secondary and fringe areas*
4-bay—*super-fringe areas*

THIS ANTENNA...

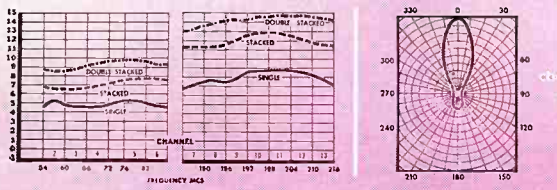


OUT-PERFORMS:



The 2-Bay CHAMPION actually gives you the performance of:

- Separate 5-element Yagis for every Low Band channel!
- Separate 10-element Yagis for every High Band channel!



Model No.		List Price
325	Single Bay	$20.83
325-2	2-Bay	$42.36
325-4	4-Bay	$88.89
Separate Stacking Harness		
325-3	2-Bay Harness	$ 2.08
325-5	4-Bay Harness	$ 4.15

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RCA Speakers—quality engineered for superior performance—are now clearly identified by this distinctive gold label. It is yaur assurance that these speakers represent the superior technical "know-how" and manufacturing techniques that have made RCA the accepted name for high-quality praducts.

Look for the gold label—symbol of superior speaker performance—and be sure af using only genuine RCA Speakers for your replacement needs.

For complete information on RCA Speakers, see your RCA Distributor.

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CREI prepares you quickly for success in

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- AERONAUTICAL ELECTRONICS

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The signs are plain as to the future of the trained men in the electronics industry. It is a tremendous industry, and—at the *present time* there are more jobs than there are trained men to fill them. But—when there's a choice between a trained and untrained applicant, the trained man will get the job. Your biggest problem is to decide on—and begin the best possible training program.

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Since 1927, CREI has given thousands of ambitious young men the technical knowledge that leads to more money and security. The time-tested CREI procedure can help *you*, too—if you really want to be helped. CREI lessons are prepared by experts in easy-to-understand form. There is a course of instruction geared to the field in which you want to specialize. You study at *your* convenience, at *your* rate of speed. Your CREI instructors guide you carefully through the material, and grade your written work personally (not by machine).

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CREI courses are prepared, and taught with an eye to the needs and demands of industry, so your CREI diploma can open many doors for you. Countless CREI graduates now enjoy important, good-paying positions with America's most important companies. Many famous organizations have arranged CREI group training for their radio-electronics-television personnel. To name a few: All America Cables and Radio, Inc.; Canadian Aviation Electronics, Ltd.; Canadian Broadcasting Co rporation; Columbia Broadcasting System; Canadian Marconi Company; Hoffman Radio Corporation; Machlett Laboratories; Glenn L. Martin Company; Magnavox Company; Pan American Airways, Atlantic Division; Radio Corporation of America, RCA Victor Division; Technical Appliance Corporation; Trans-Canada Air Lines; United Air Lines. Their choice for training of their own personnel is a good cue for *your* choice of a school.

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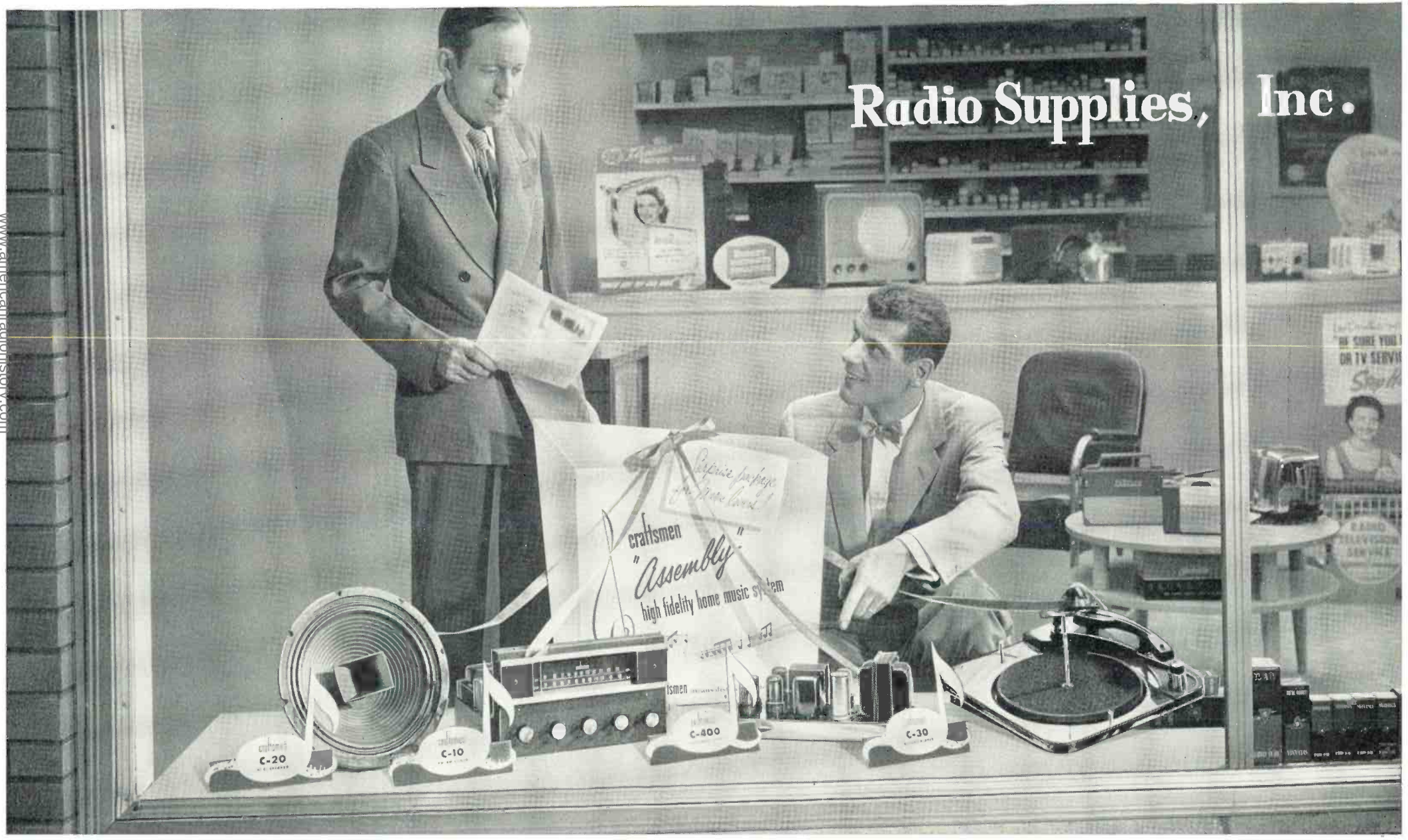


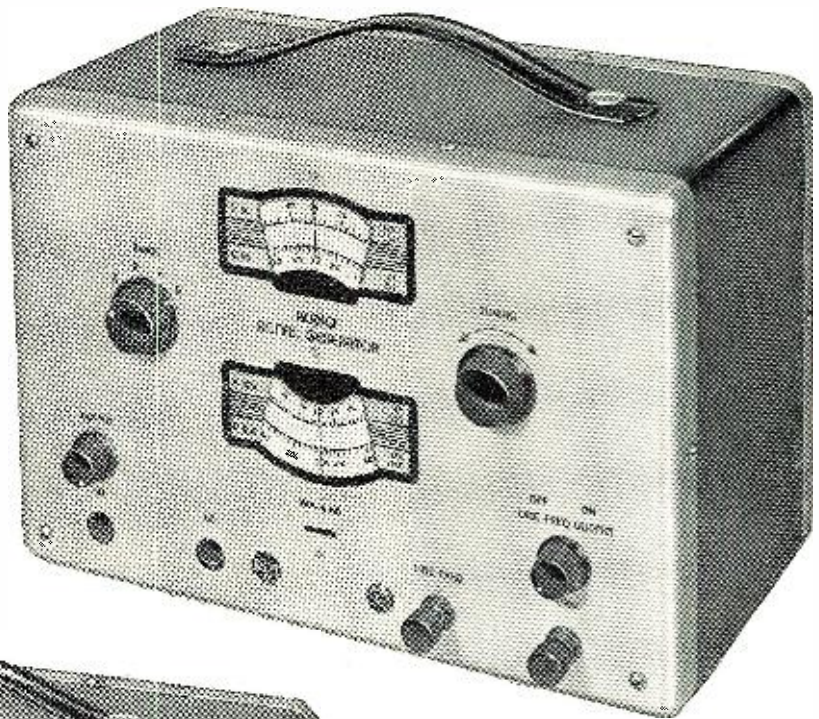
11 CPS to 30 Mc

. . . covered by two *new* RCA Companion Signal Generators for testing and trouble-shooting audio, AM, FM and TV equipment

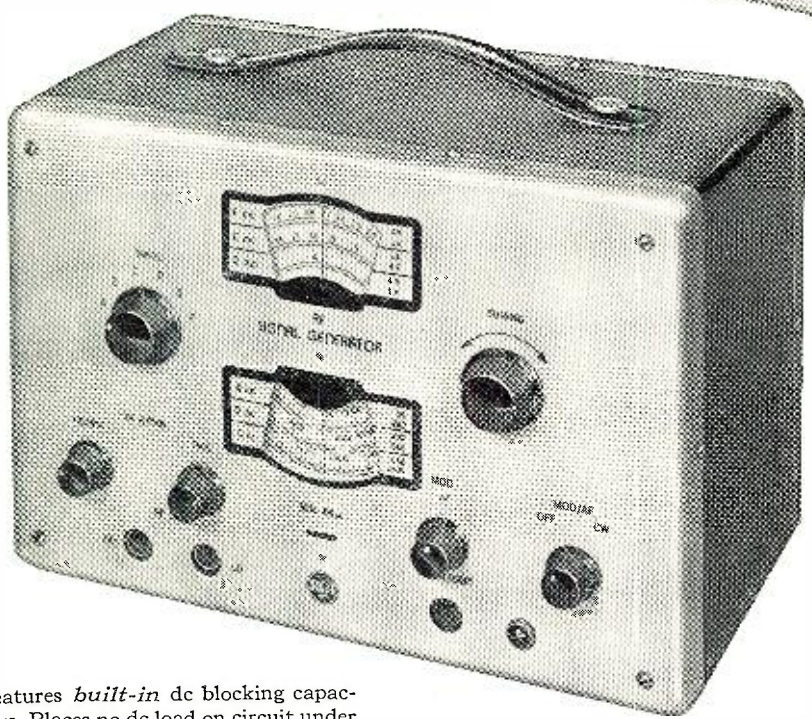
RCA WA-44A
Audio Signal Generator

Continuous sine-wave coverage from 11 cps to 100 kc

ONLY $87.50 Suggested User Price



Features new RCA-type oscillator having wide frequency range, and frequency stability of ± 3% or better. Regulated power supply. Amplified agc circuit insures an output uniform within ± 1 db over entire frequency range. Total harmonic distortion, 2% or less. Has direct-reading scales. Can be used with high- or low-impedance circuits. Useful for all response measurements. Has separate line-frequency output for inter-modulation distortion measurements. Compact, weighs only 10 lbs. Ac-operated.



Features *built-in* dc blocking capacitors. Places no dc load on circuit under test . . . protects instruments when connected to B-plus circuits. Cathode-follower output stage isolates oscillator from effects of load reactance and resistance, thereby maintaining good output waveform, voltage regulation, and frequency stability of the oscillator.

Built-in 400-cycle oscillator for internal modulation. Modulation percentage continuously variable. Dial calibrations accurate to ±1% on all six bands. Complete shielding of copper-plated cabinet and of cables for minimum leakage. Compact, weighs only 8 lbs. Ac-operated.

RCA WR-49A
RF Signal Generator

Continuous coverage on fundamentals from 85 Kc to 30 Mc

ONLY $59.50 Suggested User Price

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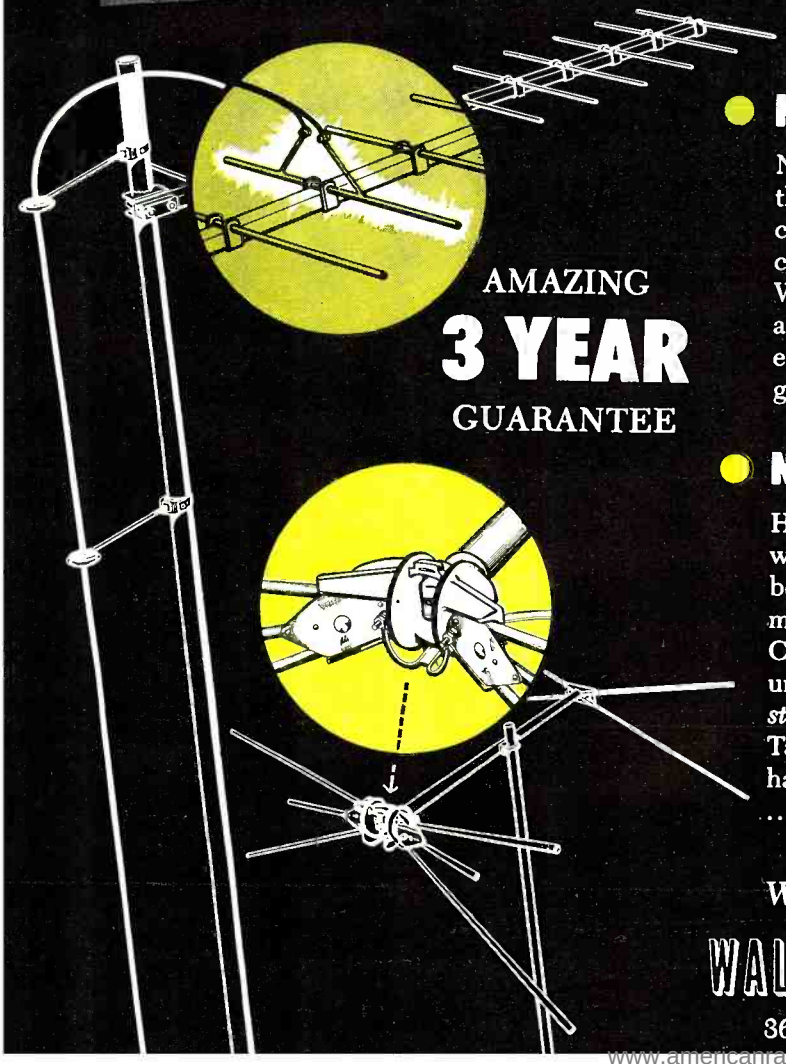
TEST EQUIPMENT **HARRISON, N. J.**

DISCOVER WHAT GOLD AND 2 INCHES OF AIR DO FOR 2 NEW WALSCO ANTENNAS



AMAZING
3 YEAR
GUARANTEE

NEW WALSCO GOLD DIPOLE YAGI *(UHF)*

No less than *24 kt. gold* plating on the receiving dipole of this great, new, 10 element Yagi. Why *gold*? Because *gold* resists corrosion better than any other metal...and *gold* is an excellent conductor. Like the most powerful *radar* antennas, the Walsco *Gold* Dipole Yagi guarantees *permanent* high gain in any location, under all weather conditions. It's custom-made for each location. The *only* Yagi that carries a 3 *year* unconditional guarantee! And it costs no more than conventional Yagis.

NEW WALSCO IMPERIAL CONICAL *(VHF)*

Here's the first radical improvement in Conicals. A new insulator which utilizes "barrier discs" and *2 inches of air space* between the terminals prevents "shorts." Soot deposits, dirt, moisture, salt, etc., *cannot* affect the insulator. This great, new Conical will therefore maintain high gain performance under any and all weather conditions. Front-end hardware is *stainless steel* to prevent corrosion losses permanently. Takes only 2 minutes to assemble because there's no loose hardware. Nothing compares to the Walsco Conical at any price ...and it's backed by the *only* 3 year unconditional guarantee!

Write for complete information

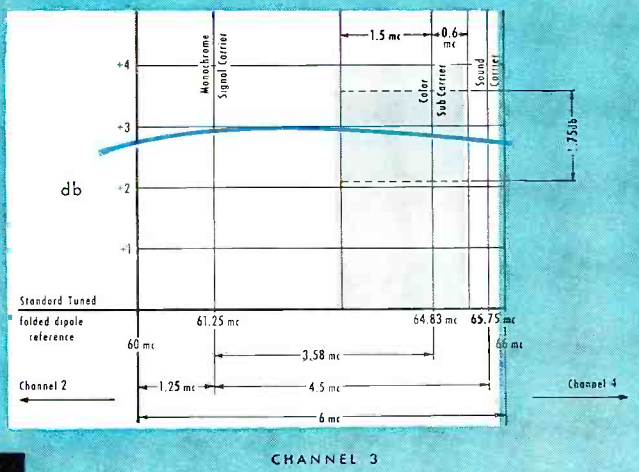
WALSCO ELECTRONICS CORPORATION

3602 Crenshaw Boulevard, Los Angeles 16, California

you're ready for

COLOR TELEVISION

with an AMPHENOL ~~INLINE~~*



CHANNEL 3

Color television is fast becoming a reality! Sets are expected to be available the first part of next year and stations are purchasing the necessary transmitting equipment. Initial costs, unfortunately, will be high but as improvements in design and production are achieved the price of color television will become within everyone's reach.

The consumer is concerned with the problems presented by television in color. He has read reports on prices and availability; all have been conflicting. He knows, however, that his set will have to be replaced or converted. What he does not know is that if *he has an* AMPHENOL INLINE*, there will be *no extra expense in antenna or installation!* AMPHENOL engineers provided for color in the original design of the INLINE*.

Every dealer, distributor and installer will want to acquaint their customers with this reassuring information. The color television market is potentially tremendous. It certainly will prove of benefit if the consumer can be reassured on one part of the cost of conversion to color.

The fact that AMPHENOL INLINEs are able to receive color television so well reflects favorably upon the engineering ability of AMPHENOL. For in ordinary black and white television the same level-gain design has proved valuable. Set owners know, now, that their AMPHENOL INLINE* is providing them with the best black and white picture their sets can deliver.

*Reissue U.S. Pat. No. 23,273

Antenna Electrical Requirements for COLOR TELEVISION

Information now available on color television has made it clear that the receiving antenna must have these characteristics:

1. Antenna gain must be flat, no gain or loss greater than one db, within 1.5 mc below and 0.6 mc above the color sub-carrier* (a width of 2.1 mc).
2. Antenna gain must be held down across the FM frequencies. Rejection of FM signals is much more important in color than in black and white television.

*Channel frequency widths are at present divided between the monochrome amplitude modulation picture carrier and the frequency modulation sound carrier. The addition of the color sub-carrier is made at 3.58 mc above the monochrome carrier.

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†Measured in accordance with proposed RETMA standards.

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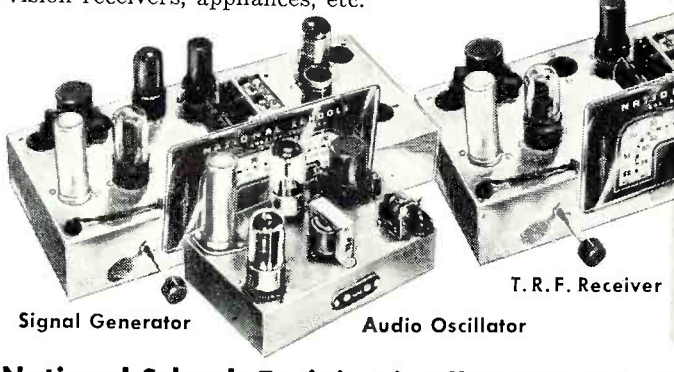

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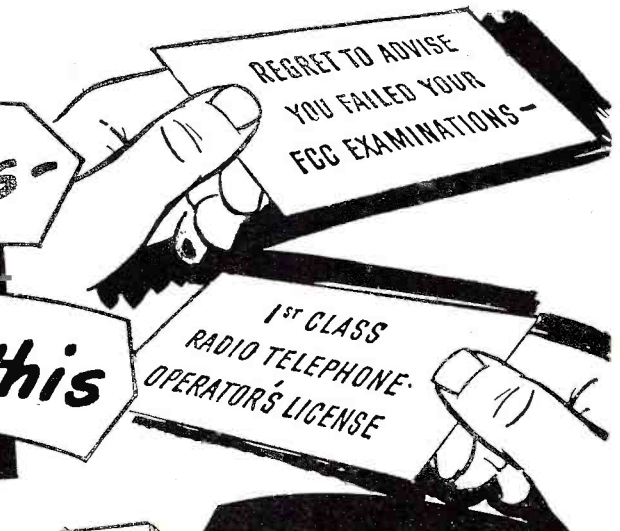

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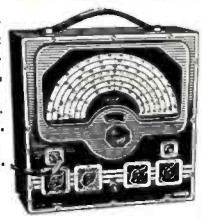

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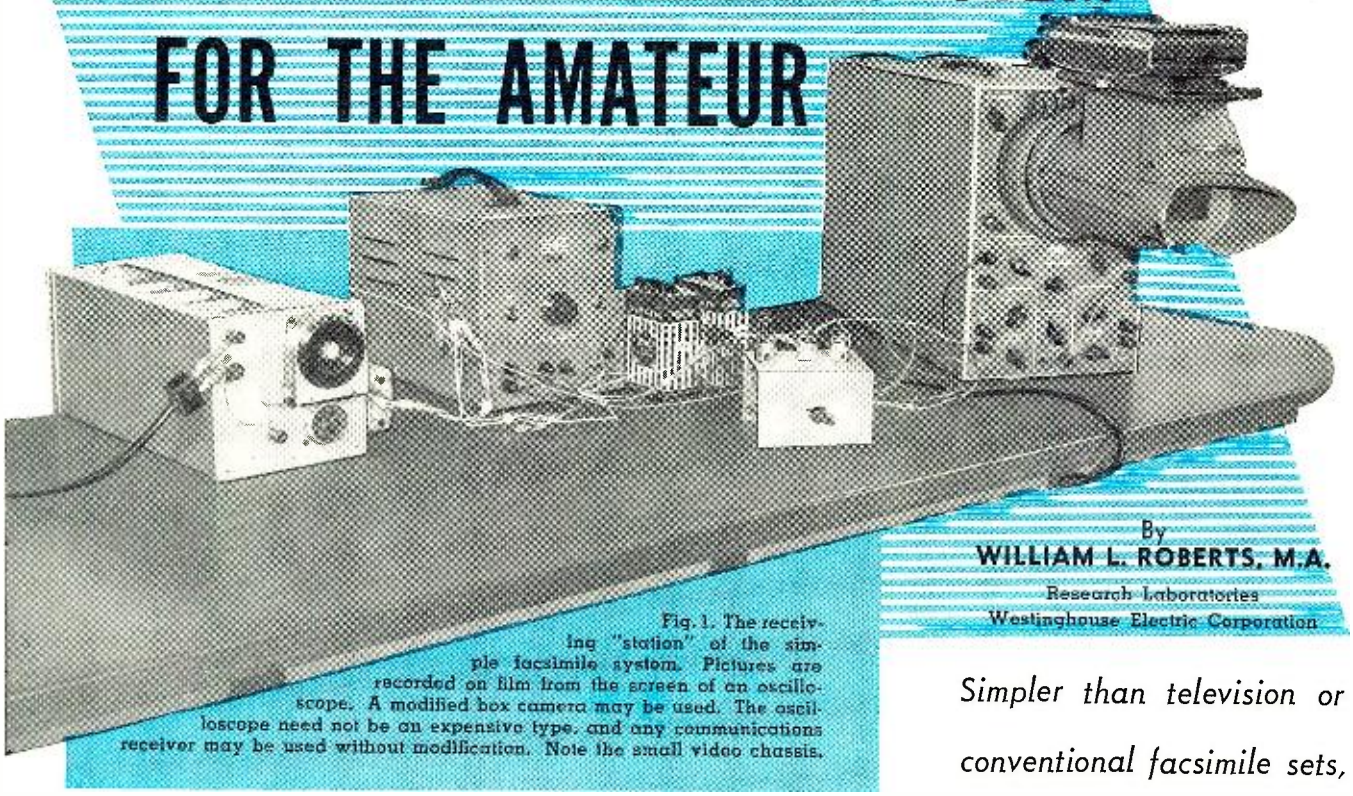


Fig. 1. The receiving "station" of the simple facsimile system. Pictures are recorded on film from the screen of an oscilloscope. A modified box camera may be used. The oscilloscope need not be an expensive type, and any communications receiver may be used without modification. Note the small video chassis.

By
WILLIAM L. ROBERTS, M.A.
Research Laboratories
Westinghouse Electric Corporation

Simpler than television or conventional facsimile sets, this interesting project is within an amateur's budget.

ALTHOUGH a certain number of radio amateurs, both in this country and abroad, are engaged in developing small television transmitters, such activities are beyond the scope, both financially and technically, of the average amateur. Moreover, the radiation of conventional video signals, designated as a type A5 transmission, is restricted to the amateur bands above 420 mc. because of the large bandwidth required. Unfortunately, communication on these bands is usually limited to distances less than the optical horizon visible from the transmitter and thus may be only on the order of 50 to 100 miles.

A simple, inexpensive facsimile system for the transmission of photographs could readily become popular and would make radio contacts a much more personal experience. Such transmissions, giving the same definition as a television picture and requiring a bandwidth no wider than that used for telephony, could be made on amateur bands where facsimile or A4 transmissions are permitted. Thus, still pictures could be transmitted on all amateur bands above 26.960 mc. with the exception of the 10-meter band (28.0-29.7 mc.). In the 11-meter band communication distances of thousands of miles are possible with modest equipment.

This article describes an experimental method for the relatively slow transmission of photographs utilizing a video bandwidth of approximately 5 kilocycles. Both the transmitting and receiving equipment are simple in design and within the financial reach of most amateurs, since the two major items required are: (a) an oscilloscope, and; (b) a camera.

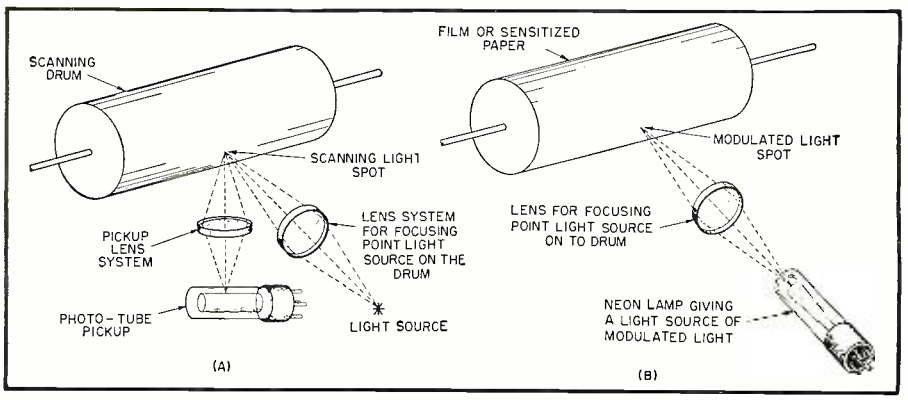
In transmitting a picture the system utilizes an ordinary oscilloscope as a flying-spot scanner and a photomultiplier as a video pickup unit. To receive the picture, the oscilloscope is used to slowly reproduce the photograph line by line while the face of the tube is being photographed. A *"Polaroid Land"* camera may be used where rapid processing of the film may be desired, but a much cheaper and simpler camera may be modified for the purpose.

Conventional Methods

Facsimile transmission and recep-

EDITOR'S NOTE: *Type A4 facsimile (amplitude modulated) is permitted in all the amateur v.h.f. and u.h.f. bands including six meters, and also in the 11-meter band (26.960-27.230 mc.). There are at present very few specific rules governing amateur facsimile. However, the signal bandwidth should be no greater than that of a correctly-operated phone transmitter and the general rules on purity of emission apply. The station call sign must be transmitted at least once every ten minutes as required by the general regulations, both in facsimile and in c.w. or phone on the same frequency used for the facsimile transmissions. This system will meet the requirements and may be applied to any good-quality transmitter in the appropriate frequency range.*

Fig. 2. Essentials of conventional mechanical scanning and reproducing systems.



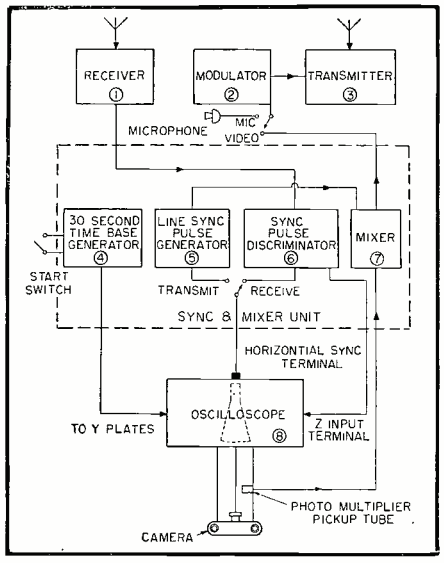


Fig. 3. Block diagram of the simple amateur facsimile system. Units 1, 2, and 3 at the top are part of any amateur phone station. The units of the sync and mixer system are fairly simple to build. Even inexpensive scopes should be satisfactory.

tion is normally accomplished by means of electromechanical devices. The photograph or material to be transmitted is wrapped around a drum capable of rotation and the scanning head consists of an optical system which focuses a small spot of light on the picture as shown in Fig. 2A. As the drum rotates, the spot of light is made to travel at a much slower rate from one end of the drum to the other. Light reflected from the subject of the picture is detected by the phototube as shown.

Similar equipment is used for recording the facsimile transmissions and four methods are currently in use, namely; photographic, wet electrolytic, dry electrolytic, and carbon paper processes.

Fig. 2B shows a sketch of the equipment for the photographic process and here it will be seen that an amplitude-modulated point source of light is made to scan a raster on a film on sensitized paper wrapped around a rotating drum. Synchronization of the transmitting and recording units is often accomplished by using driving motors which are initially brought into accurate phase relationship with each other by means of a phasing signal before the picture is transmitted. Thereafter, during the transmission of the picture, reliance is placed upon the constant speed motors to maintain their phase relationship. Other facsimile systems automatically start the recording drum at the beginning of each line scan.

In commercial facsimile practice both AM and FM systems are used. In the case of amplitude modulation, however, the signal frequency is used to first modulate an audio frequency and this, in turn, is used to modulate the transmitter.

Regulations

Because facsimile transmissions are normally made by the methods described previously, the rules and regulations laid down by the FCC relating to such transmissions are, strictly speaking, only applicable to these methods. The necessary bandwidth for facsimile transmissions is given in these rules and regulations as:

$$(KN/T + 2M) \text{ cps}$$

where:

K is an over-all numerical factor which differs according to the emission and depends upon the allowable signal distortion. This factor is set at 1.5.

N/T is the maximum possible number of black plus white elements to be transmitted per second, and

M is the maximum modulation frequency expressed in cycles-per-second.

The total number of picture elements (black and white) transmitted per second is given by the product of the following factors: (a) the circumference of the drum; (b) number of scanning lines made per unit length along the drum; and (c) the speed of rotation of the cylinder in revolutions-per-second.

The system to be described does not use mechanical scanning or recording units. Hence, these rules are not strictly applicable. However, the system fulfills the legal requirements for amateur facsimile as they stand, in regard to bandwidth, etc.

The first tests were made in the laboratory with "closed-circuit" models, which did not radiate a signal on the air. The test results were gratifying (see Fig. 10) and indicated that the system would be useful in actual communication.

The laboratory "station" used a modulated low-power oscillator coupled by r.f. cable to a receiver to simulate actual transmission. The transmitting equipment may be used with any good, stable transmitter in one of the frequency ranges in which A4 facsimile is permitted. When collaborators are found tests will be made over communications distances.

Bandwidth and Speed

If the bandwidth of a facsimile system is arbitrarily fixed at some reasonable value such as 5 kc., then to obtain pictures with the same resolution as a television image (which is reproduced with a 4 mc. bandwidth in a time of 1/30th of a second), the total time for the transmission of a photograph would be approximately half a minute.

However, with sacrifice of resolution, the time of transmission may be reduced. Similarly, if a wider bandwidth is to be employed, as is permissible on the higher frequency bands, then the speed of transmission may also be increased.

In view of the fact that no standards exist for this type of facsimile transmission, the equipment described utilizes a bandwidth of 5 kc. and was designed to give a picture with about the same definition as a television picture.

Basic Equipment

Every amateur telephone station possesses a receiver (1), a modulator (2), and a transmitter (3) as shown in Fig. 3. To convert this into a facsimile transmitting station only a "sync and mixer unit" and an oscilloscope (together with photomultiplier and camera) need be added.

Examination of Fig. 3 shows that the "sync and mixer unit" consists of four sub-units (or stages), namely: a 30-second time-base generator (4); a line sync-pulse generator (5); a sync-pulse discriminator (6), and a mixer (7).

Each of these stages, depending on

Fig. 4. Block diagram of the author's experimental facsimile transmitting system. The r.f. oscillator feeds the receiver directly, through coaxial cable. On-the-air tests have been deferred pending clarification of standards for this system.

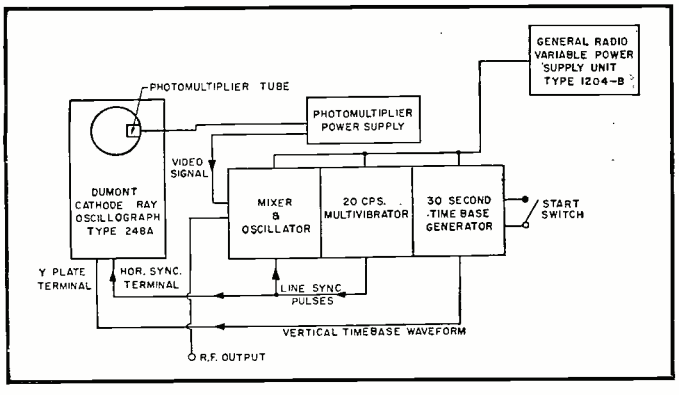
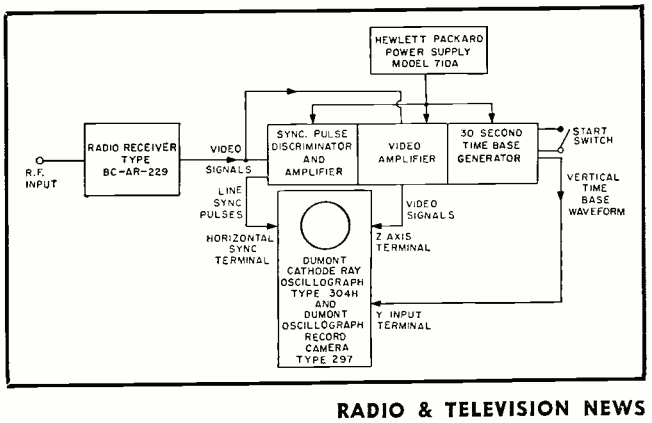


Fig. 5. Block diagram of the receiving system. The receiver, oscilloscope, and power supply were what happened to be available; other, less expensive units may be substituted. Cheap box cameras, suitably modified, may be used for recording.



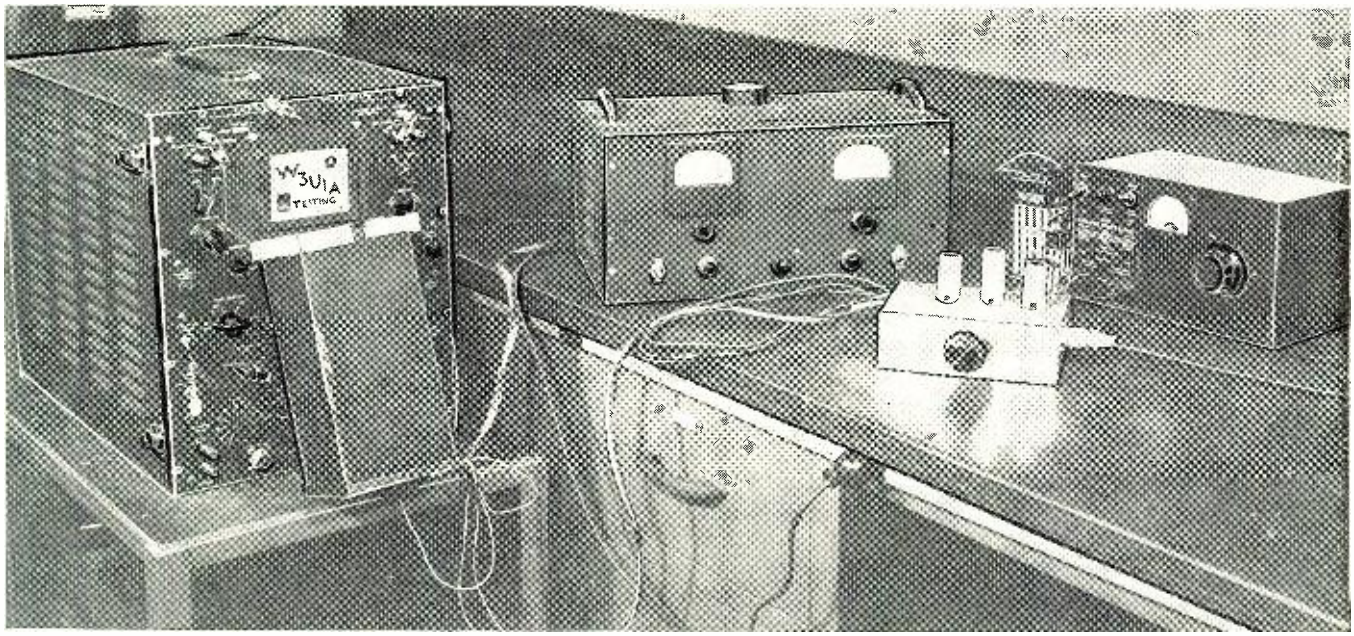


Fig. 6. The transmitting "station," consisting of oscilloscope flying-spot scanner, photomultiplier pickup tube and associated circuits (see Fig. 9), transmitter and power supply. The little transmitter chassis also houses the 30-second time-base generator and 20-cps multivibrator. Commercially-built power supply at right may be replaced by any good 250-volt d.c. supply.

its design, takes one (or possibly two) tubes. Hence, it is not a formidable unit to build, although it should be constructed so as to accommodate the high voltage supply for the photomultiplier.

The 30-second time-base generator (4) may be a conventional Miller-type circuit utilizing a pentode with a condenser strapped between its plate and grid. Shorting the "start" switch causes the plate voltage to fall linearly until "bottoming" occurs.

The sync-pulse generator (5) used only during transmission is a simple multivibrator operating at 15 or 20 cps and capable of easy synchronization to the 60-cps line frequency. Its function is twofold: to provide synchronizing pulses to the oscilloscope when it is used as a flying-spot scanner and to the mixer where they are mixed with the video signal for transmission.

The sync-pulse discriminator (6), used only during reception, is similar in design to that used in a conventional TV set. Its purpose is to separate the sync pulses from the video signals and to pass them on to the oscilloscope for synchronization.

The purpose of the mixer (7) is apparent from Fig. 3 and during transmission, mixes the video and line sync pulses for application to the modulator (2).

The oscilloscope (8) may be any available instrument, but it should have the following features: (a) a cathode-ray tube with short-persistence phosphor; (b) a *Z* input terminal with d.c. restoration; (c) a linear time base capable of good and steady synchronization at low speeds, (d) a d.c. connection to one of the *Y* plates; and, (e) good uniform brightness and focusing across the face of the tube.

The short-persistence phosphor on the face of the cathode-ray tube is required only when the oscilloscope is used as a flying-spot scanner. That used by the author was a P11 phosphor, but a P4 or a P5 should be equally suitable. (Certain tubes with P4 phosphors such as the 5BP4 and 5HP4 are available for about $5.00 on the surplus market.).

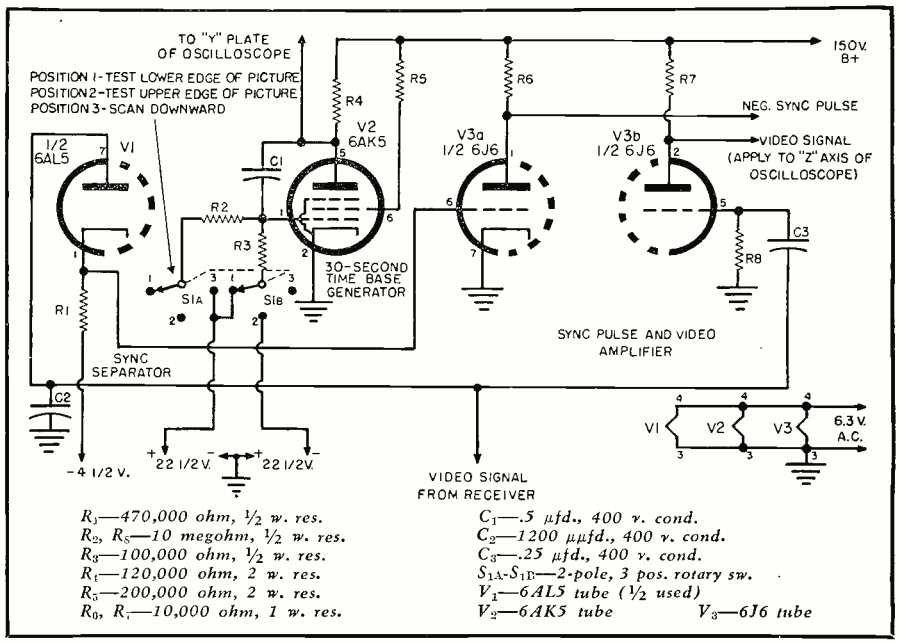
Most oscilloscopes are provided with a *Z* input terminal but in any event, an oscilloscope may be readily modified to give this provision by connecting a terminal *via* a large condenser to the grid (or cathode). The d.c. restoration should be provided by wiring a crystal diode (such as a 1N34) across the grid leak in such a manner that the grid cannot go negative with respect to the potential of the other end of the grid leak.

Although most oscilloscopes contain horizontal time bases capable of running at 15 or 20 cps which are easily synchronized, an external one could readily be built to meet this requirement. Because of the very low scanning rate of the vertical time base, a d.c. connection to one of the *Y* plates is desirable. If this is not provided on the oscilloscope, a direct connection can readily be made to one of the *Y* plates.

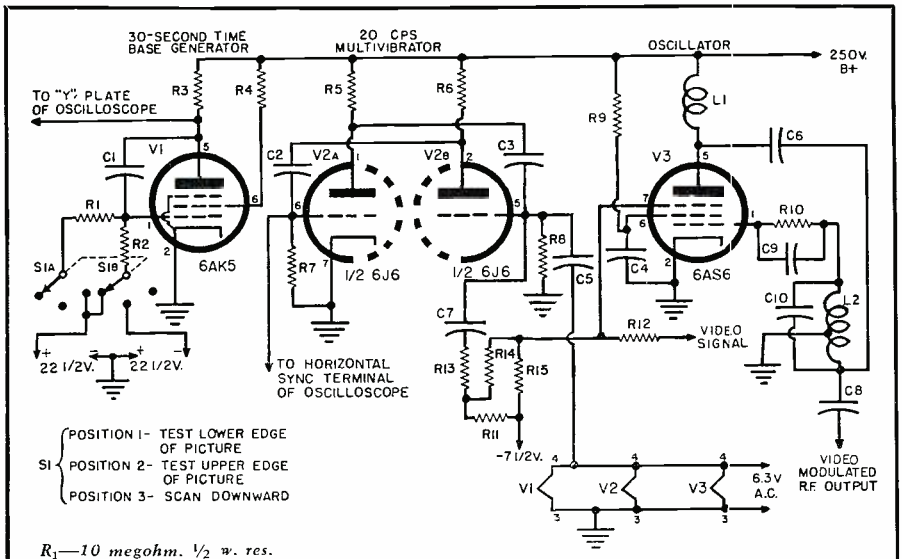
It is gratifying to find that as the video signal is applied to either the cathode or grid, the frequency response of the *Y* amplifiers is unimportant. Hence, cheap oscilloscopes are entirely suitable for the purpose.

In his experiments, the author used a *Du Mont*-modified *"Polaroid Land"*

Fig. 7. Schematic of the receiver video unit, for use with ordinary receiver.



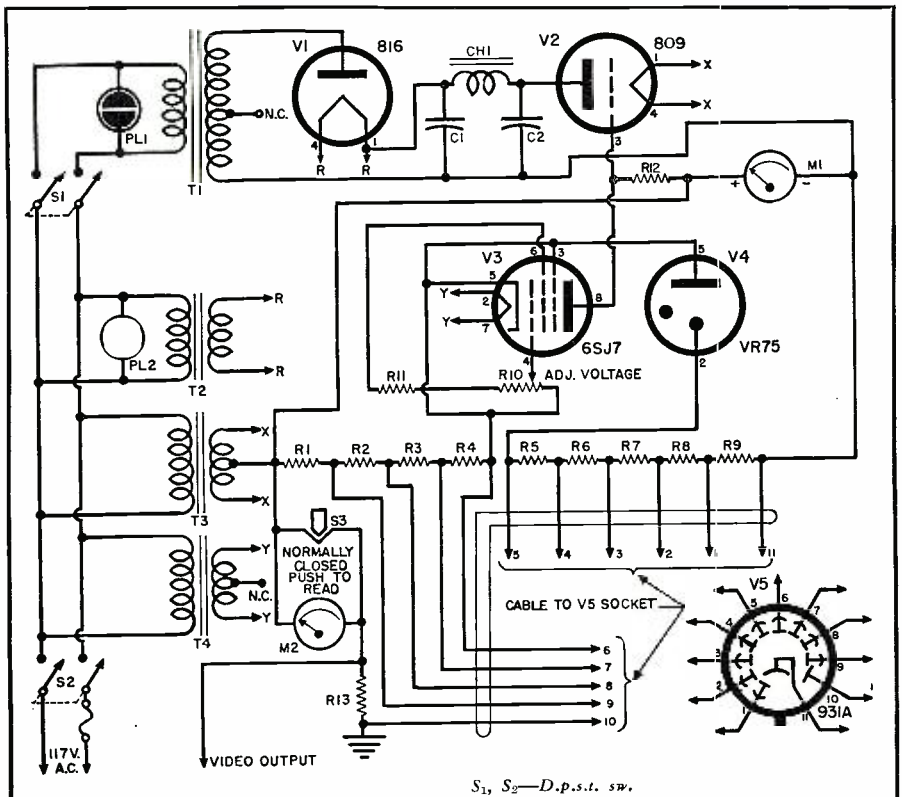
R_1—470,000 ohm, ½ w. res.
R_2, R_8—10 megohm, ½ w. res.
R_3—100,000 ohm, ½ w. res.
R_4—120,000 ohm, 2 w. res.
R_5—200,000 ohm, 2 w. res.
R_6, R_7—10,000 ohm, 1 w. res.
C_1—.5 μfd., 400 v. cond.
C_2—1200 μμfd., 400 v. cond.
C_3—.25 μfd., 400 v. cond.
S_{1A}-S_{1B}—2-pole, 3 pos. rotary sw.
V_1—6AL5 tube (½ used)
V_2—6AK5 tube *V_3—6J6 tube*



R_1—10 megohm. ½ w. res.
R_2, R_7, R_8—100,000 ohm, ½ w. res.
R_3—120,000 ohm, 2 w. res.
R_4—200,000 ohm, 2 w. res.
R_5, R_6—12,000 ohm, 2 w. res.
R_9—10,000 ohm, 2 w. res.
R_{10}—56,000 ohm, ½ w. res.
R_{11}—20,000 ohm, ½ w. res.
R_{12}, R_{13}, R_{14}, R_{15}—180,000 ohm, ½ w. res.
C_1—.5 μfd., 400 v. cond.
C_2, C_3, C_4—.1 μfd., 400 v. cond.
C_5—.05 μfd., 400 v. cond.
C_6—.01 μfd., 400 v. cond.
C_7—.005 μfd., 400 v. cond.
C_8—.001 μfd., 400 v. cond.
C_9—80 μμfd., 400 v. cond.
C_{10}—220 μμfd., 400 v. cond.
L_1—10 mhy. r.f. choke
L_2—28 t. #21 en. ½" diam. closewound. tapped 12 t. from gnd. end (4.8 mc. was used) For on-the-air tests, freq. must be within bands where facsimile transmissions are permitted.
S_1A-S_1B—2-pole, 3-pos. rotary sw.
V_1—6AK5 tube. V_2—6J6 tube. V_3—6AS6 tube

Fig. 8. Schematic of the transmitter synchronization, mixer, and r.f. systems.

Fig. 9. Circuit of the photomultiplier pickup and associated power supply.



R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9—10,000 ohm, 2 w. res.
R_{10}—50,000 ohm, 4 w. pot
R_{11}—68,000 ohm, 1 w. res.
R_{12}—510,000 ohm, 1 w. res.
R_{13}—20,000 ohm, 1 w. res.
C_1, C_2—2 μfd., 1500 v. oil-filled cond.
CH_1—8 hy. filter choke (Thordarson T20C53)
M_1—0-1000 v. voltmeter
M_2—0-100 μa. microammeter
PL_1, PL_2—NE51 neon bulb
S_1, S_2—D.p.s.t. sw.
S_3—Push-button sw. (normally-closed type)
T_1—550-0-550 v. @ 40 ma. or higher plate trans. (see text)
T_2—2.5 v. @ 2 amp. fil. trans.
T_3—6.3 v. @ 3 amp. fil. trans.
T_4—6.3 v. @ 1.0 amp. fil. trans.
V_1—816 tube
V_2—809 tube
V_3—6SJ7 tube
V_4—VR75 tube
V_5—931A tube

camera to record the transmissions because this instrument was readily available. However, it is planned to modify cheap box cameras so as to be suitable for recording purposes.

It is also interesting to note that if visual presentation of the video signals is not immediately desirable, they may be recorded on tape to be applied to the oscilloscope later. However, the recorder must have a good frequency response and must not introduce phase shifts.

Experimental Stations

To test the system, two stations were simulated in the laboratory, a transmitting and a receiving station as shown in Fig. 1 and Fig. 6. The former station utilized an oscilloscope as a flying-spot scanner, a photomultiplier pickup unit, a 30-second time base generator, a 20 cps sync-pulse generator, a mixer circuit and an r.f. oscillator shown schematically in Fig. 8. The latter station, illustrated diagrammatically in Fig. 5 and coupled to the former by r.f. transmission line. consisted of a receiver, a sync-pulse separator, a 30-second time-base generator, and an oscilloscope with recording camera. Copy was transmitted only in one direction because by so doing not only was the necessity of duplicating certain parts of the equipment eliminated, but because a one-way transmission was sufficient to demonstrate the process.

Because of his desire to test the performance of the system without undue delays, the author utilized whatever equipment happened to be on hand in a well-furnished laboratory. As a consequence expensive equipment was used where inexpensive components would have been just as usable.

Transmitter

For the flying-spot scanner, a *Du Mont* cathode-ray oscillograph type 248A was used with a photomultiplier mounted in a brass box attached by hinges to the front face of the oscilloscope. Copy to be transmitted was applied directly to the face of the tube in the form of negatives or written on the tube face with china marking pencils.

The oscilloscope utilized a 5RP11 tube and the time base was as linear as could be desired. However, the trace was not of uniform brightness and tended to be dim at the beginning and end of the sweep. Because the oscilloscope normally utilized capacitive coupling to the *Y* plates, a d.c. connection was made directly to one of the *Y* plates in the 5RP11 tube.

The photomultiplier power supply shown schematically in Fig. 9 was designed for another purpose and it was used without modification except for the insertion of a load resistor of about 20,000 ohms in series with the last dynode. Under normal operating conditions, an average d.c. current of

(*Continued on page* 128)

TV SERVICING IN THE HOME

By
RICHARD BLITZER

Discussion of the advantages of TV servicing in the home using new completely portable test instruments.

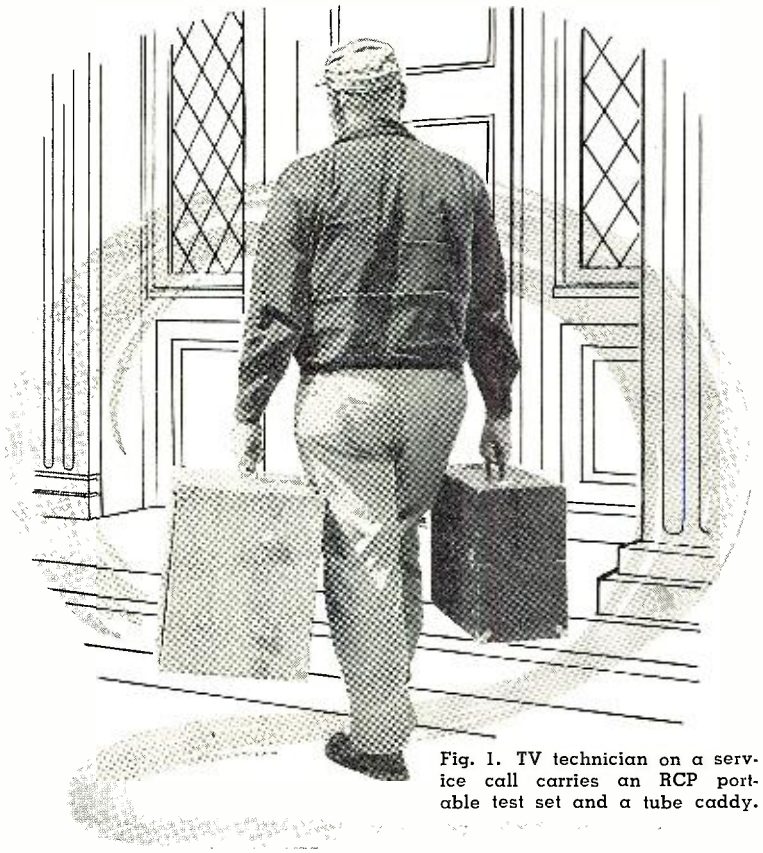


Fig. 1. TV technician on a service call carries an RCP portable test set and a tube caddy.

VERY often on a service call in a customer's home, the radio-TV technician finds himself wishing he could fix the set without having to carry the heavy chassis down several long flights of stairs. When the trouble isn't simply a tube, the usual procedure is to "pull the chassis" and carry it back to the lab.

The author, himself a TV service technician, has asked many other experienced technicians for their opinions on home servicing. Some said it would be inadvisable; others said they do as much servicing as they possibly can in the customer's home.

In the main, the objections seem to boil down to the following:

1. Lack of working space and test equipment in the customer's home.
2. Necessity for carrying many stock parts.
3. The nuisance of having the customer (or his offspring) looking over your shoulder, asking questions, and even getting in the way.
4. The possibility of damaging household furnishings.
5. The difficulty of convincing the customer, who saw you repair the set, of the validity of your bill (especially when it is large).
6. The higher operating costs resulting from the need to employ skilled outside service technicians who know as much as benchmen, and command higher salaries than the simple "tube changing" service mechanic.

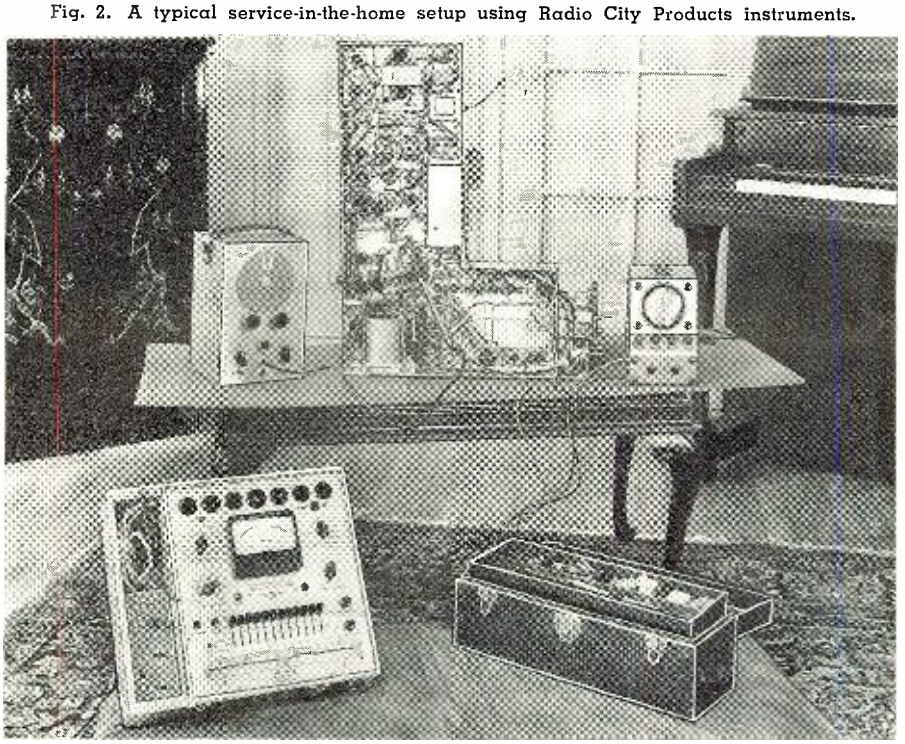
As to the first objection, most homes have a kitchen or dining room table large enough for service work. Also, compact, portable test equipment, which the technician can easily take along on all service calls, is now available, and more and more test equipment manufacturers are designing multiple functions into their individual test instruments. The carrying case in the left hand of the technician in Fig. 1, for example, contains every piece of test equipment that a service technician could need in the home. Such a test equipment set might include a tube tester (for both ordinary and cathode-ray tubes), a v.t.v.m. with high-voltage probe, AM and FM signal generators, and even a scope, and still not weigh more than 30 lbs.

Where it is apparent that the service technician will not have table space, he should not attempt to work on the floor in cramped quarters, and should remove the set to the shop.

As to the parts problem, a small supply of resistors, condensers, universally-used output transformers, and tubes, should be stocked in the truck

(*Continued on page* 126)

Fig. 2. A typical service-in-the-home setup using Radio City Products instruments.



PAGES FROM A TAPE EDITOR'S NOTEBOOK

Fig. 1. A given point on the tape is "spotted" by rapidly moving the tape back and forth past the playback head by hand.

Part 2. Methods of splicing recorded tape to provide a free-flowing performance. Actual techniques are covered.

By
DONALD C. HOEFLER

THE advantages of tape recording are well known, its most outstanding being its adaptability for editing. Before any serious editing work is attempted, one must consider the speed of the tape being used. The general rule is *the faster the better*. One can readily see that one second of sound over thirty inches of tape is easier to handle than the same sound crammed into as little as 1⅞ inches.

When 1/64 inch of 30-ips tape makes the difference between a good and bad splice—a fairly common condition in musical editing—the corresponding tolerance of 1/256 inch at 7½ ips is a near impossibility. It is often desirable, therefore, to make a 30- or 15-ips dub from a slower tape, expressly for editing, and at same time protecting the original from damage. This is also recommended for dual-track tape, for anything removed from the side being edited will result in a gap in the opposite track. Thus neither side of a dual-track tape can be edited directly, unless the companion track is expendable.

A simple editing job as a starter might require splicing together into long-play form a series of tape copies of single phonograph records. Following commercial practice, there should be a five-second pause of silent tape between selections. But as the tape stands after recording, the spaces between parts are much longer and marred by switching clicks. The problem then simply is to silence the pauses and shorten their length.

The first step involves playing the tape toward the end of the first selection, and starting a stop-watch after the music has faded out. Then follows careful listening for noises during the five seconds. If any are heard, they must, of course, be removed. This is done by pulling the tape backwards, turning the supply reel manually. When the noise is heard, the tape is stopped immediately. Then the tape is moved back and forth past the playback head until a point is found where the noise is heard whenever the tape is moved slightly in either direction. This procedure is known as "spotting", and is illustrated in Fig. 1. With the tape in this position, it is cut at each end of the housing which shields the heads, the short length removed, and the two ends spliced together. The process is repeated as often as necessary until five seconds of quiet tape is achieved. All this can be avoided, of course, by the insertion of tape known to be silent, such as erased magnetic tape or plain leader tape. In this case, the quiet tape is simply spliced to the recorded tape where the music ends. The length of silent tape is calculated as five times the operating speed of the machine. (For example: 5 seconds times 7½ ips equal 37½ inches.)

With the blank tape in place, the final step requires splicing at the beginning of the next selection. This is accomplished by pulling the tape from the supply reel past the playback head until the next music is heard. The tape is then reversed until sound just dies out, it is cut at the end of the shield housing nearest the takeup reel and spliced to the blank tape previously prepared.

There arises a somewhat more complex problem, however, when it is necessary to assemble a complete program from its composite parts without the leeway of long pauses between segments. A dramatic show, for example, which was recorded one scene at a time—or perhaps even line by line—must be joined together so as to provide cohesion and continuity.

The editor normally works with the director on this, and in order that their timing be precise the tape is marked at the exact spot where the following section should begin.

This involves another indispensable editing tool known as a china-marking or grease pencil. It is a standard stationery item, available in various colors. Bright yellow is usually best, as it shows up well against red oxide tape. But it is well to have several colors available to avoid confusion when it is necessary to place more than one mark on a given section of tape.

For precise editing the shield must be removed from the playback head so that the tape may be marked at the moment it passes the head. It is played beginning a little ahead of the point where the *segue* is desired, and the pencil point is held almost touching the tape directly over the gap on the playback head. On the director's cue, the pencil immediately strikes and marks the tape, as shown in Fig. 2, and the cut is made at the beginning of the mark. The following part is then pulled manually past the head until the beginning of the desired sound is heard, and rocked back and forth until the exact point is located. A mark is placed on the tape over the gap, as shown in Fig. 3, and a splice marked and cut. Finally the splice is auditioned to verify the result.

Until a splice is approved, it is is made there to the end previously good practice to save the tape which was removed. Then if for any reason the splice must be lengthened, some

of the identical tape may be reinserted, thus preserving the continuity of "room tone."

When breakdowns occur, due either to production difficulty or to equipment failure, the program can still be edited together by the use of the same techniques. It is important, however, when recording is resumed, that the continuity be picked up several lines ahead of the intended splice. For when a speaker begins "cold", he will usually begin with an inflection which will sound unnatural in the middle of a speech. When he is required to backtrack, he will have settled down to his normal pace and inflection by the time he reaches the point of the splice.

It naturally follows then that an editor can do much to put together a well-knit production by cutting out "fluffs" and smoothing the continuity. He may not be able to make a bad production sound good, but he can make a good one sound even better.

Some editors have argued that the frequency response curve of the playback system used for editing should have a marked rise around 4000 cycles, to take advantage of the point of greatest sensitivity of the human ear. But while the editor of radio shows and other material consisting largely of speech may find such a system to be advantageous, it is out of the question when a great deal of music is involved. The music editor may find in one instance that the only convenient place for him to cut his tape is at the beginning of a pizzacato bass note, or again it may be a very high note struck on a triangle. Thus he must have a flat wide-range system which will permit him to find a cue for cutting anywhere throughout the spectrum.

Since a much wider frequency range and greater variety of tonal values are involved in the editing of music, this work is considerably more complex and exacting than the editing of speech. A situation requiring musical editing occurs in the compositing of parts of a musical work which are incomplete due to breakdowns. Here again it is essential when recording that the artist be required to resume several phrases ahead of the point where the breakdown occurred.

Assume, for example, that an artist makes a mistake at bar 209 of a given composition and the recording is stopped. The next take should begin perhaps around bar 200. The editor will then have on tape an overlap of a half-dozen bars or so which should be identical in tempo, dynamics, and timbre. Somwhere in this area he must find a point at which to cut each of the tapes, remove the excess, join the remaining ends and produce synthetically a continuous musical performance.

If there should happen to be a pause during those few bars, the job is simple and may be accomplished by use of the techniques described for speech. But usually a musical tone must be found which will be used as the cutting cue. A sharp attack by an instrument or section is always easier to spot, and the percussion instruments, harp, piano, oboe, trumpet, French horn, and vocalists usually provide the better cues. The final spotting is done by rocking back and forth, the tape which is removed is preserved temporarily, and the finished splice is auditioned for musical correctness. The first question concerns the content. Were both cuts actually made at the same point—or at two different points which sounded similar? If the latter be true, the composite will have music either missing or duplicated. Next check for tempo and phrasing. Is it identical to that on the original composite parts? Finally check the sound of the splice itself. Does the attack sound natural? If the two cuts were not made at identical points, the resulting composite may have a double attack —sort of a stuttering effect—on one note; or the attack may have been cut off and the tape cut into the middle of the note. But even with all these precautions, there are occasions when the performances between takes differ to such an extent that a smooth splice is impossible. At this point, the editor must dig deeper into his bag of tricks.

One must re-record and *crossfade* whenever the two tapes to be joined contain a musical overlap but lack any identical points for splicing. This sometimes occurs in the compositing of breakdown parts, but it is encountered most often when a piece of music must be assembled into long-play form from composite parts originally recorded on 78 rpm records. Every side break must then be analyzed, usually with the aid of the musical score, and the treatment necessary to produce the effect of a continuous performance must be devised. Consider the case of a recorded opera where a given side ends with the end of an aria. Suppose that the following side begins with an orchestral passage which, according to the score, should begin at the same time as the last note of the aria is sung. In other words, the first note of the orchestra should begin *simultaneously* with the last note of the aria. It is obvious then that both of these records should, for a brief period, be playing at the same time.

For this job two tape machines (or two turntables, if disc is the source) are required for playback, and a tape recorder is necessary for the master recording. The two playback machines are placed side by side, with one of the recordings on each, and the outputs are fed into a mixer whose output supplies the tape recorder and monitor system. The outgoing part is then played a few times, and a musical cue is established which will be used as the

(*Continued on page* 126)

Fig. 2. When a succeeding sequence of tape is to be applied to an earlier part, the point at which the splice is to be made is marked on the first tape while it is being played back.

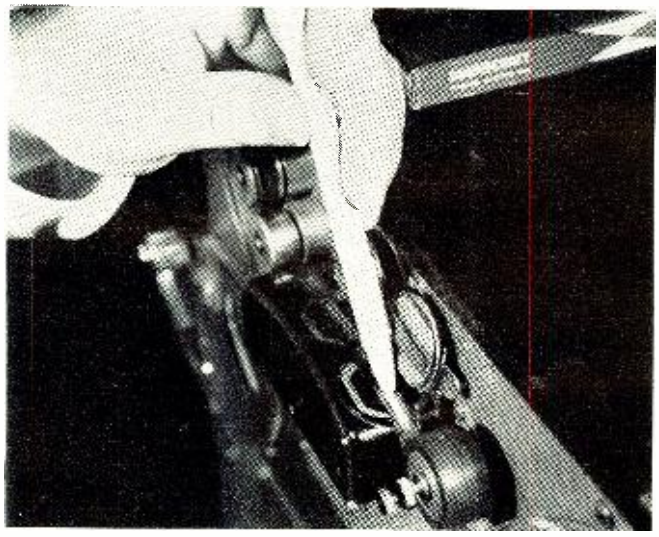
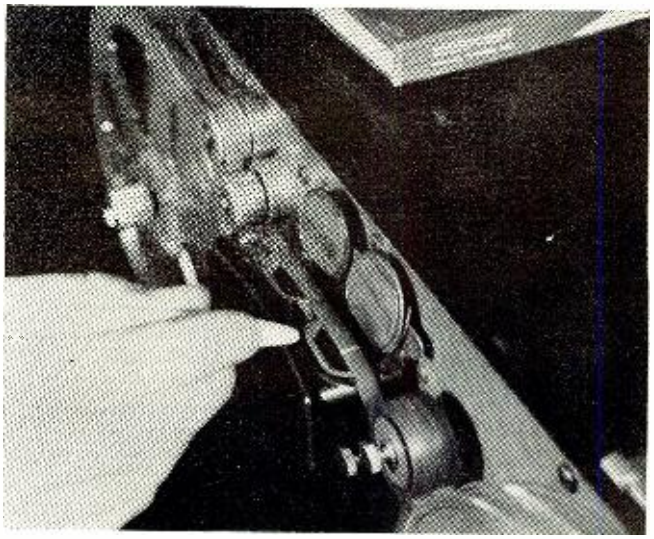


Fig. 3. When a desired sound has been isolated to a given point, a mark is made at that point. Since the sound heard on the tape is directly over the playback head, that is where mark is made.



THE Compleat FIDELITY

THE TV SET

By **DON V. R. DRENNER**
Engineer, Station KGGF

Part 2. A booster for the Craftsmen TV-200 and a vertical blanking circuit to be added to improve fringe reception. Data on an equalizer for the RC-10 will appear next month.

LAST month the author described the various components which comprised his home installation for high-fidelity reception and gave details on the wall baffle-box which was designed and built to house his *Western Electric* 35-watt speaker.

This article covers several modifications made on the author's *Radio Craftsmen* TV-200 television chassis in order to provide primary area reception in what is essentially a fringe area.

Our choice of the *Craftsmen* TV-200 for the television end of "The Compleat Fidelity" was dictated by *fidelity*. We mean to the ear as well as to the eye.

The intercarrier set, while economical, just doesn't have the capabilities of the split-sound type when it comes to audio. Lack of limiting and the "intercarrier buzz" are well known. So we wanted separate i.f.'s for the video and sound, and at least two limiters.

Being in a fringe area we needed a booster, so we made that. It is a 6BQ7 (or a 6BZ7), in a neutralized cascode circuit, patterned after one in *"Sylvania News"* for November 1951.

We could have modified the 200's front end and installed a cascode tuner. But an r.f. amplifier, even a low-noise high-gain one, feeding the mixer directly does not give as good a noise figure as when feeding a pentode 2nd r.f. stage *before* the mixer. So the original r.f. stage became our 2nd. When other channels become available (we receive only Channel 6 now) another booster will be built or a channel switch added. If all this sounds fussy, well we receive usable signals when our neighbors have a screen full of snow!

The cascode circuit shown in Fig. 1 uses neutralizing to improve the noise figure. In construction, isolate the input and output coils, and keep all leads short, particularly the input and output coils.

The coil table (Table 1) should be used as a guide since some variation of a turn or so is to be expected in the grid and plate coils.

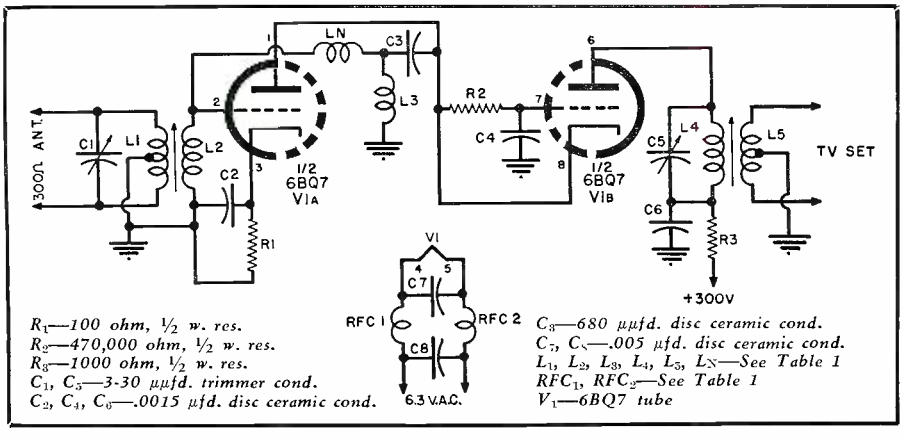
A separate power supply is preferred, but the necessary heater and plate voltages may be picked up from the TV set.

CHANNEL	L_1*	L_2	L_3	L_4	L_5*	L_N	RFC_1, RFC_2
2	3 t.	12 t.	18 t.	18 t.	4 t.	32 t.	12 t.
3	3 t.	10 t.	14 t.	18 t.	4 t.	32 t.	12 t.
4	3 t.	8 t.	14 t.	12 t.	4 t.	32 t.	12 t.
5	3 t.	8 t.	11 t.	12 t.	4 t.	20 t.	12 t.
6	3 t.	8 t.	11 t.	12 t.	4 t.	20 t.	12 t.
7	2 t.	3½-4 t.	8 t.	5 t.	1 t.	11 t.	5 t.
8	2 t.	3½-4 t.	8 t.	5 t.	1 t.	11 t.	5 t.
9	2 t.	3½-4 t.	8 t.	4 t.	1 t.	11 t.	5 t.
10	2 t.	3½-4 t.	8 t.	4 t.	1 t.	10 t.	5 t.
11	2 t.	3½-4 t.	8 t.	4 t.	1 t.	10 t.	5 t.
12	2 t.	3½-4 t.	8 t.	4 t.	1 t.	10 t.	5 t.
13	2 t.	3½-4 t.	8 t.	4 t.	1 t.	10 t.	5 t.

*L_1 and L_5 are center-tapped. L_1, L_2, L_4, L_5—#24 en., 5/16" dia. slug-tuned forms; L_N—#24 en., ¼" dia.; L_3, RFC_1, RFC_2—#20 en., ¼" dia. All coils are close wound.

Table 1. Winding data for the various coils required in the booster circuit. Fig. 1.

Fig. 1. A simple booster circuit which can be added to the Craftsmen TV-200 set.



R_1—100 ohm, ½ w. res.
R_2—470,000 ohm, ½ w. res.
R_3—1000 ohm, ½ w. res.
C_1, C_3—3-30 μμfd. trimmer cond.
C_2, C_4, C_6—.0015 μfd. disc ceramic cond.
C_8—680 μμfd. disc ceramic cond.
C_7, C_5—.005 μfd. disc ceramic cond.
L_1, L_2, L_3, L_4, L_5, L_N—See Table 1
RFC_1, RFC_2—See Table 1
V_1—6BQ7 tube

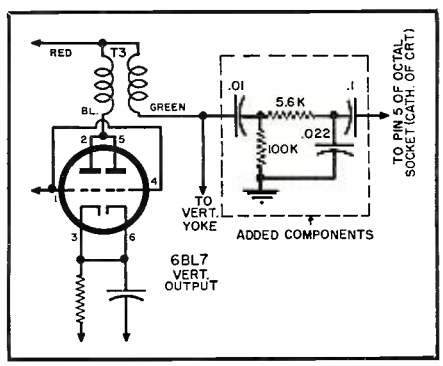
Vertical Blanking

One of the most annoying problems in many TV sets, particularly in fringe area service, is the visible vertical retrace lines. These appear when the brightness control is advanced. Theoretically, the black level is set at the transmitter, and if your d.c. restorer is functioning, or the tube isn't weak, you shouldn't have to touch the brightness control once it is set. In a weak signal area, however, too often average brightness will coincide with prominent retrace lines.

In the *Craftsmen* TV-200 used in

(*Continued on page* 146)

Fig. 2. Circuit for vertical retrace blanking.



A Dual Channel RECORDING SYSTEM

By OLIVER READ *

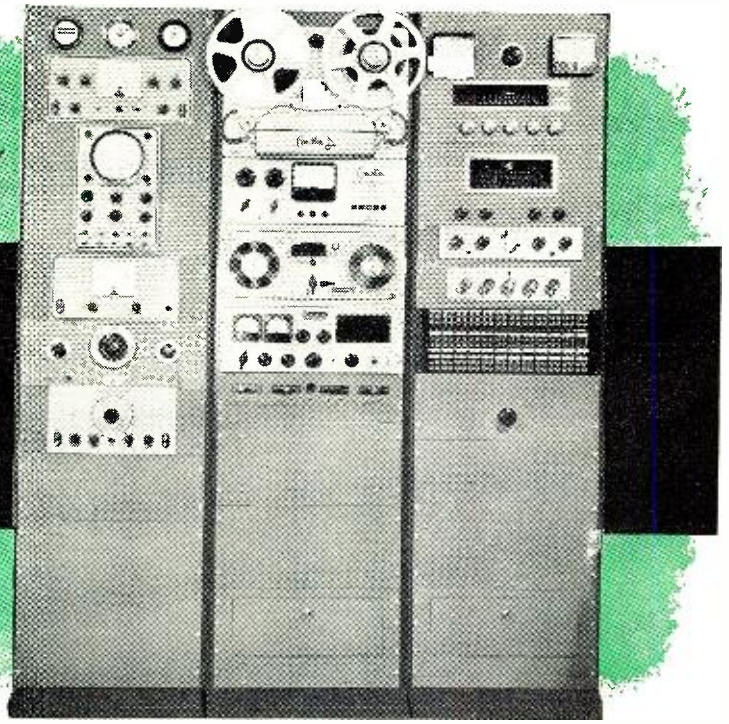


Fig. 1. The relay racks comprising the system are interconnected by means of cables to permit simple relocation of the system at any time, as required.

Part 2. Three standard 6-ft. relay racks and a turntable console contain all of the essential components, providing complete facilities for monaural and binaural recording.

ONE of the prime requisites of a hum-free audio system is to isolate the various signal circuits, so that there will be no crosstalk between components resulting from audio levels differing by approximately 20 db.

Reference to Fig. 1 shows the mounting of components on the control rack (right side) comprising the following: *Fisher* and *Craftsmen* FM-AM tuners, preamp-equalizers, jack panels, line amplifier, monitor amplifier, power amplifier, and the three barrier-type terminal blocks.

A somewhat simplified means for selecting various circuits is employed at the inputs to the system. Each of the preamp-equalizers (Fig. 4) is normally equipped with five separate inputs, any one of which may be selected at the control panel of the preamp by means of a switch. In this system, all of the inputs, such as pickups, microphones, etc., are connected permanently to the preamps, but each of these inputs is so wired within the system that ready access to these circuits is always available by means of patch cords. Note that each tuner, microphone, pickup, and tape channel is connected to the preamplifiers through double (normalled) jacks, so that continuity of signal remains intact under normal conditions (Fig. 2) and when no patch cords are inserted into the jacks. This circuitry employs the "double jack" system. Another, used by *CBS* and others, uses a single jack and three-way plug, Fig. 3. It should be noted that the diagram (Fig. 4) is in simplified form, and only the signal circuit (hot lead) is indicated. In addition, of course, the system employs a return wire and a separate insulated shield. Following good engineering practice, all shielded pairs are insulated over-all to prevent unintentional grounding of the shields when bunched and laced and mounted within the racks. In practice, these various shields are grounded only at the input or output of a component. The jack frames (no signal connection) are grounded to the rack at the jack panel, Fig. 5. The entire system is unbalanced, that is, one side of the signal circuit is at ground potential.

The only exception—and strictly up to the user—would be to modify the design for a balanced condition, especially for the bridging bus. It has been found from experience in testing such systems that, for general recording or all-around audio measurement work, it is not essential to employ the balanced system. Because most high-fidelity components are designed strictly for unbalanced connections, it is well to follow that standard in a system such as this.

It is foolish to enter into the construction of a professional system without providing spare jacks to take care of additional circuits when required. These have been provided, anticipating future changes, and will be required from time to time.

All principal signal circuits terminate in the jack field (Fig. 6). Accordingly, any signal is available for test, and each input or output may be "picked up" by means of a patch cord and plug, see Fig. 9. For example, if a dual channel is required from the two outputs of P-E_1 and P-E_2, then patch cords would be inserted in the output jacks of the preamps and connected to any two of the four power (or monitor) amplifiers shown in Fig. 4. In this application, the bridging bus and the line amplifier would be bypassed. In normal use, however, the line amplifier and bridging bus remain permanently (normal) in the circuit.

The entire system (for monaural) is designed to be completely operative without the use of any patch cords. Such cords are only intended to alter the permanent connections as they appear (Fig. 4). It will be obvious that many modifications may be made for connecting various components by means of patch cords.

The wiring diagram for the control rack (Fig. 10) is in simplified form and shows only one-half of each signal pair. In all cases, the return wire indicated by dotted lines is incorporated. The jack panel (top) contains all of the jacks terminating at the inputs of the preamplifiers. For test purposes signals may be selected from the lower jacks, or signals may be fed from a test oscillator, etc. into the jacks on the upper row. This is most convenient for re-recording, dubbing, or for miscellaneous test purposes. Substitute phono pickups may be easily patched into the phono channels of the preamps for comparative tests. Because

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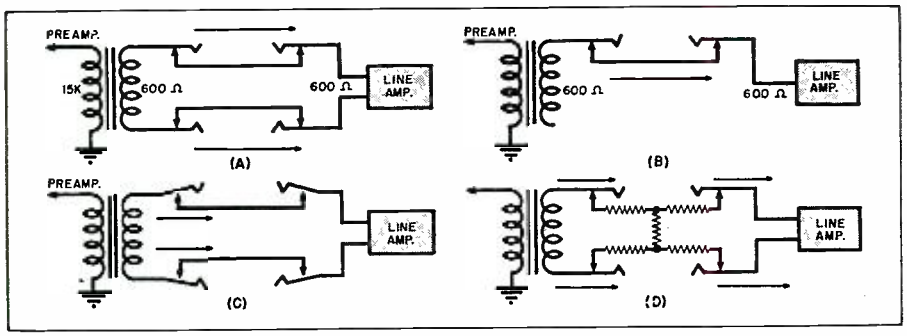


Fig. 2. (A) Typical normalled through circuit. (B) Simplified method used in Fig. 4. (C) Action of jack springs. (D) An alternate loss pad circuit.

Fig. 3. Patch cord and plugs for the CBS single-jack system. See text for details.

these are all low-level circuits, all pairs are bunched separately and isolated from the other circuits of the system. The cable containing these low-level circuits terminates in a barrier strip (Fig. 7) at the bottom panel of the rack. The various components are connected into the system at this point.

The center row contains the line-level and some of the power-level jacks. Most of them are wired permanently to the bridging bus. Reference to Fig. 10 will show a 750-ohm resistor connected to one pair of jacks. This is called the terminating resistor and serves to load the circuit so that the total parallel impedance of all the equipment permanently connected to the bus will total 600 ohms. It is important, of course, to maintain this impedance inasmuch as the vu meter and its multiplier are calibrated for a source impedance of 600 ohms. Most of the components fed by the bridging bus are of high impedance. In this particular installation, amplifiers 1, 3, and 4 are designed for an input impedance of 100,000 ohms. Amplifier #2 (*McIntosh* 50W2) is provided with a 20,000-ohm bridging input. The *Concertone* network tape recorder is also of a high input impedance.

Note that a master gain control is inserted between the line amplifier and the bridging bus. This should be a high-quality broadcast-type control, having a constant resistance of 600 ohms both in and out. In application, it serves to adjust the level at the bridging bus and represents a line level of approximately +4 vu.

The lower jack panel was designed to provide spare jacks and for connecting miscellaneous components such as the matching transformers, hybrid coil, diameter equalizers, etc. These transformers are mounted on a panel directly below the bottom row of jacks, as seen in Fig. 8. The panel also mounts the line amplifier, which is a modified *Pickering* 230H preamp. Equalization circuits were removed and a dual 100,000-ohm pot added ahead of the input grid. An output transformer was added to match a 600-ohm line. The dual pot terminates at the outputs of the preamplifiers, as shown in Fig. 4, and serves as a mixer and level set. The outputs of the two preamps employ cathode followers, and are designed to be fed into a load of 100,000 ohms.

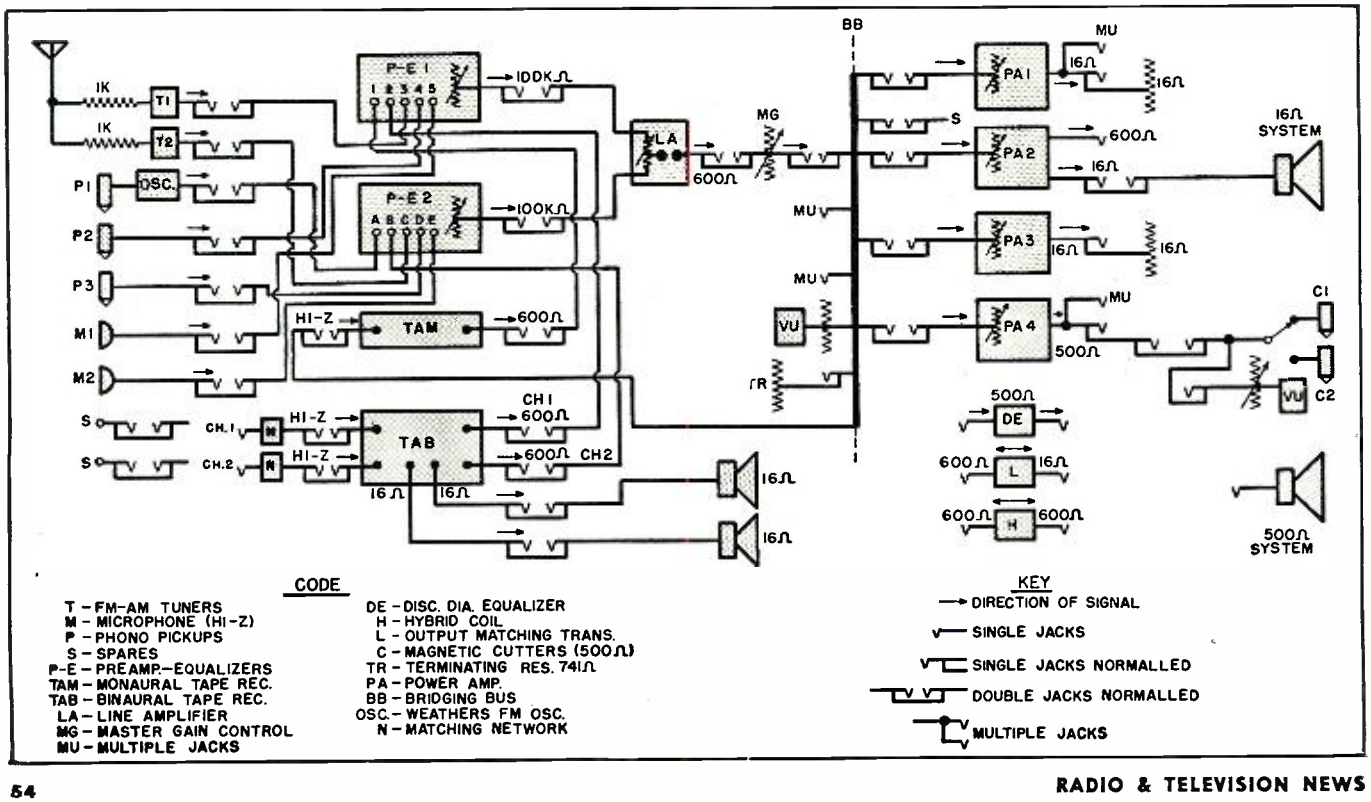
The output of the monaural tape machine (*TAM*) normally is wired for a balanced output of 600 ohms. This was modified to an unbalanced connection and feeds to $P\text{-}E_1$.

The outputs of the binaural tape machine (*TAB*) are also wired for a balanced connection. The machine, however, may be ordered for an unbalanced output which simplifies the connection to $P\text{-}E_2$.

The inputs of the *Magnecord* are for 50-ohm microphones. These remain as is for field work or for binaural recording for identical 50-ohm microphones. Suitable bridging pads have been installed in this system so that the outputs of $P\text{-}E_1$ and PE_2 may be patched to the inputs of *TAB* for binaural recording from signals fed through the two preamps. This setup has been used recently for "off-the-air" binaural recording from simultaneous AM and FM transmissions. The system is easily modified for various binaural connections and will be obvious to the user.

Because the *Magnecord* has its own self-contained power amplifier, play-

Fig. 4. A simplified block diagram of the system. The jacks are connected as shown in Figs. 2 and 10.



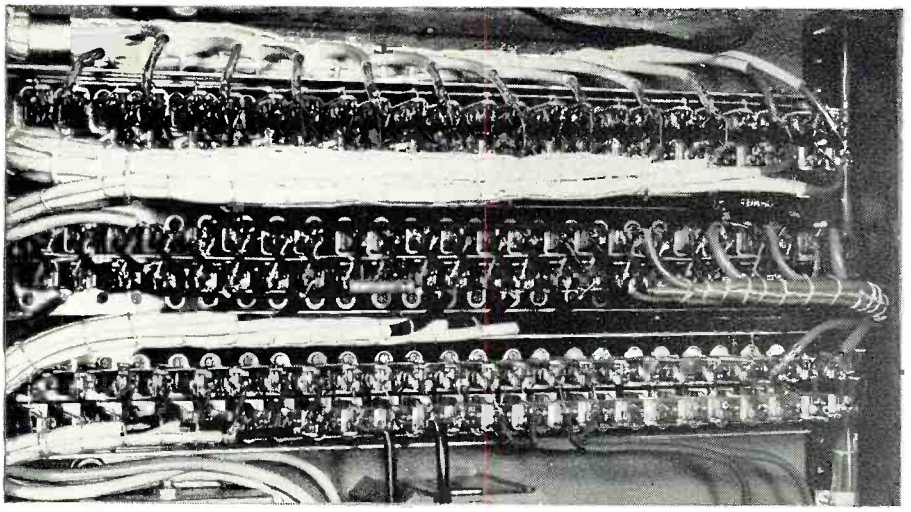


Fig. 5. Rear view of jack panels. The circuits are grouped at three (low, line, and power) levels to prevent crosstalk. See Fig. 6 for front view.

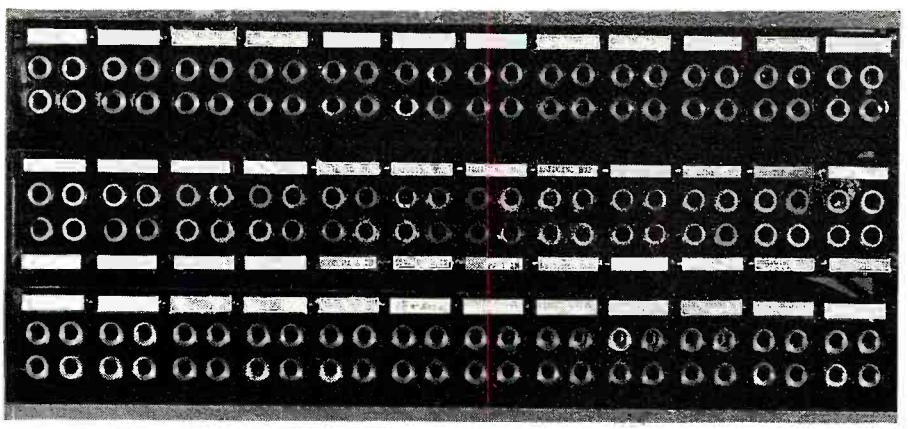
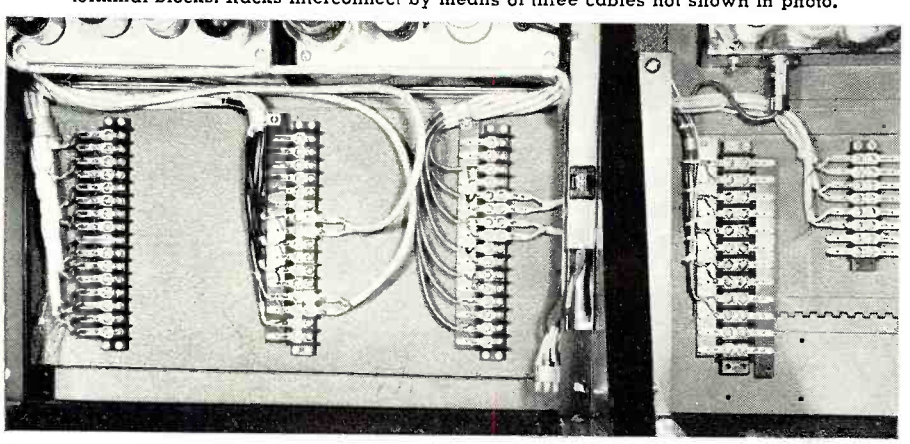


Fig. 6. The three double-jack panels. Jack frames must be grounded to rack.

back may be obtained through two identical speakers, separated by at least 8 feet, and with a very worthwhile spatial effect added by setting the preamp selector switches to positions 2 and *B* respectively, and by combining the two binaural signals through the system to a monaural speaker which is centrally located as a point source of sound. In practice, the effect is somewhat startling and, in many cases, especially in reproducing symphonic works, provides a most pleasing listening effect. It is important, of course, that all loudspeakers be properly phased for binaural reproduction, and equally important to phase the monaural speaker when used in conjunction with this technique.

It is important to choose similar components for any binaural application. The *Fisher* and *Craftsmen* tuners, for example, have similar characteristics. They are both fed from a common high-gain FM antenna with isolating resistors of 1000 ohms connected as shown. In practice there has been no interaction using this method. (*Continued on page* 156)

Fig. 7. Signal circuits connect to the low-level, line-level, and power-level terminal blocks. Racks interconnect by means of three cables not shown in photo.



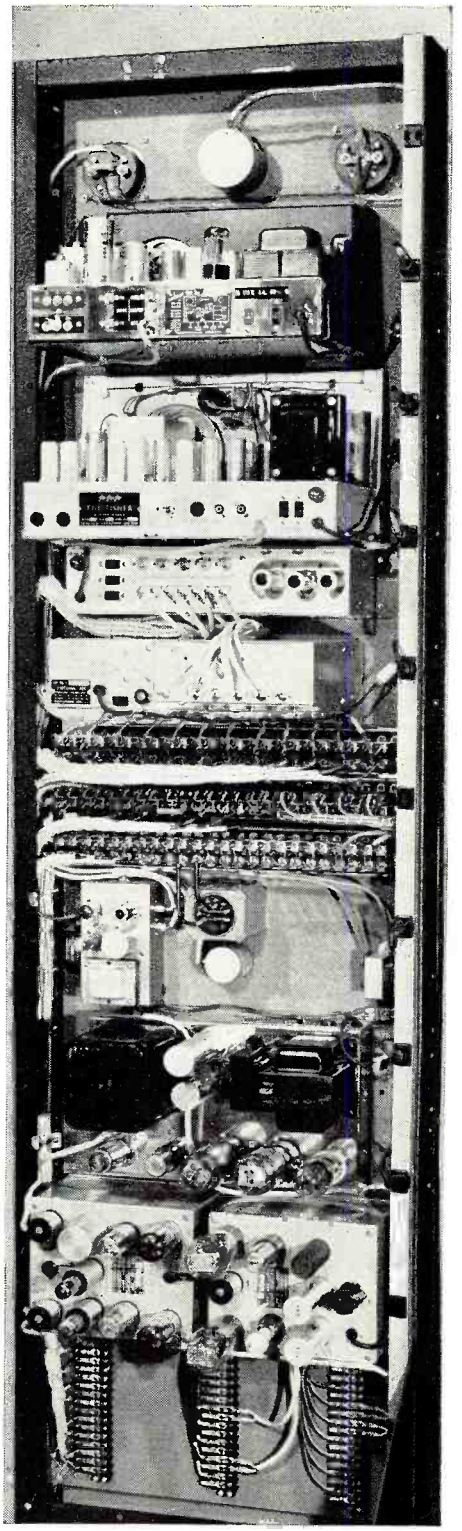
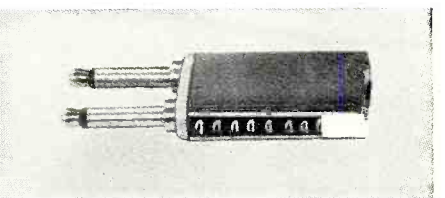


Fig. 8. Over-all rear view of the control rack. Low-level and line-level circuits (left side) and power level and a.c. (on right side) prevent crosstalk in system.

Fig. 9. Plug for double-jack system. Notches serve to indicate polarity and usually are inserted with these on the left side.



The Purist
A NON-CORNER HORN

By
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and
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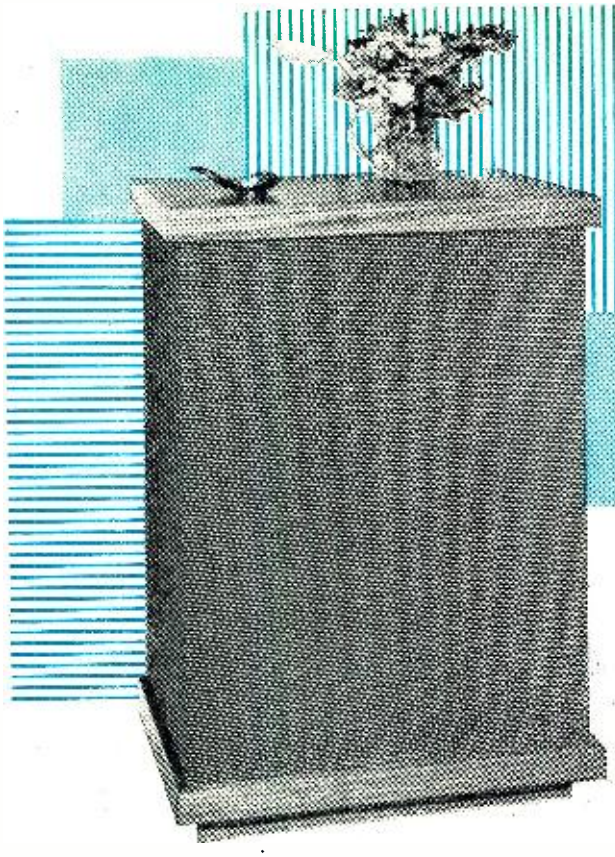


"The Purist," a commercial version of a non-corner horn.

Evolution of a non-corner horn which meets seven exacting criteria as to appearance, size, performance, and price.

DURING the past decade more attention has been devoted to loudspeakers and loudspeaker enclosures than almost any other phase of audio development. This has been so because the loudspeaker and its necessary housing has been and still is the weakest link in the audio chain with respect to distortion, frequency response, transient response, and power handling ability.

The authors have spent the last year working out a horn-type enclosure which does not rely on the corner of the room to act as an extension of the horn mouth. At the outset, the following criteria were established:

1. The mouth area of the horn should be adequate to eliminate reflections from the horn mouth and to avoid standing waves inside the horn.

2. The horn should have a slow taper rate in order to obtain extended low-frequency response.

3. The ratio between the effective area of the speaker and the area of the throat of the horn should be approximately unity to insure close coupling while avoiding distortion due to non-linear compression of the air.

4. The design should be completely non-resonant in order to preserve transient response and avoid the "Johnny One Note" bass.

5. The air loading on the speaker should be increased in order to reduce speaker distortion, increase power handling capabilities of the speaker system, and improve the acoustic damping on the speaker cone.

6. The size of the enclosure should be such that it will fit into the average living room without dwarfing the grand piano.

7. The styling should be such that it will match both modern and traditional decor.

Early experimental work indicated that a horn which exhausted on the front of the cabinet would not be practical because the horn would have to be much too large to meet the criterion for compact size. Further work on the problem indicated that a horn exhausting on the sides might result in an increase in the effective mouth area by the formation of images of the mouth along the wall and floor. A horn of this type was constructed. Fig. 1 shows a cross-sectional view of this design and illustrates how the enclosure exhausts on both sides. Fig. 2 shows images of the horn mouth. However, this enclosure proved to be too large if the other criteria were to be met and this approach was abandoned.

Next, the principles underlying the "Super Horn" design were re-examined. Fig. 3 shows a cross-sectional view of the "Super Horn" and Fig. 7 shows the same cabinet with the front grille cloth and frame assembly removed to illustrate the acoustic images formed by the floor and walls of the room. Images I_1, I_3, and I_5 are real images and I_2 and I_4 are virtual. The existence of these images can be easily proved by setting up three hand mirrors in a mutually perpendicular configuration so that they represent the walls and floor of a room. Inserting a small piece of paper in the position that the horn mouth would normally occupy will clearly illustrate the manner in which the acoustic images are formed. This same technique can be followed with the other enclosures referred to in this article.

Fig. 4 shows how two "Super Horns" may be used side-by-side along a flat wall. This is possible because each horn appears to the other as a wall and the expected images are formed along the wall and at the floor. However, an enclosure of this type is difficult to style so that it will fit in with conventional furnishings. Fig. 10 shows how four of the "Super Horns" could be used in the center of a room. Each horn gains its images from the presence of the others and the floor. If this configuration is cut along line *A-A'* a conventional rectangular enclosure results. The fact that an enclosure of this type exhausts on three sides enables it to use the walls on both sides and the floor in front to gain adequate mouth area by the image method. Fig. 8 illustrates the formation of these images. A rearrangement of the upper internal baffles simplifies construction and increases the internal bracing of the enclosure. This approach enables us to satisfy the criteria established for such an enclosure.

The commercial models of this improved enclosure have been named "The Purist". Fig. 9 gives the im-

(*Continued on page* 142)

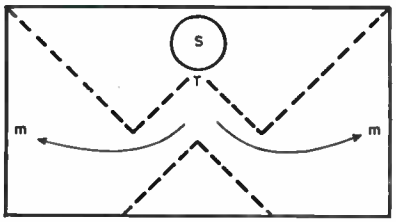


Fig. 1. Front view showing horn path in an early experimental wall horn model.

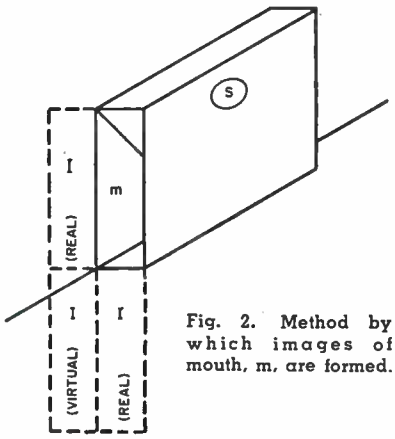


Fig. 2. Method by which images of mouth, m, are formed.

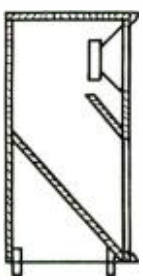
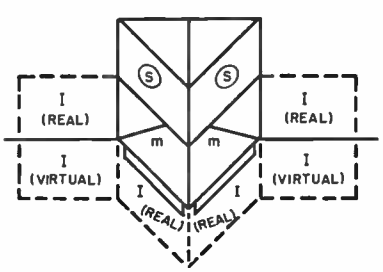
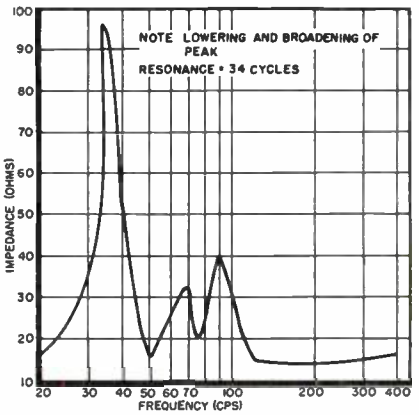


Fig. 3. Cross-section view of the company's "Super Horn" enclosure, as described in the Sept. 1953 issue.

Fig. 4. How two "Super Horns" can be used along a wall and how images are formed. See text.





Impedance curve of a 15-inch speaker in "The Purist." The Chamber for this test was deliberately unpadded to show any standing waves or reflections.

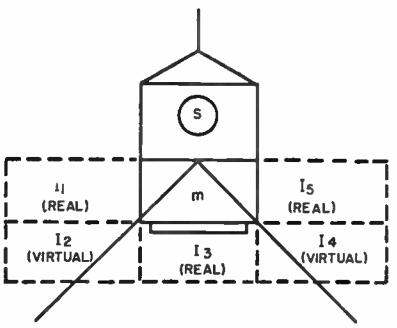


Fig. 7. Front view of the "Super Horn" (also shown in Fig. 3) illustrating how the images are formed. See text for details.

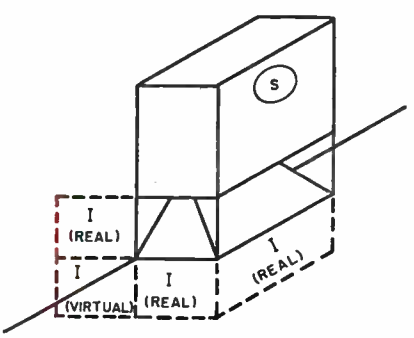


Fig. 8. "The Purist," located along a wall. showing method by which images are formed

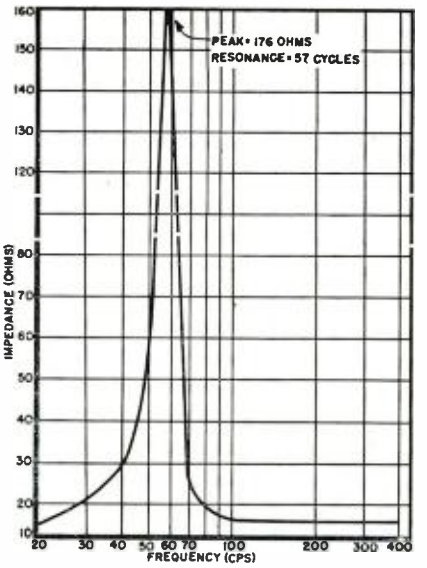


Fig. 9. Same speaker as in Fig. 6 mounted in well-padded infinite baffle of the same dimensions as "The Purist" cabinet.

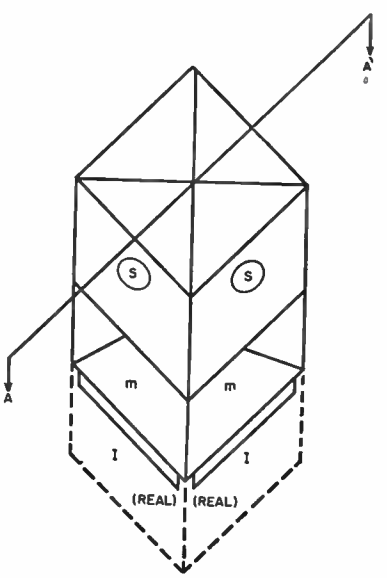


Fig. 10. Four "Super Horns" located in the center of room and how images are formed.

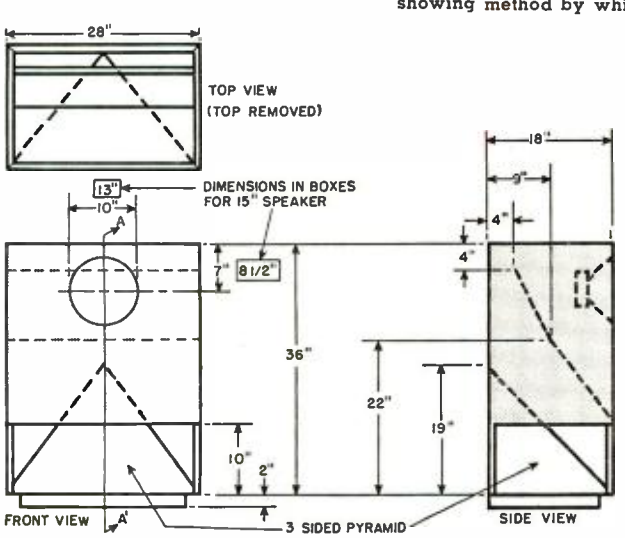
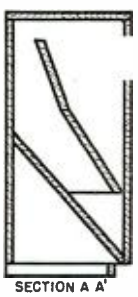
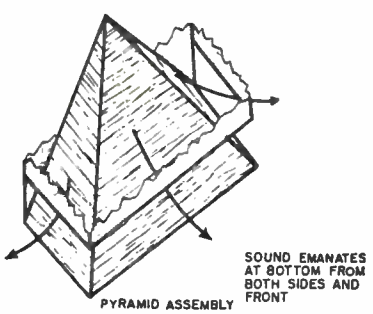


Fig. 5. Complete mechanical details for building "The Purist" enclosure. Care must be taken to insure an airtight seal otherwise performance will be impaired. All joints should be both screwed and glued for rigidity.



SECTION A A'



PYRAMID ASSEMBLY

Servicing TV LOW VOLTAGE SUPPLIES

By **MILTON H. LOWE**
Coastal Publications Corp.

A high proportion of TV troubles occur in the "B" power supplies. Here are the various types with service tips.

THIS article is intended for those service technicians who mistakenly feel that the easiest troubles to clear up are those which develop in the TV receiver "B+" supply.

The newer types of low-voltage supplies, as used in 1953-1954 receivers, differ in certain respects from their earlier counterparts. You can no longer expect to find only a straightforward full-wave supply comprised of one or two dual-diodes and associated circuit components, or a few selenium rectifiers stacked to function as a voltage doubler or tripler. Rather, you can expect to find two separate full-wave circuits which supply both low and high "B+" potentials, or other modified versions of the old full-wave circuit. In addition, a number of manufacturers have been forced to return to electromagnetic speakers, due to the defense effort requirements for magnetic materials, and this has resulted in the use of the speaker field coil as the filter choke which has a definite bearing on troubleshooting. Complicating the problem still further is the variety of power supply hook-ups, and the manner in which the d.c. is distributed to the various stages of the receiver.

In general, there are three categories of low-voltage supply troubles. First, there are those which are definitely "B+" supply troubles. That is, the symptom indicates trouble in the "B+" supply and the trouble is actually located there. Second and third, are those which *may* be in the "B+" supply. These include those troubles whose symptoms indicate a defect in the low-voltage supply, but whose actual trouble location is elsewhere; and those which don't look like power supply troubles, but are. The latter two categories are the most troublesome. The ability to recognize each type supply, and understand its particular features, is essential to efficient troubleshooting.

Fig. 1 is the simplified schematic diagram of a seemingly familiar basic type of low voltage power supply. As far as the supply itself is concerned, it consists of a single 5U4G connected in a full-wave rectifier circuit with a single "pi" section filter. The choke in this filter is the field coil of the speaker. The easiest way to recognize this type supply is either to look at the speaker to see if it is an electromagnetic type, or to look at the chassis to see if a filter choke is mounted in the vicinity of the supply.

In tracing through the entire schematic of this receiver, a number of interesting points were noted and incorporated in the simplified diagram. These have to do with the use of tubes functioning as voltage dividers, in addition to their normal function. The audio output tube, for example, is connected in series with the plate circuits of the tuner, the sync circuits, the video amplifier, and the a.g.c. delay circuits—all across the power supply. Thus, if the sound output stage should become defective, the potential developed in its cathode circuit would change, and the aforementioned stages would operate improperly, if at all. Notice also, that the plates of the 1st and 2nd i.f. amplifiers are effectively in series. The cathode of the 2nd i.f. amplifier operates at approximately 120 volts above the chassis ground potential and thus supplies the plate of the 1st i.f. amplifier with its plate potential. Therefore, if either the 2nd or the 1st i.f. amplifier tube becomes defective, the "B+" voltage to the other stage will suffer.

In all the receiver models represented by the schematic in Fig. 1, except the 19B1, a cascode type tuner is used. The circuit hook-up in the tuner is such that the plates of the r.f. amplifiers are in series, in much the same manner as the i.f. amplifiers. Therefore, if the r.f. amplifier tube should become defective or is removed from its socket, there will be no "B+" voltage for the 1st r.f. amplifier at pin number 1 of the socket.

Now, examine the heater circuit connections. Notice that this is relatively straightforward, with the tubes grouped in banks so as to distribute the heater current drain uniformly, and with the tubes in the tuner furthest from the 6.3 volt winding of the power transformer. This is done to minimize heating fluctuations of the cathodes and thus reduce some of the noise generated in the tube.

Finally, notice that the transformer is completely shielded, both primary from secondaries, and the case itself. This tends to eliminate any vertical modulation of the raster which may result from a difference in the local power source frequency and the transmitted vertical sync pulse recurrence frequency.

Another receiver which, as far as the power supply is concerned, is almost identical to the *Admiral* schematic shown in Fig. 1 is the *Capehart* model CX-37. The principal power-supply difference is that a conventional filter choke is used in the *Capehart,* inasmuch as the speaker is of the permanent-magnet type.

The only test equipment required for locating trouble in the power supply is a combination voltohmmeter, preferably a v.t.v.m. All measurements are taken with respect to the established reference level. In some circuits, this reference level is the "B—" bus, in others, it is the chassis. The first measurement to be taken is the potential at the output of the filter, point 1 in Fig. 1. In most supplies of this type, the potential at this point is +250 volts with respect to ground. A tolerance of 10% is usually allowed. If this potential is incorrect, the next step is to measure the a.c. line voltage across the primary of the transformer. This is usually from 110 to 120 volts a.c. If this voltage is low, the "B+" voltage will be low and, conversely, if it is high, the "B+" will be high.

Assuming that the input voltage is correct, the next step is to measure each half of the secondary voltage. This is usually about 275 volts a.c. from the center tap to either side. Do not attempt to measure the full secondary voltage unless the meter test leads can withstand a 600 volt potential and you are extra careful not to get across the secondary. Failure to obtain a step-up ratio of 1 to 2 or more (for each half of the secondary) usu-

ally indicates a defect in the power transformer.

If the correct potentials are obtained at the transformer, measure the d.c. voltage at the input to the filter, point 2 in Fig. 1. This will usually be from +20 to −20 volts d.c. more or less than the a.c. voltage measured across half the secondary. The exact figure depends upon the load on the power supply, and the value of the condenser used on the input side of the filter. If a potential of about +275 volts is not obtained, the trouble may either be a weak rectifier tube or a filter condenser whose value has decreased due to aging. If the filter input voltage is correct, but the filter output voltage is not, the trouble is either due to a defective field coil or unusually heavy load, which might be caused by a high resistance short in one of the receiver stages. This can be tracked down by testing "B+" voltages to each stage and comparing these readings with the normal measurements in the service data.

Dual-Type Supplies

In Fig. 2 is shown the simplified schematic diagram of the low-voltage power supplies of the *CBS-Columbia* receiver models 21T11, 21C11, 21C21, 21C24, and 21C31B. This dual-type low voltage supply is becoming increasingly popular because it provides for more efficient "B+" voltage distribution and better regulation of the individual "B+" voltages. The lower voltage supply utilizes a 5Y3 connected in a full-wave circuit with a single section "pi" filter. The maximum current capacity of the 5Y3 isn't as great as that of the 5U4G (which is used in the higher supply), but in this case it is sufficient because the lower voltage potential is applied to the stages that draw little current. These stages are the video amplifiers, sync circuits, i.f. amplifiers, 4.5 mc. sound i.f. amplifiers, and the mixer-oscillator in the tuner. The higher "B+" potential is applied to the vertical and horizontal sweep circuits, the sound output stage, the damper, and the r.f. amplifiers in the cascode tuner. The 1st r.f. amplifier receives its plate voltage from the cathode of the 2nd r.f. amplifier, as is usually the case in cascode tuners. The heater hook-up is straightforward, with the heaters of the tubes in the tuner and the i.f. amplifier decoupled from the other heaters by means of inductor-condenser networks.

The technique for locating trouble in this type supply is similar to that discussed for the circuit of Fig. 1. One of the differences, of course, is the fact that the two supplies in Fig. 2 have different a.c. potentials applied to the plates of their rectifiers. The potential at the plates of the 5U4 is approximately 320 volts a.c. and that at the plates of the 5Y3 190 volts a.c. The voltage at point 1 is approximately +350 volts d.c., and that at point 2, approximately +160 volts d.c.

Heater decoupling networks have been incorporated in the tuner, i.f.

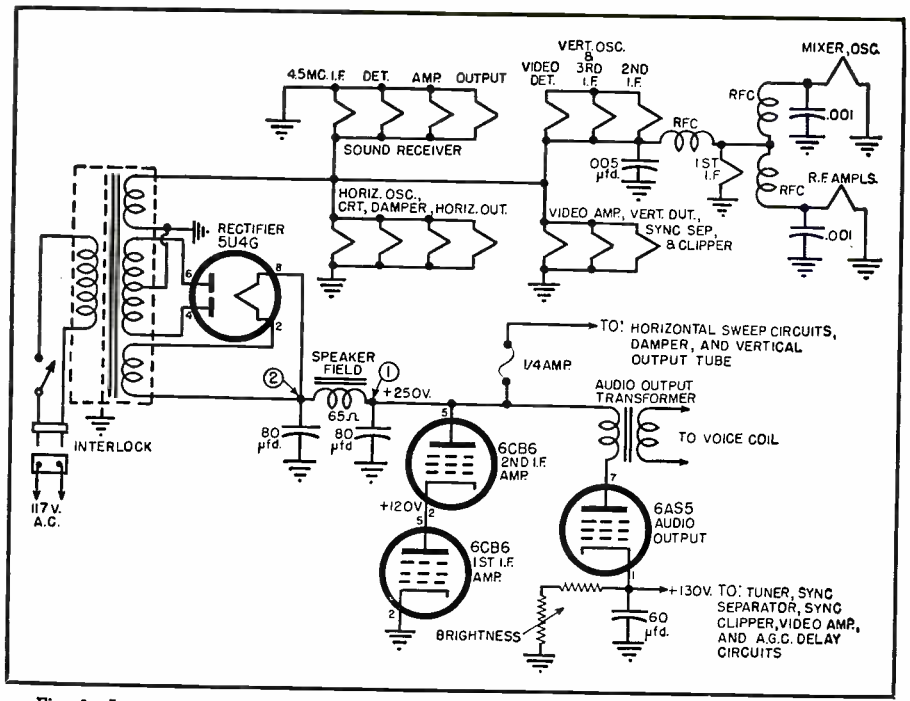


Fig. 1. Low-voltage power supply of the Admiral 19B1, 19C1, 19E1, 19F1A, and 19H1.

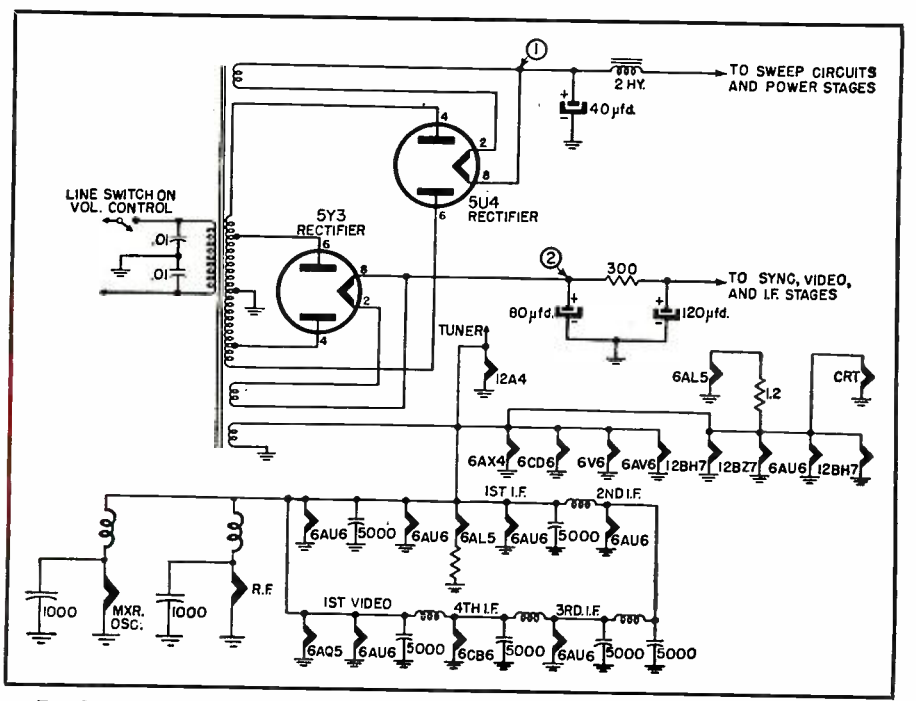
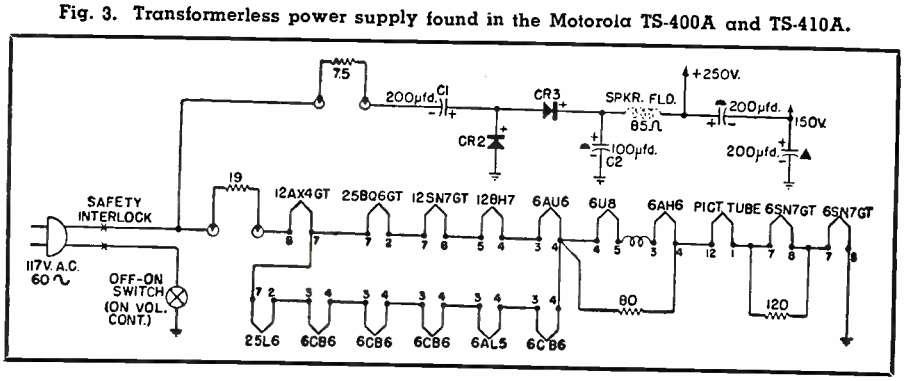


Fig. 2. Dual-type supply found in some CBS-Columbia, Admiral, and Zenith receivers. The "B+" circuits fed by each rectifier are selected according to their current requirements; thus, the sweep and power stages obtain their "B+" from the 5U4 tube, whose maximum current capacity is higher than that of the 5Y3, used for other stages.

Fig. 3. Transformerless power supply found in the Motorola TS-400A and TS-410A.



amplifier, and video amplifier stages because the heater-to-cathode interelectrode capacity of the tuner and i.f. tubes provide a low impedance path by which the r.f. and i.f. signals can be coupled to the video stages. This would cause the picture to have alternate dark and light lines that could be horizontal, vertical, diagonal, or combinations thereof. This interference can readily be recognized by the fact that r.f. interference due to external causes appears only on certain channels depending upon the frequency of the source of interference, whereas the internal interference due to defects in the heater decoupling networks is likely to occur on all channels.

The troubles most likely to occur to the decoupling networks are open or partially shorted inductors or an externally shorted condenser. The condensers are usually mica and since they are worked at a low voltage level, they are unlikely to short or open internally, or become leaky as paper condensers do. The inductors however, are fragile and likely to be damaged if abused, or open if the heaters to which they are connected should short and draw excessive current. You should be able to smell these inductors if they have been overheated. If the r.f. choke in series with the r.f. or mixer tubes should open, these tubes would not light. If another r.f. choke opened, the heaters in its string would not light.

A good point to remember when servicing this type of circuit is that a 5U4G, whose emission has dropped off below the point where it can be used satisfactorily in the higher supply, may be directly substituted in the low "B+" supply. No alterations need be made in the wiring, because the plate and filament connections are the same for both tubes. Notice that a filter choke is used in the higher "B+" supply to take care of the greater pulse and transient content of the sweep circuits.

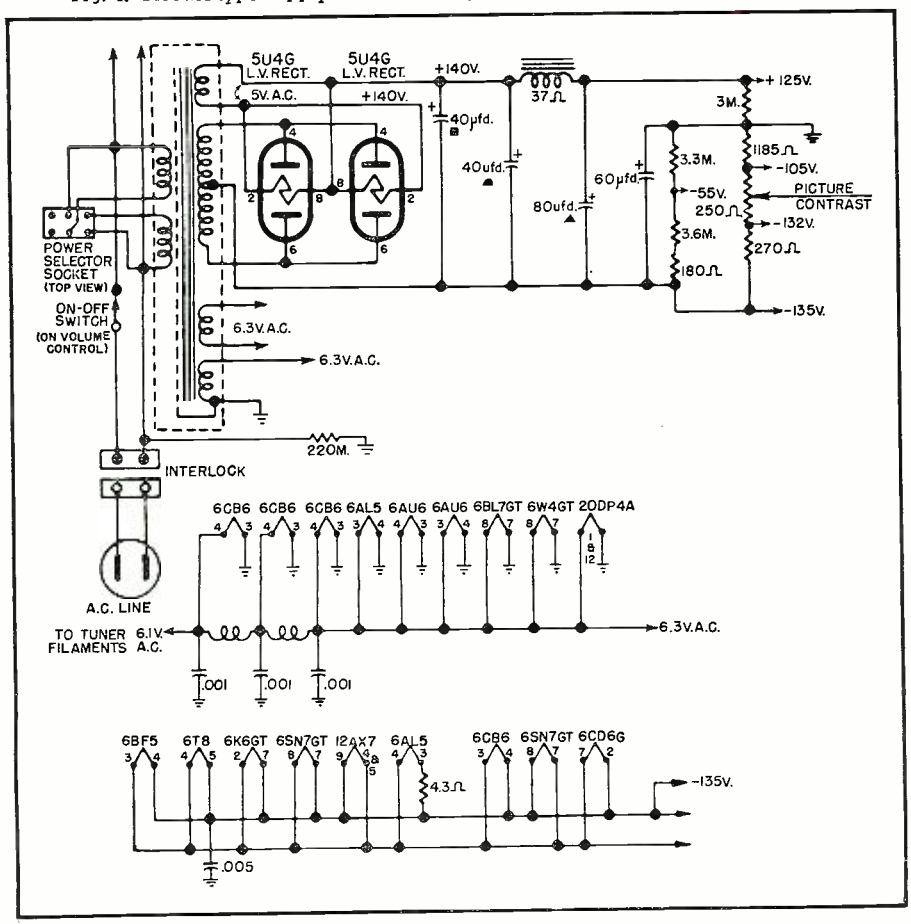
Other circuits which are very similar to the one shown, are the *Admiral* chassis 23A1 and the *Zenith* models K2872R and K2873E. The principal circuit difference is that both the *Admiral* and *Zenith* chassis use two 5U-4G's. Also, the filter networks are more elaborate and use chokes throughout instead of resistors.

Another popular type of supply is shown in Fig. 3. This circuit uses two selenium rectifiers in a half-wave voltage-doubler circuit to obtain a "B+" voltage of 275 volts from the 117 volt a.c. line. The 7.5 ohm surge resistor limits the current that can flow through the filter condenser C_1. Notice that the speaker field coil is used in the "pi" section filter. This supply makes use of the audio output tube to furnish the low "B+" of 150 volts in a manner similar to the circuit shown in Fig. 1. From Fig. 3 it may appear as if the 150 volts is derived from a capacitive voltage divider, however, this is not the case. The 150 volt point is taken from the cathode of the audio output tube. The 200 μfd. electrolytic condenser merely gives additional filtering for the "B+" at that point. The higher "B+" voltage is applied to the power stages, damper, etc.; the lower "B+" voltage is applied to the other circuits.

Since this is a tranformerless receiver, the heaters are hooked-up in a series-parallel combination so as to drop the entire line voltage in conjunction with the 19 ohm line dropping resistor. Receivers which make use of this type supply (besides the ones given in the caption of Fig. 3), are the *Motorola* chassis TS-395A and the *Crosley* chassis 385, 386, and 387. These receivers, however, use a special transformer to obtain heater voltages only. These heater-transformer types are much easier to troubleshoot because one burned-out heater won't cause the whole string to go out.

The most difficult task when troubleshooting a supply that uses selenium rectifiers is to determine whether or not the rectifier itself is defective. There are two qualitative tests that can be performed to determine the quality of the suspected rectifier, but the results must not be accepted as conclusive, just as checking certain types of tubes with a tube tester is not the perfect method of determining whether or not the tube will work in the given circuit. For the first test for selenium rectifiers, use an ohmmeter to check the forward and reverse resistance readings of the rectifier. Of course, the power must be off, and the circuit leads disconnected from the selenium stack. The ratio of back-to-forward resistance should be at least 100 to 1 if the rectifier is to be considered satisfactory. The other test is to measure the voltage drop across the rectifier while the receiver is in operation. If a drop of more than 5 volts is measured across the stack, the rectifier is probably defective.

Fig. 4. Bleeder-type supply found in the Sylvania models 22M-11A and 22M-11B.



Bleeder-Type Supply

A typical bleeder-type supply is shown in Fig. 4. Except for minor differences in the voltage dividers and their filters, this type supply is found in the latest *Du Mont, Emerson, Andrea,* and *DeWald* models. This circuit stems back to the old 630-type supply. Its principal innovation is that the voltage divider outputs are approximately equal, negative and positive, rather than just a few volts negative (for bias) and the rest of the potentials positive. The main advantage of these negative and positive potentials is that it allows for more versatile circuit connections, and thus results in a receiver whose over-all design is greatly improved. Notice that the power transformer is completely shielded, as it was in the *Admiral* model shown in Fig. 1. Two heater secondaries are required to minimize heater-to-cathode potential differences. One heater winding supplies those tubes whose cathodes are operating at or near ground potential. The

(*Continued on page* 144)

REVIVING THE JAM-JAR RECTIFIER

By **ELBERT ROBBERSON**

Remember, Old-Timers? The electrolytic rectifier, a cheap, rugged d.c. source.

HAMS of twenty-five years ago had an easier time than today's crop. Tubes had only three elements, and to get high-voltage d.c. a tray full of *Mason* jars, affectionately dubbed the "slop rectifier," was commonly used. Once in a while it was also called a "chemical" or "electrolytic" rectifier.

The materials were cadged from the junkyard and the jam closet, so the cost was nil; and no filament transformer was needed. As the "bridge" connection was used, a center tap was unnecessary, and the d.c. voltage output was equal to that of the a.c. input.

Furthermore, the output was so smooth that the only filtering needed was a couple of microfarads—and you could even use jam jars for this, too. For, besides being rectifiers, these jugs were also self-healing electrolytic condensers!

Although seldom heard of today, they still work—and a little re-designing has brought them up-to-date.

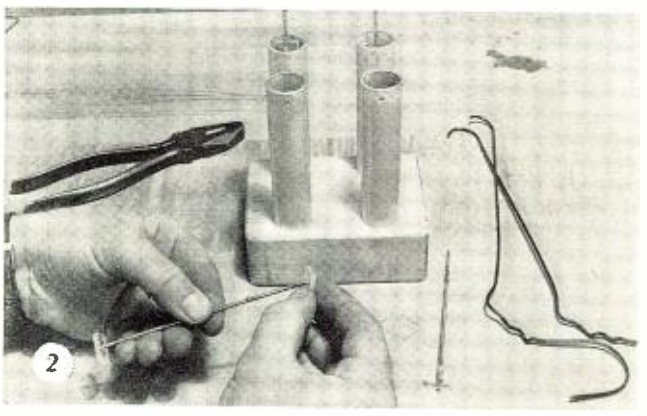
To compare the old and the new, one of the old jugs is shown in the first illustration, alongside a 1953 version. The 4-cell unit will give about 117 volts intermittently, or 80 volts all day.

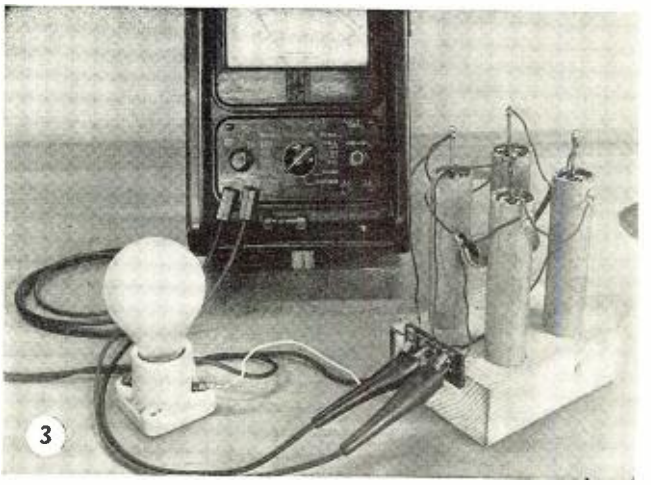
Construction is simple. Certain metals form an oxide coating when subjected to a current flow in an electrolyte. This coating acts as an insulator for current in one direction, and a low resistance the other way. Thus, it will rectify a.c.

The most plentiful of these metals is aluminum, in a solution of borax. The other electrode can be lead or iron.

Whereas a generation ago a bank of such cells would be made of glass jars holding (*Continued on page* 160)

One of the old jam-jar rectifiers shown with today's streamlined version. The older type had aluminum and lead sheet electrodes; newer uses tubing and ordinary wire coat hangers in its construction.





Pictures at right show steps in making rectifiers. (1) Preparing materials: 5" lengths of 1" aluminum tubing, coat hangers, wood block, borax. (2) Fitting plastic spacers, 5/8" square, to the wire anodes. (3) "Forming" the rectifier bridge, by connecting it to the a.c. line in series with a 100-watt bulb. As oxide forms on the aluminum, the bulb dims, d.c. output rises.

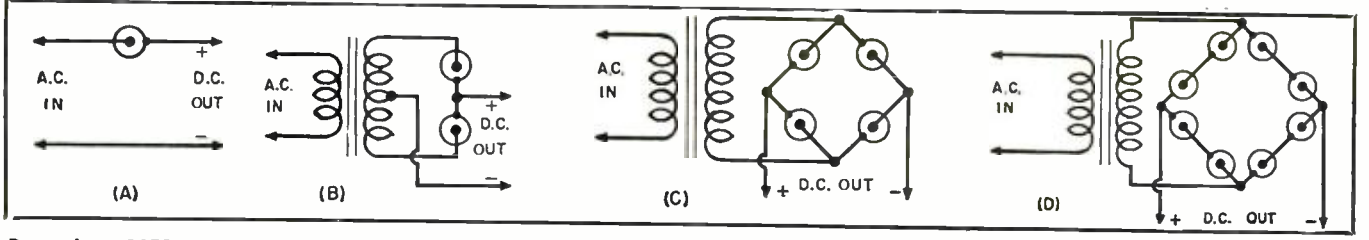


Fig. 1. Possible connections. (A) Half wave, not very useful. (B) Ordinary full wave center-tapped. (C) Bridge connection. (D) Higher-voltage bridge (cells added in multiples of four).

the CBS Colortron

Fig. 1. Over-all view of CBS-Hytron's picture tube for color television. It is engineered so that it may be produced in quantity.

By
ROBERT B. TOMER and **WILLIAM R. SULLIVAN**
CBS-Hytron

A new color tube—although its operation is basically identical to the RCA tube, its mechanical construction is so different that production problems are eliminated and restrictions on potential tube sizes are removed.

IT has long been recognized that one of the principal obstacles to low-cost, mass-produced color television has been the means by which the colored picture was reproduced. In recent years, most of the effort in this field has been directed toward perfecting a cathode-ray tube, capable of creating colored pictures in much the same manner as those used in black and white television. The problems involved in the successful accomplishment of this objective are prodigious. However, there has been tremendous progress in the direction of solving many of them.

Until recently, the only successful color tubes which had been demonstrated were exceedingly difficult to manufacture and almost as difficult to adjust and maintain in operation. With the announcement by *CBS-Hytron* of its new *CBS*-Colortron, the last barrier to mass production color television appears to have been removed. This new tube makes use of principles already demonstrated as being sound in earlier color tube designs and goes beyond that point to achieve a simplicity of design closely approaching that of black and white tubes.

Before discussing the improved features of the *CBS*-Colortron, a review of the earlier type of color tube may be helpful. One of the most successful of these earlier color tubes makes use of the principle of parallax to achieve the necessary separation of the three primary colors within the same tube structure. Three electron guns, located in the neck of the tube, are modulated by three individual signals. The beams from these three guns are aimed so as to come together, or converge, upon a mask containing a multiplicity of small holes. As the three beams pass through the holes in the mask, they become divergent again and arrive at the screen as three individual beams. The screen is printed with three types of phosphor, capable of producing the three primary colors —red, green, and blue. The individual phosphors are printed as very small dots on the screen and are arranged in groups of three so as to form little triangles, or triads, each containing a red, a green, and a blue dot. As the three individual beams strike the screen, they are caused to fall exactly over the center of one of the three color dots. Thus, the beam from the red signal gun passes through the mask and travels on to strike the red dot on the screen. The beam from the green signal gun passes through the same hole to continue on and strike the green dot. The blue dot is excited in like manner. This principle of separation by parallax is shown in Fig. 3A.

As stated earlier, tubes utilizing this principle have been demonstrated before. Their chief drawback has been their inherent complexity of construction and their dependence upon highly skilled artisans during their assembly. It has been because of these factors that the first estimates of color television set costs have been so high. It was inevitable that lower cost and more reliable designs would be sought. The *CBS*-Colortron is the result of such an effort.

The color television picture tube differs from its counterpart in black and white in three essential respects. It is these basic differences which will ultimately determine the cost differential between a color television picture tube and a black and white tube. The first of these differences is in the gun structure. The color picture tube in its present practical form requires three electron guns as compared to only one in the black and white tube. While it may conceivably become possible to design color tubes in the future, having only one gun, at present the three gun design seems to be the only practical design for a compatible color system.

The second essential difference consists of the mask which permits the three beams to be separated at the screen for proper color registration. There is no way of eliminating this added element in the parallax type of color tube. However, its method of fabrication and assembly leaves much latitude for improvement and consequent cost reduction.

The last essential difference consists of the special tri-phosphor screen, used in color television tubes, as compared with the simple screen used in black and white television. There appears to be no possibility of eliminating this essentially complex part of the color tube. However, once again the method of producing the screen leaves considerable area for improvement.

It has been in the latter two areas that the greatest significant advances have been made in the *CBS*-Colortron. Earlier designs made use of a flat, prestretched mask, firmly bolted to a heavy spacer frame, which was in turn clamped to the glass plate containing the phosphor dots. This assembly was not only difficult to maintain in proper registration during its assembly, but created equally difficult problems in evacuating and outgassing the completed tube. Because of the large mass contained in this structure, the time required to raise and lower the temperature of the entire tube during the evacuation process was considerably longer than for black and white tubes. This, of course, added to the ultimate cost of such a tube. In addition, the losses due to non-linear expansion and contraction in this subassembly ran very high, adding even further to the cost.

Other factors contributing to the high cost in the earlier flat mask type

of color tube were such items as an internal decorative mask and the use of an additional glass panel used to seal the open end of the tube and serving as a window through which to view the phosphor screen mounted inside the tube. Both of these items are eliminated in the *CBS*-Colortron.

In order to achieve a significant reduction in the cost of preparing the phosphor screen, a new method of printing the dots had to be developed. The method used in the earlier color tubes was a silk screen process. This is a sort of stenciling operation where a silk screen, containing a pattern of holes, is laid over a flat glass plate and the phosphors are forced through it onto the glass by a wiping or squeegeeing motion. The process is essentially a hand operation, requiring a high degree of skill and experience. Since it must be repeated three times on each screen, the possibility of error multiplies rapidly.

A method of depositing the phosphor dots through the use of photographic techniques has been perfected which results in a great improvement in accuracy and which is capable of being performed by automatic equipment, thus effecting a substantial reduction in cost. This photographic technique has certain other advantages that may exceed those of direct cost. Through the use of this technique, it has been possible to eliminate the use of a separate piece of flat glass for supporting the phosphors. They can now be deposited directly onto the faceplate as in the black and white tube. By eliminating the extra glass surfaces of the older flatplate color tube, contrast is improved in the picture because there is less light dispersion and fewer halations caused by room lights, windows, etc. Still another advantage accrues from the placing of the phosphors on the inside of the faceplate. This inside surface is, of necessity, a curved surface so as to be able to serve as an arch and support the weight of the atmosphere pressing in upon the faceplate which would otherwise cause it to collapse.

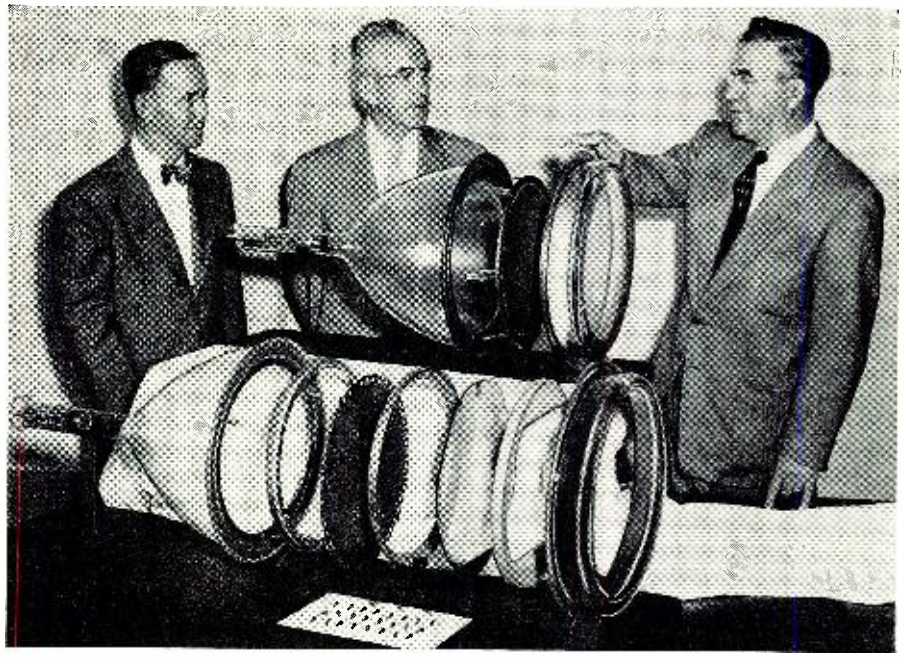


Fig. 2. The CBS-Colortron (top) in "exploded" form to show component parts as compared to the separate components which go to make up another type color tube.

The use of a curved phosphor screen permits the use of a matching, curved mask. This combination of a curved mask and a curved faceplate distinguishes this type of tube from the earlier flat mask and flat phosphor plate tube.

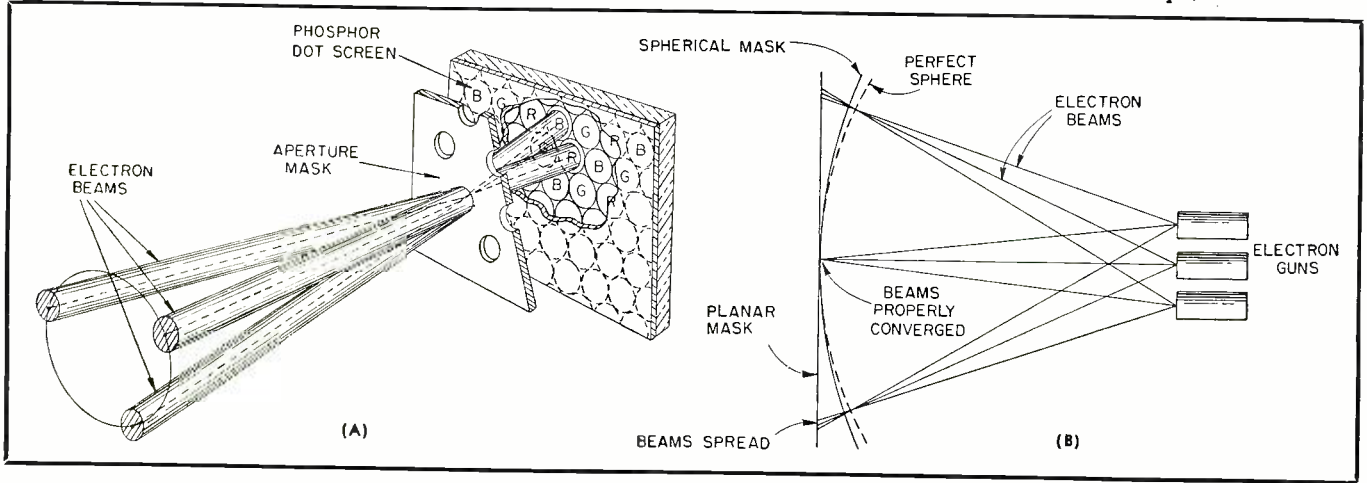
One of the most difficult problems for the circuit designer using the flat mask type of color tube is that of obtaining proper convergence over the entire screen area. Fig. 3B shows diagrammatically why this problem exists.

It can be seen that in the case of a flat mask tube, if the beams are brought to convergence at the center of the screen, they will not be properly converged out near the edges of the picture. This is because the beams describe an arc as they swing back and forth across the mask, and the mask, being flat, fails to coincide with the plane of their point of convergence except at one point. Dynamic means of correcting this condition are required within the color receiver. A parabolic voltage waveform is required to modulate the convergence lens in order to shift the plane of the convergence point back onto the mask near its edges.

It is apparent from Fig. 3B that if the mask were a section of a sphere, the need for this dynamic convergence would be virtually eliminated. Actually, in a practical tube design, the mask and faceplate curvatures do not coincide exactly with the plane of the convergence point of the three beams. However, the correction obtained with even a moderate amount of curvature is considerable, and in the case of the *CBS*-Colortron, it is on the order of six to one over the flat mask type of tube. This means that the requirements placed upon the circuit designer are greatly lessened and the problems of the service technician in maintaining

(*Continued on page* 182)

Fig. 3. (A) Convergence of the three beams at the mask. Note that each beam passes through the hole in the mask at the correct angle to strike its corresponding phosphor dot. (B) Illustrating the need for dynamic convergence to correct for the variation in length from deflection point to the aperture mask as the beams travel from the center to the edge of the mask. Note that the use of a spherical mask reduces the amount of correction required.



TROUBLESHOOTING

By
WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS

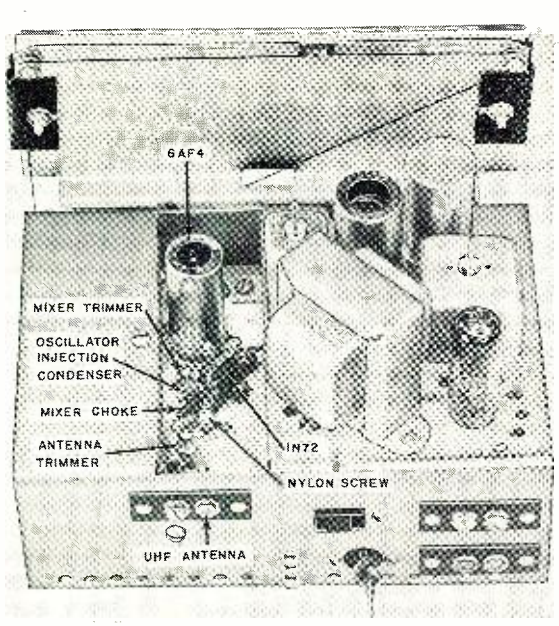


Fig 1. Top rear view of the Mallory TV-101 u.h.f. converter. Note the socket with spring clips for the 1N72 crystal mixer.

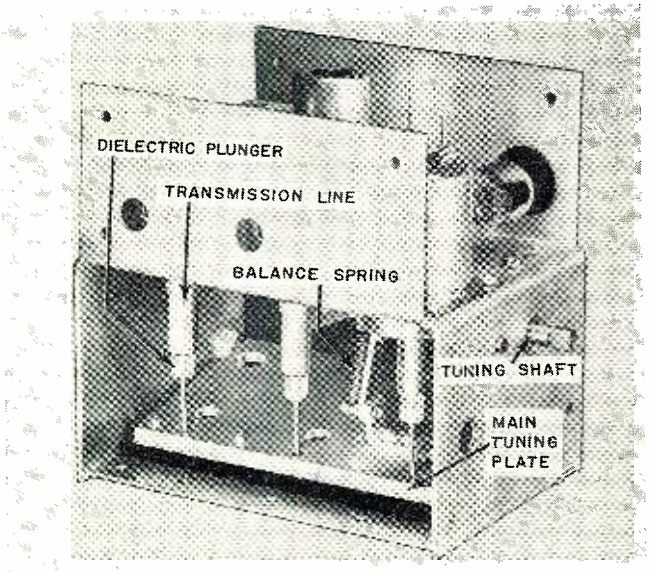
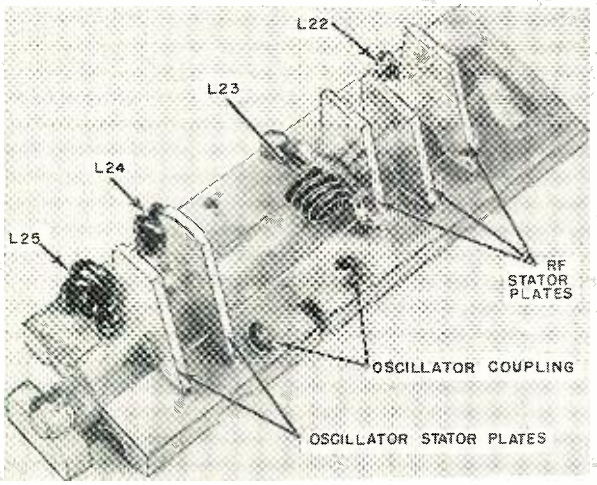


Fig. 2. Rear view of the Granco converter showing the two r.f. preselector and one mixer cavities with dielectric plungers.

Fig. 3. A typical u.h.f. coil strip for the Standard Coil 82 channel turret tuner. The vertical partitions are condenser plates.



WHEN u.h.f. tuners and converters first appeared in the customer's home, the average service technician often referred all service work to the manufacturer. As u.h.f. equipment becomes more popular and technicians have more opportunity to familiarize themselves with it, troubleshooting u.h.f. tuners and converters will become part of the regular TV service business.

This article discusses the basic u.h.f. tuner circuits, lists their defects, and describes a number of popular models and their typical troubles. The v.h.f. tuner or i.f. section which is often part of a tuner or converter is not considered here, since most service technicians are familiar with those sections.

The main difference between a u.h.f. tuner and a converter is its physical location rather than its electrical characteristics. If it is mounted in a separate box on top of the TV set, it is usually considered a converter, while the same unit, mounted on the main chassis and housed inside the receiver, is called a tuner. The u.h.f. circuits of both are identical and therefore subject to the same defects. For this reason, whenever we refer to a tuner, the same holds true for a converter and *vice versa*.

Basic Circuit

The u.h.f. portion of all tuners to date consists of an r.f. network, a local oscillator, and a mixer. Some manufacturers are planning to use an r.f. amplifier stage for the u.h.f., but except for experimental models, none of the popular u.h.f. equipment now in use has an r.f. stage. A basic u.h.f. tuner circuit is shown in Fig. 5. To cover all channels, either L_1, L_2, L_3, or the corresponding condensers may be varied. In Fig. 5 the three resonant circuits are shown as simple coils and condensers, but transmission lines, parallel inductances, and switching networks are more commonly used. In commercial tuners the resonant circuits are often either shortened transmission lines or some other arrangement that permits varying the resonant frequency over a wide range. Some of the switch-type v.h.f.-u.h.f. tuners, such as the *RCA* KRK-25, actually use small coils and condensers. Some tuners make use of printed circuits, these are, however, rare.

When we consider the diagram of Fig. 5, the troubleshooting problem appears much simpler than when we look at the actual u.h.f. tuner. The number of possible defects due to the u.h.f. portion obviously is quite limited. We can list the potential defects for each section:

1. The r.f. network
   - *a.* Misalignment or poor tracking
   - *b.* Short or open in tuning condensers, coils, or contacts
   - *c.* High resistance solder connection
2. Mixer
   - *a.* Defective crystal or tube
   - *b.* Misalignment or poor tracking
   - *c.* Short or open in tuning condensers, coils, or contacts
   - *d.* High resistance solder connection
3. Oscillator
   - *a.* Defective tube
   - *b.* Wrong frequency or poor tracking
   - *c.* "B+" or heater chokes shorted, open, or grounded
   - *d.* Incorrect "B+" or heater voltage
   - *e.* Defective r.f. bypass condenser
   - *f.* Open or shorted coils, condensers, resistors, or contacts
   - *g.* Open or shorted oscillator injection loop
   - *h.* High resistance solder joint or bad ground

These cover practically all the electrical defects that can occur in a u.h.f. tuner or converter, but this does not

THE U.H.F. TUNER

With the proper equipment, service technicians can repair most u.h.f. TV tuners. Here's how.

take into account such mechanical defects as broken dial cords, corroded contacts, misadjusted dials, burned-out panel lamps, etc. Any technician who has serviced a.c.-d.c. radios will be familiar with this type of trouble and, in any event, these mechanical defects are fairly easy to spot.

The fifteen items listed can produce a variety of symptoms and may require considerable servicing. The trouble-shooting procedure will be simplified greatly if we keep these items in mind, because many of these defects can be checked fairly quickly.

Before deciding that a particular defect originates in the u.h.f. section, a number of tests should be made to pin down the trouble. Usually, the only service calls due to the u.h.f. section are those where either nothing is received on the u.h.f. channel or the signal is weak, intermittent, or subject to interference. Such defects as unstable horizontal or vertical hold, distorted picture, and hum in the sound are never due to a tuner defect. Wherever more than one station can be received, the second station can serve as a check on the tuner operation. This holds true where one is on u.h.f. and the other on v.h.f. If the defect appears on both stations, the u.h.f. section is obviously blameless. Even where two u.h.f. stations only are received, chances for mistracking on both are small. However, some of the other items on our list of defects will hold for the entire u.h.f. band and can not be checked in this way.

The four general symptoms for defective u.h.f. tuner operation can each be traced to particular defects, and can each be located by definite tests.

1. No u.h.f. reception: To make sure this is due to the tuner, check whether a v.h.f. or another u.h.f. station can be received. Where no other signals are available, connect a v.h.f. or i.f. signal generator to the output of the u.h.f. mixer and modulate the signal with 400 or 1000 cycles. If bars appear on the screen, the u.h.f. tuner or antenna is at fault. Check the antenna installation for broken wires or bad connections. To service the tuner, do the following:

a. Measure "B+" and heater voltages. Check these voltages at the u.h.f. tuner terminals as well as directly on the pins of the oscillator tube socket.

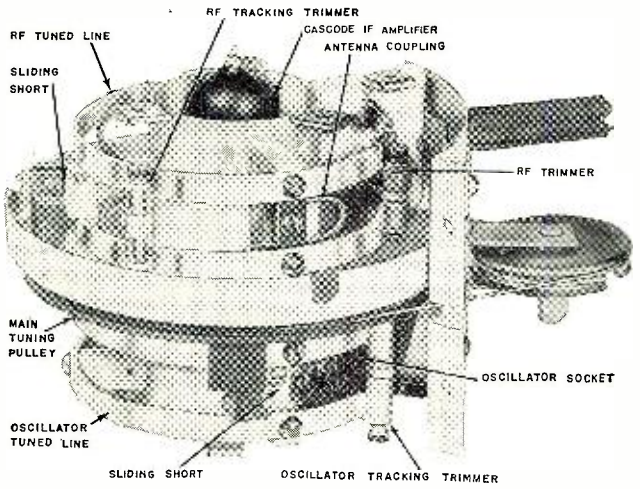


Fig. 4. The Kingston u.h.f. tuner, used in Regency converters. Note the parallel transmission lines and sliders for tuning.

b. Replace oscillator tube, then replace mixer crystal.

c. Check all coils for opens; all tuning condensers for shorts.

d. Connect u.h.f. sweep generator to antenna input and observe response on scope. If nothing gets through, one of the components in the r.f. network is probably open or shorted. Try another mixer crystal or substitute a u.h.f. crystal detector probe.

e. If the r.f. network is OK, check the oscillator for oscillation. Connect the v.t.v.m. with a 1-megohm series resistor to the oscillator grid and check for negative grid bias. Tuning the oscillator, or placing a grounded object near one of the tank coils should vary this bias considerably. To check frequency, use a grid-dip meter and observe the dip in bias voltage when the oscillator and grid-dip meter frequencies coincide. Another way to determine frequency is with a sweep generator and oscilloscope. Tune the r.f. network and sweep generator until a "birdie," due to the local oscillator, is visible. To make sure that the "birdie" is created by the oscillator, place your screwdriver on the oscillator grid and observe that the "birdie" will shift or disappear. The frequency of the local oscillator is found by tuning the marker signal, sometimes part of the sweep generator, until the two "birdies" coincide.

f. With the r.f. network, mixer, and local oscillator all operating properly, any loss of signal must occur either in the antenna and lead-in wires, or else after the mixer. Leaving the u.h.f. sweep generator connected, use a crystal detector probe and trace the path of the signal from the output of the mixer through the v.h.f. or i.f. circuits.

Fig. 5. Basic u.h.f. tuner circuit.

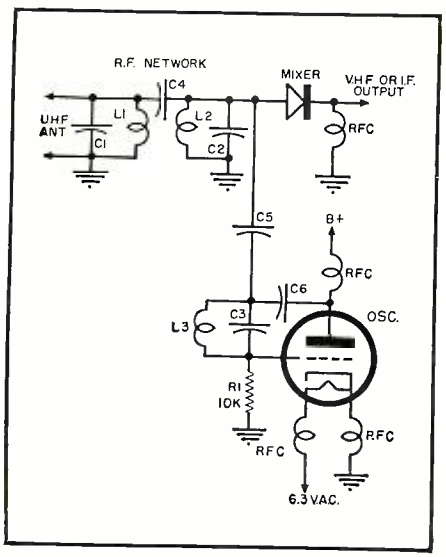
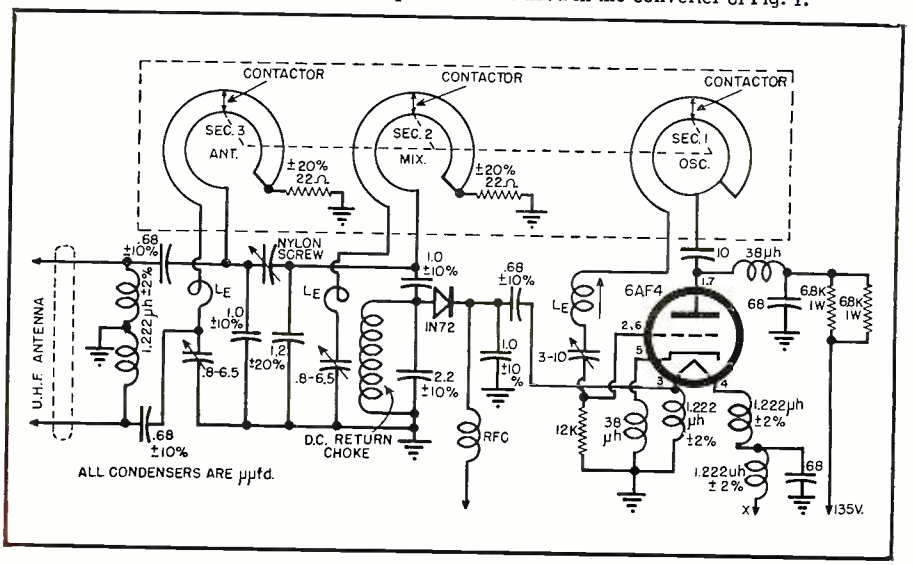


Fig. 6. Schematic of the Mallory u.h.f. tuner, used in the converter of Fig. 1.



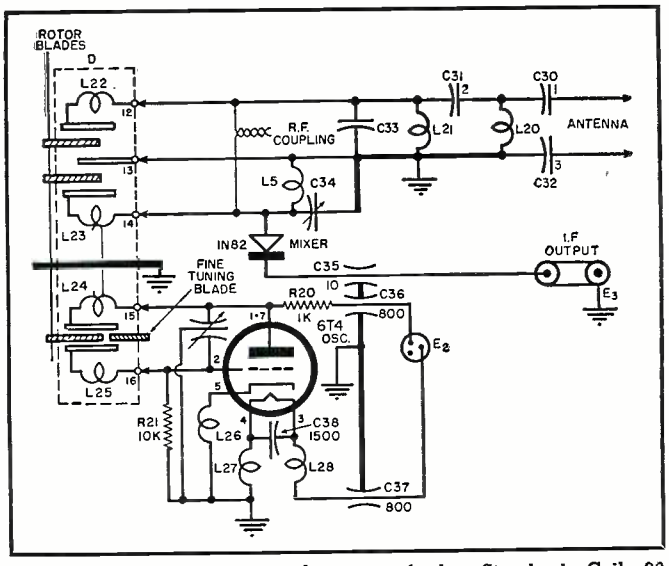


Fig. 7. Partial schematic diagram of the Standard Coil 82 channel turret tuner showing the u.h.f. portion and strip.

2. Weak signals: As mentioned previously, eliminate all other circuits as culprits before suspecting the u.h.f. tuner. It is best for this type of defect to bring the receiver to the shop where a good strong signal should be available and comparison with other sets possible. If it is definitely established that the loss of signal strength occurs in the u.h.f. tuner, the following steps are indicated.

a. Measure oscillator plate and heater voltages.

b. Replace the mixer crystal.

c. Connect a u.h.f. sweep generator and oscilloscope to observe the bandpass of the r.f. network. Refer to the manufacturer's data for correct alignment instructions. If the r.f. and mixer networks are misaligned, considerable loss in sensitivity will occur. Where no exact alignment data is available, tune the bandpass for maximum amplitude at the weak station.

d. The only remaining defect could be insufficient oscillator injection voltage. Try a new oscillator tube, then check the oscillator injection circuit. In some tuners this is a 1- or 2-$\mu\mu$fd. condenser; in others a coupling loop or link is used. Replace the condenser or check the loop for an open connection. In order to check the operation of the oscillator injection network, the i.f. side of the mixer can be disconnected from its ground return and a milliammeter inserted. Crystal current due to the oscillator output should be between 0.1 and 1.5 ma.

3. Intermittent: One type of intermittent occurs on every channel and can be caused by tapping, squeezing, or jarring the tuner. Such a defect is due to a bad solder joint, or broken lead or component, and can invariably be located by mechanical inspection. The second type of intermittent occurs only at certain points in the band, especially when the tuning mechanism is used. From this description, noisy contacts, corroded wipers, or shorted condenser plates are probably the trouble. Again the defect can be repaired by simple mechanical means.

4. Interference: Many of the current u.h.f. tuners and converters radiate a considerable amount of their oscillator signals. Although interference between two receivers is rare in most u.h.f. areas because of the channel allocations and the higher i.f. frequencies, it is possible to run into this trouble. Some of the tuners operate the oscillator below the incoming signal, while others employ harmonics of the local oscillator. Interfering beats due to other u.h.f. equipment appear in the same manner on the screen as v.h.f. or i.f. interference. The remedies are the same; *i.e.,* shielding of the offending tuner, orienting the antenna and transmission line for minimum interference and, as a last resort, relocating one or both antennas.

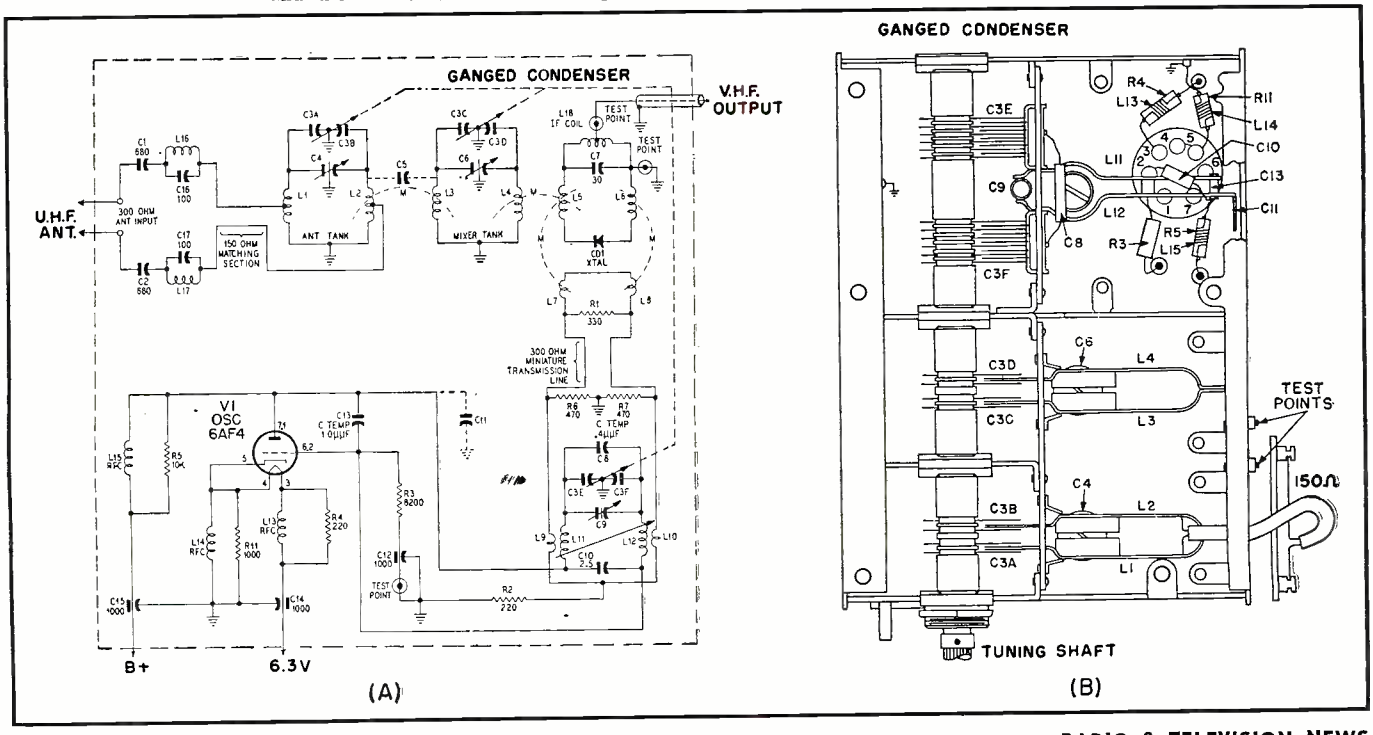
In addition to oscillator radiation, strong v.h.f. stations sometimes ride through the u.h.f. tuner and beat with the output of the u.h.f. section, or interfere directly as a superimposed picture. The only remedy for this is the use of an efficient high-pass filter in the input of the tuner and shielding of the u.h.f. network and the connection to the v.h.f. tuner, in the case of an external u.h.f. converter.

Typical U.H.F. Tuners

One of the widely used u.h.f. tuning mechanisms is the *Mallory* u.h.f. system which is found both in tuners and in external converters. The circuit diagram of the u.h.f. portion is shown in Fig. 6, and we can clearly distinguish the r.f. network, the mixer, and the oscillator circuits. The r.f. network is double tuned, one tuned circuit

(*Continued on page* 169)

Fig. 8. (A) Schematic diagram of the continuous u.h.f. tuner used by Philco in its TV receivers. (B) Bottom view of the tuner showing the ganged variable tuning condenser and the flat brass horseshoe-shaped strips which are the preselector tank coils.



INEXPENSIVE APPLAUSE METER

By **BASIL C. BARBEE**

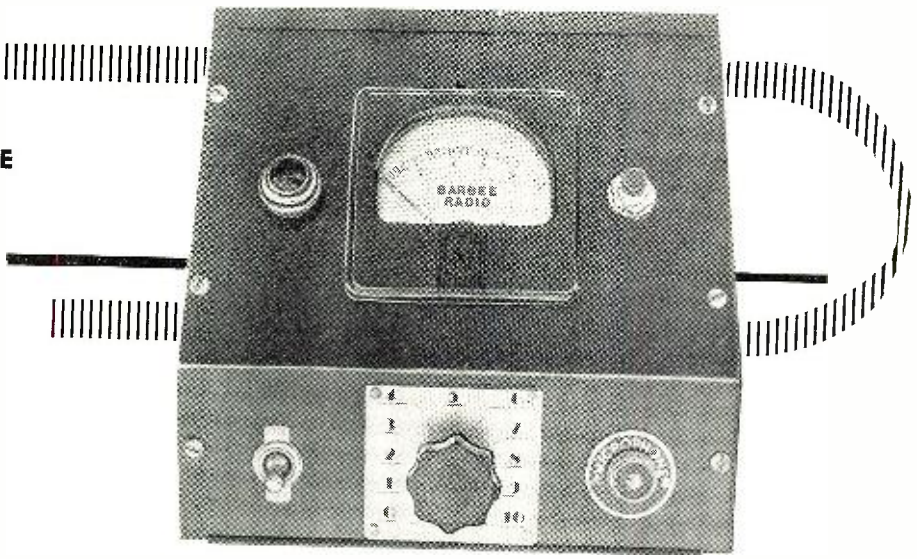


Fig. 1. Over-all view of the author's applause meter. This one was housed in an old v.t.v.m. cabinet but any other suitable housing could be substituted.

Combine an audio amplifier, rectifier, and d.c. milliammeter into a weighted circuit for integrated indication of applause.

FREQUENTLY the radio or audio man is called upon by local service clubs to furnish an applause meter for the impartial judging of audience response to the efforts of hitherto undiscovered entertainers. Since these "talent shows" or "amateur contests" are always charity affairs, a professional-type applause meter, such as used on radio network "give-away" shows, is not justified.

All too frequently, the hastily lashed-up "applause meter" consists simply of a voltmeter clipped across the theater p.a. speaker line. This arrangement is highly unsatisfactory, for while the maximum level of each round of applause is read, an equally, if not more, important factor, the *duration* of the round, is guessed at or ignored altogether.

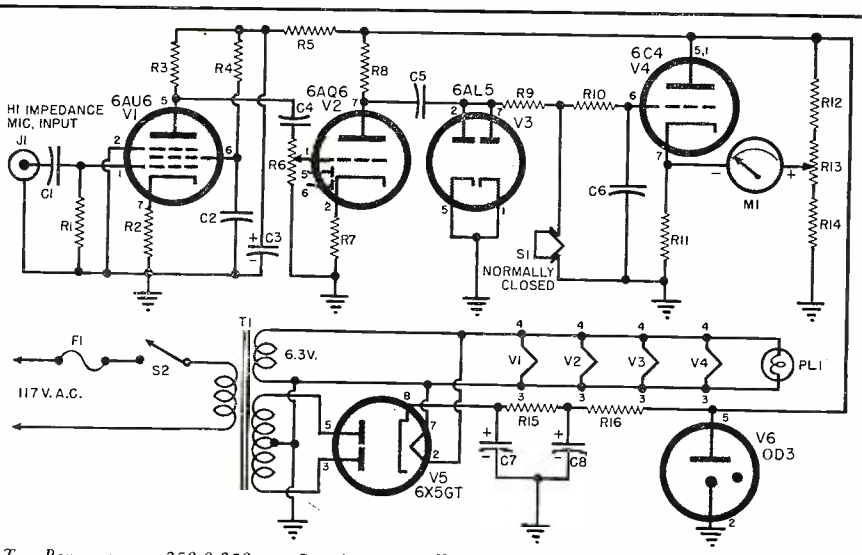
The applause of a single person consists essentially of a series of very short, highly damped bursts of sound, repeated at an average rate of about three per second. The amplitude and repetition rate of the bursts and the duration of the series of bursts, that is to say, the amplitude and total number of bursts, are functions of the enthusiasm of the applauding person. The applause of a group of persons consists of a number of these series, superimposed on each other with bursts scattered in almost random fashion. The average pulse amplitude and the total number of bursts emitted are functions of audience enthusiasm. Both the amplitude and the number of bursts increase with increasing audience enthusiasm for the act being applauded.

It may be seen from these considerations that measurement of the reaction of an audience in favor of an individual act may be approximated fairly well by integrating pulse amplitude with respect to time over the time interval of the duration of the round of applause following that act.

Fortunately, this difficult-sounding mathematical operation may be accomplished quite simply by electronic means. The instrument shown in the photo, Fig. 1, was designed and built in about three hours. Probably another hour would have been spent punching the chassis except for the fact that the chassis and power-supply of a discarded v.t.v.m. were used. The unit incorporates a preamplifier

(*Continued on page* 158)

Fig. 2. Complete schematic diagram and parts list covering the applause meter. Standard parts are used throughout for ease of construction.

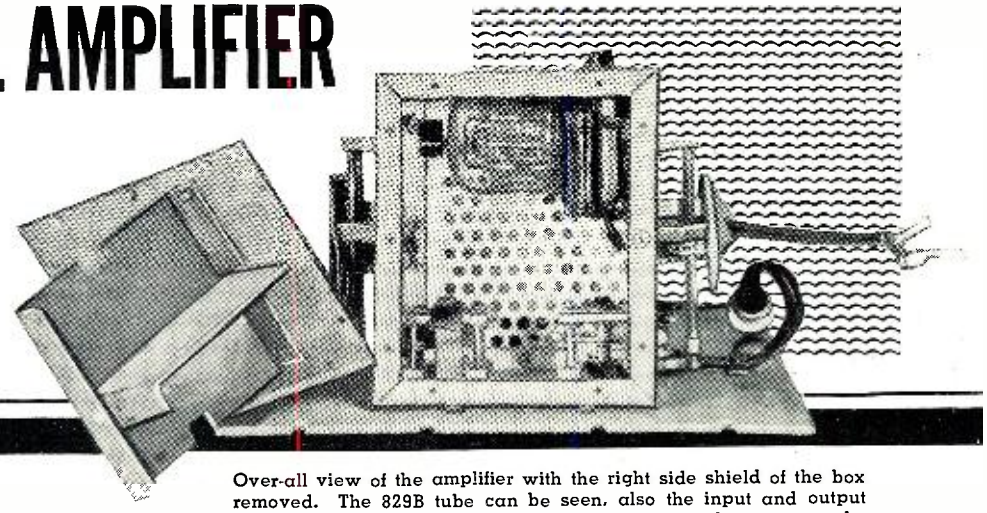


T_1—*Power trans. 250-0-250 v. @ 40 ma.; 6.3 v. @ 2 amps.*
V_1—*6AU6 tube*
V_2—*6AQ6 tube*
V_3—*6AL5 tube*
V_4—*6C4 tube*
V_5—*6X5GT tube*
V_6—*0D3 tube*

R_1—*2.2 megohm, ½ w. res.*
R_2—*1500 ohm, ½ w. res.*
R_3—*220,000 ohm, ½ w. res.*
R_4—*390,000 ohm, ½ w. res.*
R_5—*47,000 ohm, ½ w. res.*
R_6—*500,000 ohm pot ("volume control")*
R_7—*2200 ohm, ½ w. res.*
R_8—*100,000 ohm, ½ w. res.*
R_9—*15 megohm, ½ w. res.*
R_{10}—*470 ohm, ½ w. res.*
R_{11}—*1000 ohm, ½ w. res.*
R_{12}—*60,000 ohm, 2 w. res. (two 120,000 ohm, 1 w. res. in parallel)*
R_{13}—*500 ohm pot*
R_{14}—*1800 ohm, ½ w. res.*
R_{15}—*1000 ohm, 10 w. wirewound res.*
R_{16}—*1500 ohm, 10 w. wirewound res.*
C_1—*.005 µfd., 600 v. cond.*
C_2—*.1 µfd., 600 v. cond.*
C_3—*8 µfd., 450 v. elec. cond.*
C_4—*.02 µfd., 600 v. cond.*
C_5—*.01 µfd., 600 v. cond.*
C_6—*2 µfd., 200 v. paper cond. (see text)*
C_7-C_8—*8/8 µfd., 450 v. elec. cond.*
F_1—*1 amp fuse (3AG)*
PL_1—*Pilot light (#47)*
J_1—*Microphone connector (Amphenol PC-1M or equiv.)*
M_1—*0-1 ma. d.c. meter*
S_1—*Push-button sw., momentary, normally-closed*
S_2—*S.p.s.t. toggle sw.*

A 220 MC. R.F. AMPLIFIER

By
LEROY W. MAY
W5AJG



Over-all view of the amplifier with the right side shield of the box removed. The 829B tube can be seen, also the input and output butterfly variable condensers. The ground strap of copper can be seen grounding the rotor of the output or plate butterfly. The shield isolates the tube from the butterflies and also shields between the butterflies which, in effect, shields the input and output circuits from each other and from the 829B tube.

Construction details on a half-wave line amplifier which makes adequate power practical on the 220 megacycle band.

THE amplifier to be described is neither new nor original. It is just a smooth working 220 mc. r.f. amplifier that is free from parasitics or other undesirable side effects that quite often show up around these frequencies.

It was originally designed to be used with an *Amperex* AX9903 tube, but somehow the necessary nineteen bucks were never in one place at one time. Therefore, one of the old spare surplus 829B tubes, that we have had around for years on 144 mc., was used. It is anticipated that some day in the future one of the AX9903 bottles will move into the socket, replacing the old tired 829B that presently rents the space.

Tired or not, though, the 829B works very well in this amplifier. With an input of 80 watts unmodulated, the output, as estimated from observing a 60-watt lamp, could safely be said to be at least 55 watts. Under full modulation at this input, the 60-watt lamp will burn brighter than normal and if a sustained whistle is used, the bulb will turn blue and finally give up the ghost. At these frequencies, the lamp bulb test is none too accurate, but in the absence of some better way to measure the power output, almost everyone uses this method. Inputs up to 120 watts may be used with the 829B but a small fan is recommended for cooling under these conditions.

The 829B tube is rated in the tube manuals for full output to only 200 mc. How much derating should be made for the 220 mc. operation is not definitely known. One thing we found out for sure. It isn't as easy to get going on 220 mc. as on 144 mc. Now 220 mc. may not appear to be much higher than 144 mc. (actually it is 53%) but they don't list that 200 mc. maximum in the tube books for nothing.

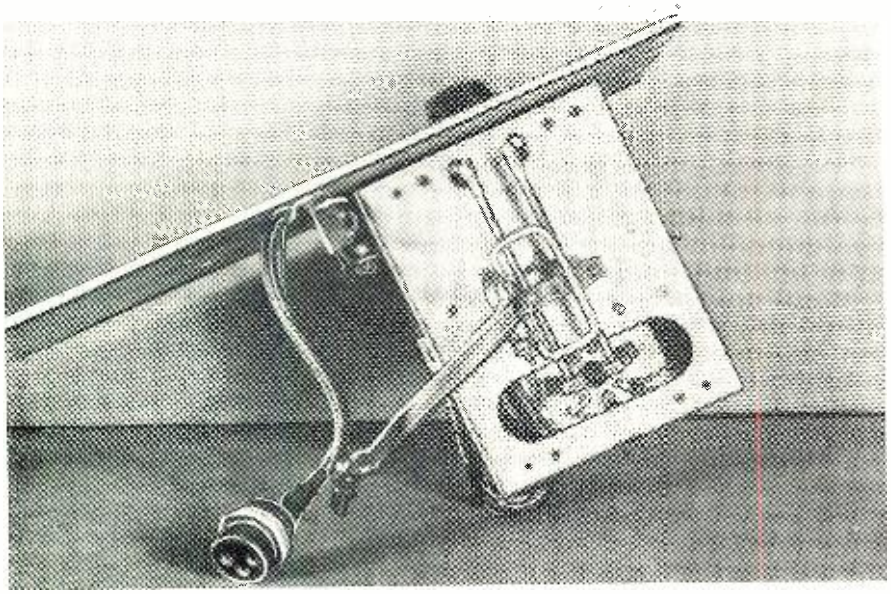
One thing that bothered us quite a bit when we started using the 829B on 220 was its high input capacitance of 14.5 $\mu\mu$fd. This showed up in the form of an extremely small coil to resonate on 220 mc. Next, a quarter-wave shortened line was used. This helped some, but even then, a line that would tune looked pitifully short, and it was.

A lot had been heard about half-wave lines, but up until now they had hardly been needed. No particular trouble was encountered on 144 mc. with quarter-wave sections. Now, however, appeared to be an excellent time to start in on them and see if perhaps they might help in this situation.

Right off, it was found that half-wave lines would do the job. Enough line was available when the grid dipper indicated 220 mc. resonance to actually see and feel. After a little playing with the tube and some makeshift lines to ascertain the approximate length necessary, it was decided to go ahead and see if an amplifier could be built in a permanent fashion.

After a look in the stockroom (junkbox for lowbrows) we found a gadget that looked promising. This was the housing for the r.f. section of the old radar transmitter called the ASB-4. This thing used a gob of 15E's and had a mess of lines attached thereto. The box, which measured about 5 x 5 x 6 inches, had a couple of openings in the proposed top and bottom and a pair of cathode lines which appeared to be in the right position to engage the input and output prongs of an 829B tube. The

The input lines are shown in this photograph. The output lines are identical. The tube socket is visible through the cut-out. Other ends of the lines go through the openings in the box to the stators of the butterfly-type condenser units.



lines turned out to be just the right length after the tuning condensers were hooked on the ends of them and the construction was such that excellent isolation was obtained between the input and output circuits.

Now you might not have an ASB-4 around, but with a box of about the same dimensions and few inches of 3/16 or ¼ inch copper tubing, you can duplicate the deal perfectly. In fact, it will probably beat this one for looks. One of the stock utility boxes with removable side covers will fill the bill.

A look at the photos and a few words will suffice to get this amplifier construction moving. The tube is mounted inside of the box with the socket jacked up off the chassis about half an inch. Four 1½ inch machine screws with nuts will accomplish this. Immediately under the tube socket is the opening in the chassis that will allow the grid lines to be soldered to the grid lugs of the 829B socket.

Directly above the 829B tube will be seen the opening in the chassis that will allow the plate lines to be connected to the tube pins. Large size *Fahnestock* clips with pieces of soft copper strip about a quarter-inch wide are employed to connect to the plate lines.

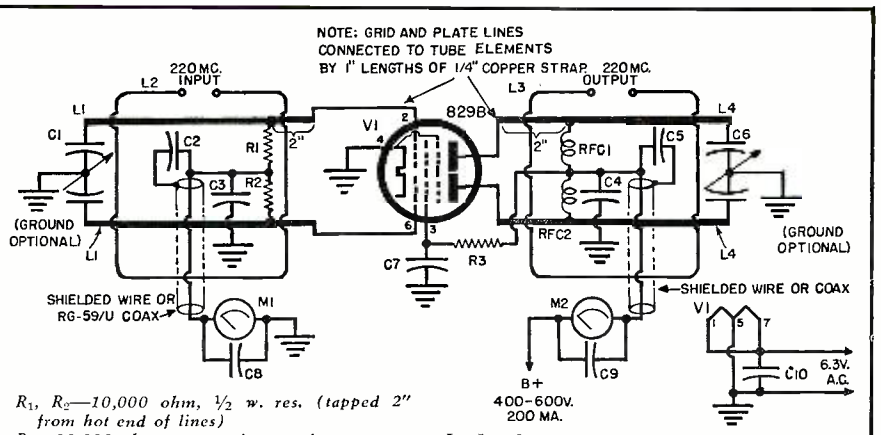
The grid tuning condenser and the plate tuning condensers, which will be at the opposite ends of the pairs of lines, are mounted inside the box with their shafts running through the front. Thus, when a panel is mounted to the box, the tuning controls are accessible from the front. Clearance holes are drilled in the top and bottom of the box so that the lines may be connected to the stators of the tuning condensers. These are surplus butterfly-type condensers obtainable for around thirty-five cents each and mounted with 6/32 studs. The rotors are normally floating and, in the amplifier, it may be found that the operation is better with one or both grounded. In our particular layout, it was found that a slight amount of hand capacity effect existed on the plate tuning condenser and grounding the rotor cured this. The grid condenser rotor was left floating. If it is found necessary to ground the rotor, use a wide piece of copper strip and bolt it down to the nearest place on the chassis.

When using half-wave lines it becomes necessary to feed in the plate and grid voltages at a point of minimum r.f. voltage. This point is quite easy to find and may be done with the grid dip meter before applying power. Merely use a sharp-pointed lead pencil and touch the line along its length until you find a point where it has no effect or a minimum effect on the meter. As a check, after the amplifier is finished and fired up, the pencil may again be used, this time to look for minimum r.f. sparking at the pencil point. Home-made chokes are used at this point to feed in the plate voltage to the plate lines, while the bias to the grid lines is fed in at the minimum r.f. point through a couple of 10,000 ohm, ½ watt resistors.

Output and input coupling loops consist of "hairpins" formed by No. 14 bare copper wire insulated with spaghetti, and are located at the minimum r.f. voltage points on the lines. A pair of ceramic pillars from BC-375E tuning units hold each one of these loops in place. Coupling to the input and output is adjusted by bending the loops in relation to the lines.

This amplifier was driven by a converted 522 transmitter operating on 220 mc. and more than enough drive is obtained. The final of the 522 was running about 22 watts input and 25 or 30 grid milliamps could be pumped into the 829B amplifier

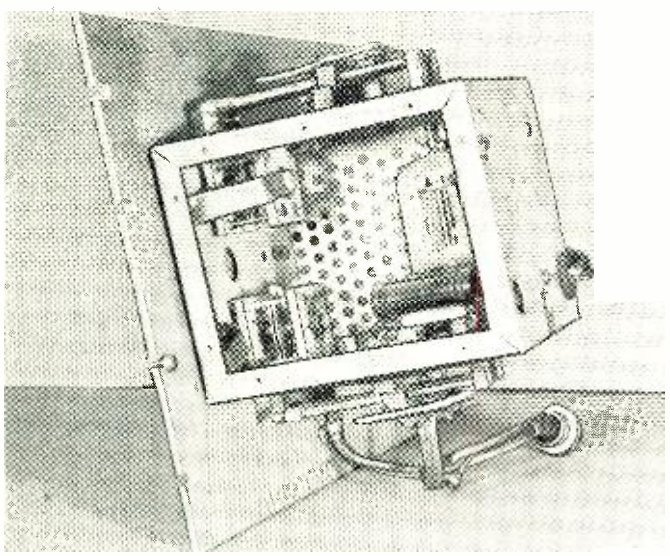
(*Continued on page* 118)



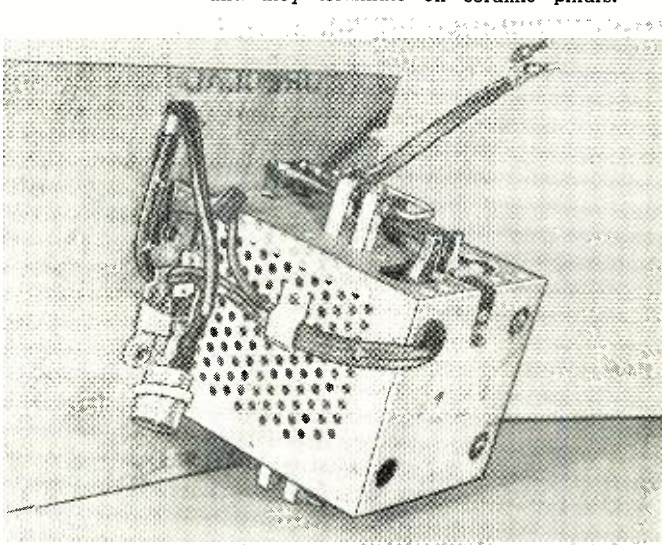
R_1, R_2—10,000 ohm, ½ w. res. (tapped 2" from hot end of lines)
R_3—20,000 ohm, 10 w. wirewound res.
C_1, C_6—3-12 μμfd. surplus butterfly cond. (capacity measured in series)
C_2, C_5, C_7, C_8, C_9, C_{10}—.005 μfd. disc. ceramic cond.
C_3, C_4—.001 μfd. feedthrough cond.
L_1 L_4—5" of 3/16" or ¼" copper tubing, spaced center-to-center ¾".
L_2, L_3—Input and output coupling loops. #14 bare copper wire, 1" wide, 2" long
RFC_1, RFC_2—11 t. #20 en., ⅛" dia. close-wound, tapped to plate lines 2" from hot end of line
M_1—0-25 ma. d.c. milliammeter
M_2—0-300 ma. d.c. milliammeter
V_1—829B tube

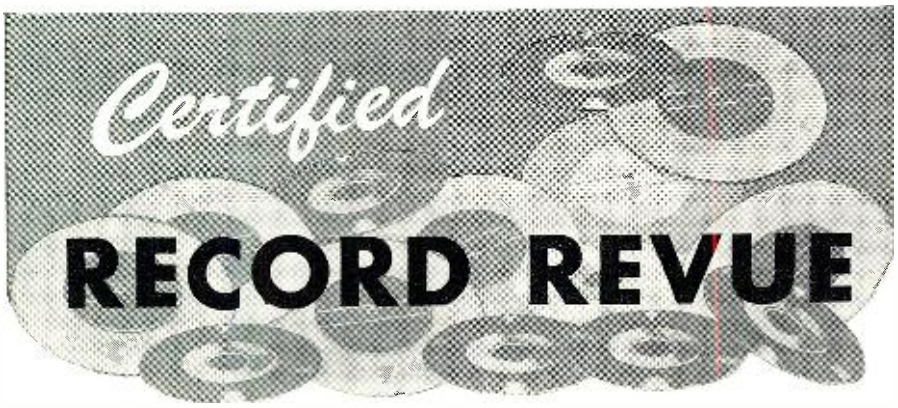
Complete schematic diagram and parts list for the 220 megacycle r.f. amplifier.

Another view of the r.f. amplifier with one side of the box removed to show the internal construction. The shield cover is not visible in this photograph. 829B may be seen at right.



Opposite side of the box. The ventilating holes are essential to aid in cooling the tube. The input lines are visible on top of the chassis and they terminate on ceramic pillars.





By **BERT WHYTE**

WITH this issue, the "Certified Record Revue" goes into the fourth month of its existence. Your response to our request for comments in the first issue has been immediate and enthusiastic.

We are frank to admit that we approached the idea of a record reviewing column in RADIO & TELEVISION NEWS with some trepidation. After all, there was no precedent for such a feature in a technical magazine. Your many, many letters have been a source of personal gratification to the author.

Your letters and the opinions and ideas expressed therein have been carefully screened with a view toward giving you what you want in this column. There were those who felt that more attention should be given to the musical values of the recordings and others who want a more technical critique than is now being offered. In the main, most of you who wrote wanted the present balance of technical evaluation and musico-esthetic considerations to be maintained.

On two points there was almost complete unanimity of opinion: one, the naming of the equipment used in reviewing the records and two, the comparative analysis of different recordings of the same musical work. Both practices will be continued, in fact, with the next issue comparative reviews of recordings old and new will be incorporated in this column.

Keep those letters coming in and I'll do my level best to try and make everyone happy. Since by the time you read this column Christmas will be upon us, let me take this opportunity of wishing you a Merry Christmas and a year of happy listening.

Equipment used this month: *Pickering* 260 pickup, *Fisher* master audio control, *McIntosh* 30-watt amplifier, *Jensen* G610 "Triaxial" in the *"Read Fold-a-flex"* enclosure.

BEETHOVEN

SYMPHONY #5 in C, EGMONT, CORIOLAN, AND LEONORE #3 OVERTURES

Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury "Olympian Series" MG 50017. AES curve. Price $5.95.

SYMPHONY #5 IN C, SYMPHONY #8

NBC Symphony Orchestra conducted by Arturo Toscanini. Victor LM 1757. Orthophonic curve. Price $5.72.

What! This old chestnut again? And *two* recordings at that, I can hear you exclaim. OK, so this warhorse among warhorses has been done for the 14th and 15th times. You may ask why, with good reason. How come *Victor* and *Mercury* are trying to buck the competition of thirteen other versions? Are they really necessary? My answer is yes, and I consider their issue a tribute to the respective musical directors of *Victor* and *Mercury*. Both these worthy gentlemen had the courage to release these recordings on the premise that they were *needed*, that none of the previous recordings were totally satisfactory. I heartily concur, with some reservation. This reservation lies within the nature of Beethoven's 5th itself. I don't think *any* recording, or for that matter concert performance of this symphony can be *totally* satisfactory. The temptation for conductorial interpretive "tampering" is too great, the discipline demanded of the orchestra formidable indeed. However, this is merely academic. Let us take a listen to these latest entries and find this justification of which I speak.

Beethoven 5th is the work that will be herein reviewed, as you have surmised from the above. The other works should come in for more attention, but alas, space is always at a premium. Suffice to say that the three great overtures have never been afforded such fabulous recording. With the drive and spirit that Dorati imbues in his reading of them, these little jewels of Beethoven's genius become more sparkling and scintillant than ever. Toscanini's reading of the 8th symphony is somewhat restrained for him, but nevertheless must be considered the best on records at present.

In the Beethoven 5th we find *Victor* and *Mercury* on opposite sides of the fence with their respective recording techniques. *Mercury*, having considerable success with their single-*Telefunken*-over-the-podium pickup, uses it again in this recording, with stunning effect. *Victor* is sticking by its guns and continues the multi-mike, console mix type of recording. The result in both cases, is that we now have two of the best sounding Bee-

(*Continued on page* 136)

Capsule reviews of records old and new for your Christmas gift-giving.

AURIC—Suite from Les Matelots

SATIE—Parade
Columbia ML 2112, 10" LP
Modern, jazzy type of thing with some amusing writing. Excellent sound and performance.

BARTOK—Third Piano Concerto
Columbia ML 4239, 12" LP
The last work of this genius and one of his most listenable. Dissonance, atonality, it's all here, but very interesting. Good sound.

BARTOK—Music for Strings, etc.
Mercury MG 50001, 12" LP
A tremendously powerful work. Might have to listen to it a couple of times before you begin to appreciate it, but it's worth your time. A top recording excellent for transients.

BERG—Wozzeck
Columbia SL 118, two 12" LP
Another hard one to love at first hearing. This awesome tale, once understood and digested, can be a terrific listening experience. Great performance and some wonderful sound.

BERNSTEIN—Age of Anxiety
Columbia ML 4325, 12" LP
This is the second symphony of Leonard Bernstein, "enfant terrible" of modern American music. It's pretty deep stuff, even a little grim, but nevertheless fascinating. Try section entitled the "Masque." Jazzy figurings and all sorts of good transients.

DEBUSSY—Le Martyre de St. Sebastien
Allegro All 3004, 12" LP
Little known work of Debussy, this is beautiful, grandiose music, gorgeous solo, choral, and orchestral effects. Definitely recommended.

HINDEMITH—Philharmonic Concerto and Apparebit Repentina Eies
Capitol P8134, 12" LP
The opening brass chords in the "Apparebit" are worth the price of the record. Huge sonority. Massive orchestration in the concerto and near the end a wonderful bit of writing for trio. Good sound.

HONEGGER—Concerto da Camera
Capitol P 8134, 12" LP
Some spritely, interesting writing for flute and English horn. Very good playing and some of the best woodwind reproduction on records.

KODALY—Missa Brevis
WCFM, four 12" LP
Modern treatment of a Mass in time of war. Tremendously rich in scoring and with some low, low organ pipes to test your speaker.

MILHAUD—Creation du Monde
Columbia ML 2203, 10" LP
Man, this is red hot! About the jazziest modern in existence. Wonderful performance and plenty of hi-fi.

NIELSEN—Symphony #6
Mercury 10137, 12" LP
One of Denmark's foremost symphonists, this is among his most interesting works. Highly dramatic with a slightly astringent flavor. Magnificent sound especially in the movement called "Burlesque."

SCHONBERG—Gurrelieder: Lied der Waldtaube
Columbia ML 2140, 10" LP
To those of you who think Schonberg nothing but atonality and discord, listen to this. A truly beautiful and poignant work. Fine performance and excellent sound.

SCHUMAN, WM.—Judith and Undertow Ballet Suites
Mercury 10088, 12" LP
Two powerfully written and blood-curdling ballets. There is plenty of hi-fi pyrotechnics in these two!

Music IN EVERY HOME

Christmas is Coming!

The holiday gift-giving season opens up a lucrative market for the audio dealer. Be ready to cash in on these opportunities.

Carl Fischer, Inc., New York Music house, promotes the sale of hi-fi gear with this effective display.

THE AGE of high fidelity is upon us and the buying spirit of Christmas will undoubtedly climax a period of unexcelled consumer promotion. No longer can we conclude that high-fidelity merchandise is only for the technician and audio enthusiast. The breadth of the market has changed; everyone who stops to listen is a potential customer.

Today more and more dealers are aiming their sales stories at the general consumer. From the window to the counter the merchandising story of high fidelity has taken its place with the promotion of leading music products. No longer does the dealer have to translate the meaning behind "high fidelity." The average consumer today is constantly on the receiving end of hi-fi indoctrination, either through the editorial text of leading national magazines or through the stepped-up advertising campaigns of manufacturers.

High-fidelity dealers of all varieties have within their grasp the tremendous opportunity of placing music at its best within every home. However certain selling patterns have to be compromised to reach this new opening market. The very fact that it is the home magazines which are the recipients of the largest space advertising is indicative of the trend of thinking of the manufacturer. Add to this the editorial emphasis given music in the home by these very same magazines. In short the place of high fidelity in the home is related to better living within the home. The design trends point up the importance of interior selling in the general hi-fi sales story.

There is every indication that the market of tomorrow is a non-technical one. The customer, a majority of whom will be women, is anxious to see as well as hear. Therefore the very element of the dealer's surroundings will be most important in the production of greater sales. The customer's interest should be considered first—show him what he likes to see; make him comfortable; above all don't try to make his decision.

The volume customer of high fidelity this Christmas will be a far different breed than that which the dealer has previously faced. No longer shall he be registered as a "bug"; rather he should be considered as one of many who value good listening. The technical circuitry is only of interest as it relates to what he hears. Sure, just as the early television purchaser, he will consider himself one of the chosen few and high-fidelity ownership will be noted with pride. He will discuss with his neighbors the advantages of owning a high-fidelity unit as if he were an authority on reproduction. That of course will be the greatest factor in the development of increased sales . . . the germ of the "have's" will affect the "have-not's" and before long the term "high fidelity" will become almost as popular a subject of conversation as early television.

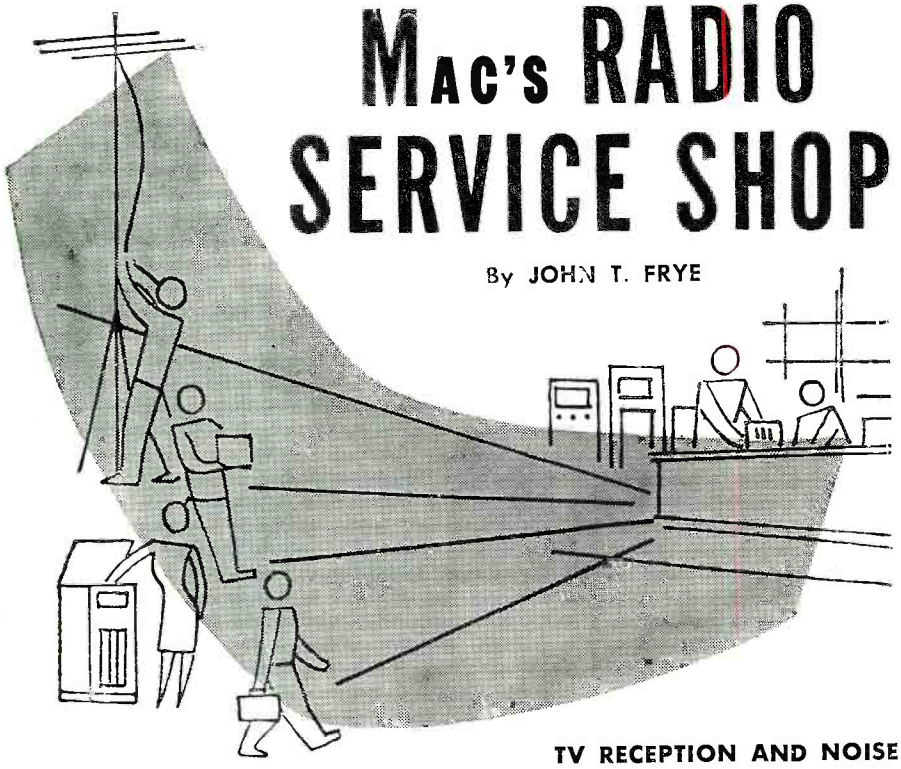
One point should be constantly kept in mind—the customer views audio components not as complete entities within themselves but rather as parts of a complicated mechanism. Therefore, in evaluating a program of component selling, one must be aware that although plugging one component into another is a simple matter the purchaser prefers that you make the assembly.

It should never be forgotten that the growing consumer market thinks in terms of the good "old" radio-phonograph and, as such, he thinks in terms of a complete package. To take the complexities out of high-fidelity selling, it would be desirable to de-emphasize the switching console. The average consumer watching the varied paraphernalia put to use likes to get back to the common "off-on" knob. The onlooker is beset with confusion at the variety of equipment, the wiring, and the lights that intermittently flash "on" and "off." Consider the uninitiated as you would a backward child, broaden his perspective through association. Set up working systems within consoles and have comparisons made through simple known controls. This system has presently been adapted in the recently opened outlets of *Electronic Workshop* and *Sun Radio*, both in New York City.

As a dealer in audio products, you are faced with an entirely new breed of customers. They will be more frequent and less demanding technically. They want to buy what they can see as well as hear. At times their innocence may seem insufferable; but patience, fortitude, and good consumer merchandising will pay more than adequate dividends. This Christmas can be a "green" one for hi-fi dealers with the cash registers playing "Jingle Bells" all day long. -30-

MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE



TV RECEPTION AND NOISE

AS MAC stepped briskly inside his service shop, glad to be out of the cold December drizzle, he heard his assistant, Barney, reading aloud to Miss Perkins, the office girl, an item from the morning paper:

"'And the meeting of the noise-abatement group was addressed by Mr. McGregor, local radio and TV service shop owner, on some of the technical aspects of noise generation and its effect on local television reception'—Hey, how about that?" the youth broke off as he saw his employer. "Why didn't you tell me you were going to talk? I'd like to have been there."

"It was bad enough as it was," Mac answered as he shrugged out of his overcoat. "You know how hard it is for me to try to make any kind of a public speech anyway; and if I had had to look at your grinning mug out front, I'd never have been able to say a word."

"How did you get roped in on the deal?"

"Harold, over at the bank, asked me to make the talk. He had been instrumental in getting things rolling on this 'better television' group in the first place; but he said things were beginning to get a little out of hand. What had started out to be an investigation of the possibilities of improving reception was rapidly deteriorating into a witch hunt. Extremists in the group were determined to 'do something' about poor reception. Some were in favor of 'ordering' an FCC truck into the area to make a noise survey. Others wanted to deliver an ultimatum to the mayor and city council either to clean up receiving conditions 'or else.' Still others were drafting proposed city ordinances forbidding the use of any device whatever that disturbed television reception. Harold thought that if I could present a few facts and figures on local signal strength, noise measurement, FCC policy, and so on, it might help to cool things off a little. Otherwise, he said he had nightmares of himself being pushed along at the head of a French Revolution kind of mob marching on the City Building."

Barney chuckled at this picture and then went on to ask, "Did you cool things off any?"

"I don't know. They had a discussion period before my talk that gave me a good idea of how they were thinking. Most of them were convinced that noise in our town was way above normal and that this abnormally high noise level was what stood between us and good television reception. What I tried to do was point out as tactfully as I could the things that should not be done because they would just be a waste of time. For example, I explained that the Federal Communications Commission does not provide a service for making noise surveys. They do have mobile units used for locating unauthorized radio stations and interference sources using radio frequency energy, but unless the interference is to a radio service involving safety of life and property, investigations are normally conducted only during periodic inspection trips to an area."

"Strictly speaking, we are not supposed to be receiving television here, anyway, are we?" Barney asked.

"That's right. The closest v.h.f. station is seventy miles away, and the next closest is better than a hundred. On top of that we are located down in a river valley that averages fifty to seventy-five feet below the surrounding terrain. Our average at-the-set signal strength delivered by a yagi antenna fifty feet in the air is around five to ten microvolts as measured with our service-type field strength meter. Sometimes, with a good thermal inversion, this will climb to two or three thousand microvolts; but these times are rare. They only serve to make people wonder why reception can't be like that all the time. As the signal grows weaker, the noise comes up in the sound along with snow in the picture; and that provides many people with the answer: noise is the villain. If it were not for excessive noise, they reason, good reception could be had all the time."

"How did you go about talking them out of that idea?"

"I tried to explain what the FCC considers necessary in the way of signal strength for good reception, and I'm afraid I got a little too technical there. I told them that the basic unit of measuring field strength is the one microvolt of potential that is developed in a conductor exactly one meter long by the magnetic flux of a radiated wave of the proper strength sweeping across it. Waves that are weaker or stronger are expressed as so many 'times'—decibels to us—below or above this basic strength of one microvolt-per-meter. This measured voltage, of course, is that actually produced in our standard antenna proper mounted in free space; it is not the voltage delivered to the set."

"Never mind simplifying things from here on in," Barney said. "You've got me interested now. How much signal does the FCC say we need?"

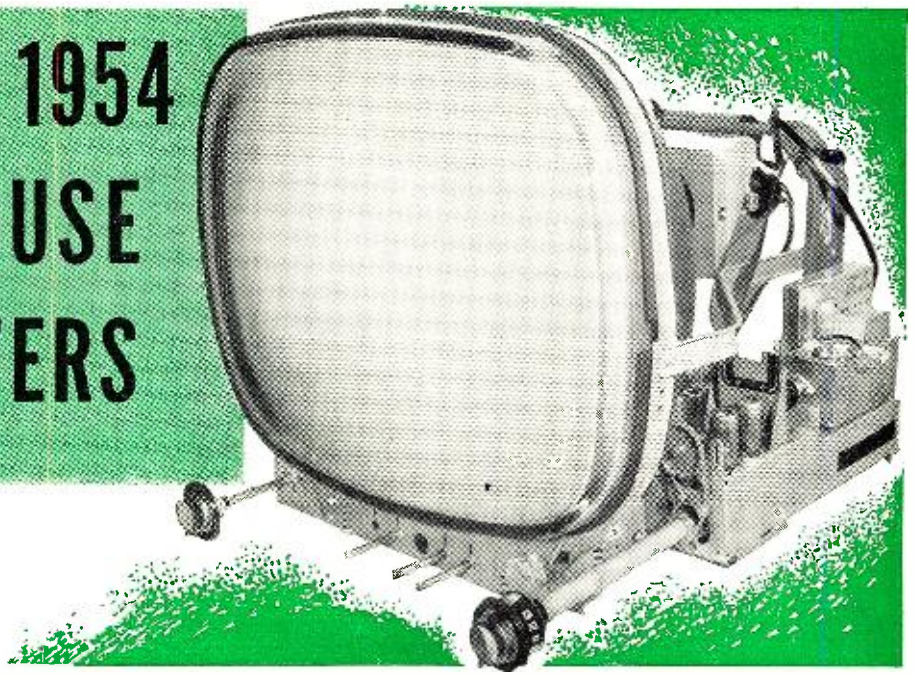
"Depends somewhat upon where you live. They list two grades of service: A and B. Grade A service is intended to provide reception quality acceptable to a median observer—whoever that is! !—at least 90 percent of the time at the best 70 percent of the receiver locations at the outer limits of the service. The receiving antenna is to be a half-wave dipole for channels 2-13 and an antenna with 8 db gain on channels 14-83. The lead-in is figured as being fifty feet of 300 ohm twin-lead. It is assumed that urban noise conditions will prevail that will contribute all the way from 0 to 14 db of noise. Under these circumstances, the FCC specifies a minimum of 68 db above 1 microvolt-per-meter on channels 2-6, 71 db on channels 7-13, and 74 db on channels 14-83."

Barney hauled down Terman's *"Radio Engineering"* and turned to the db tables in the back. "Let's see now," he mused. "That would mean we need about 2500 microvolts on the low v.h.f. channels, 3300 microvolts on the high channels, and around 5000 microvolts on the u.h.f. channels."

"That sounds reasonably close," Mac agreed. "Grade B service is figured to provide quality acceptable to our mythical median observer 90 per-

(*Continued on page* 176)

KNOW YOUR 1954 WESTINGHOUSE TV RECEIVERS



By
W. L. WRIGHT
TV-Radio Service Dept.
Westinghouse Electric Corp.

Fig. 1. The V-2243-1 chassis shown with the Model H-804 all-channel u.h.f. tuner mounted above and to the rear of the v.h.f. tuner.

Information on circuits u.h.f. provisions, and alignment for the rapid servicing of the Westinghouse 1954 chassis.

INCORPORATED in the new *Westinghouse* television receivers (Models 769T21, 770T21, 771T21, 772K21, 773K21, 774K21, 775K21, 776K21, 786K21, and 787K21) are many design features of particular interest to the television technician. In addition to a simplified sound circuit, an improved sync system, and unique provisions for the installation of an all-channel u.h.f. tuner, the entire chassis layout has been designed for easy servicing. Other new features include relocation of the auxiliary operating controls, addition of an a.g.c. control on the rear of the chassis, improved width and horizontal linearity controls, easily adjustable yoke mount, and a removable safety glass.

For operating convenience, the horizontal hold, vertical hold, and brightness controls are located behind a hinged panel attached to the receiver cabinet. These controls are equipped with small rubber knobs to facilitate adjustment. The channel selector and fine tuning control for both v.h.f. and u.h.f. remain in the usual position on the right-hand side of the chassis (see Fig. 1). The dual "off-on-volume" and picture control are located on the left-hand side of the chassis. The addition of an a.g.c. control on the rear provides for receiver sensitivity adjustment to compensate for signal conditions in different locations and variations in i.f. amplifier tube characteristics. Slider type width and horizontal linearity controls are located on the right rear of the chassis for ease of adjustment. Other service adjustments located on the rear of the chassis are the height, vertical linearity, focus control and the quieting control (see Fig. 5). The deflection yoke mounting bracket has been redesigned to provide free movement of the deflection yoke while it is being positioned and to insure that the CRT cushion firmly supports the flare on the CRT. The front glass plate can be removed for cleaning without removing the chassis from the cabinet. Four ¼" self-tapping screws hold the control panel to the cabinet. Removing the control panel exposes the mounting bracket that secures the front glass to the cabinet.

New Sound System

Simplification of the sound system in the new line of *Westinghouse* TV receivers is achieved by the use of a 6BN6 gated-beam tube as the FM detector and a 6BK5 beam-power pentode as the audio output amplifier. The limiter (control) grid of the 6BN6 is capable of changing plate current from cut-off to saturation with only a small input signal, therefore only one sound i.f. amplifier stage is required to drive the 6BN6. The relatively high audio output voltage of the 6BN6 in conjunction with the high power sensitivity of the 6BK5 eliminates the need for an intermediate audio amplifier.

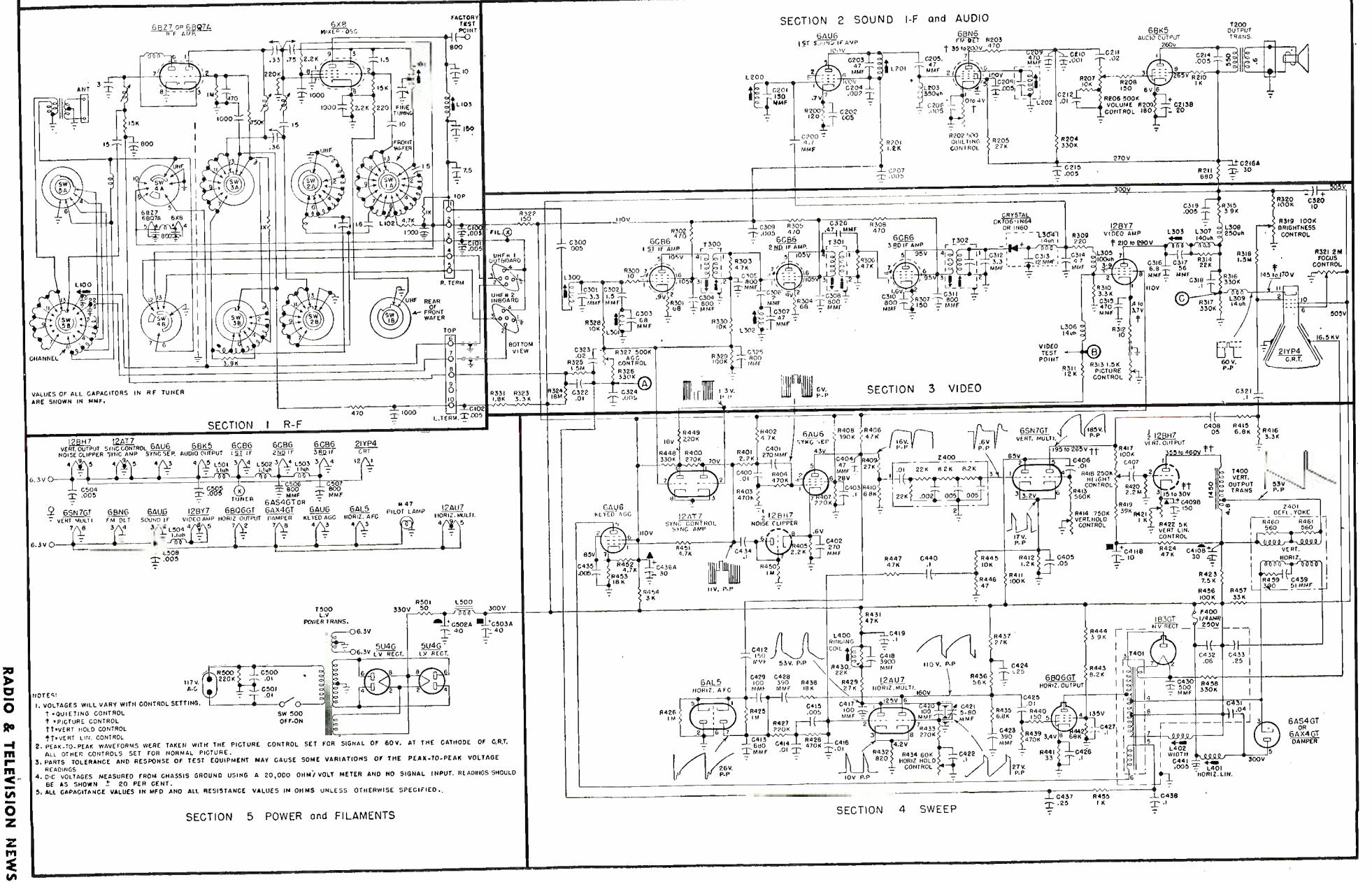
Use of the 6BN6 gated-beam tube as an FM detector eliminates the need for limiter stages. A signal voltage of 1.25 volts r.m.s. at the limiter grid of the 6BN6 is sufficient to drive the tube from cut-off to saturation. When the tube current is at the saturation level, higher inputs cannot increase the plate current. Therefore, amplitude limiting occurs when the signal voltage at the limiter grid exceeds 1.25 volts r.m.s., making the detector insensitive to amplitude fluctuations (AM). To obtain these conditions, the control grid bias on the tube must be set at the point where the tube operates in the correct portion of its characteristic curve. The cathode resistor (quieting control, see Fig. 2) is variable so that the AM-rejection characteristics can be adjusted for optimum performance during alignment of the receiver sound circuits.

New Sync System

The new sync system insures maximum effectiveness over a wide range of input signals and a high degree of noise immunity. As shown in Fig. 2, direct coupling is employed between the video detector and the sync amplifier grid (through L_{306} and R_{311}). On strong signals a negative bias voltage is developed across the video amplifier grid resistor, R_{310}, and tends to appear on the grid of the sync amplifier as a result of the direct coupling. If the sync amplifier grid was allowed to remain at a negative potential, the incoming sync pulses (which are negative going) would drive the sync amplifier tube considerably beyond cut-off, causing the sync pulses to be compressed. To prevent this undesirable condition, a positive potential is applied to the grid of the sync amplifier through the voltage divider network, R_{419}, R_{311}, L_{306}, and R_{310}.

The action of the sync control tube now becomes important. The full a.g.c. voltage developed by the receiver is applied to the grid of the sync control tube. Strong signals develop a high negative a.g.c. voltage which is sufficient to cut off the conduction in the sync control tube.

Fig. 2. Complete schematic diagram of the Westinghouse V-2243-1 television chassis including the v.h.f. tuner.



Therefore, under strong signal conditions the sync control tube represents an open circuit and allows the positive potential on the grid of the sync amplifier tube to remain at the level determined by the divider network.

On weak signals, the a.g.c. voltage is low enough to allow the sync control tube to conduct. When the sync control tube conducts, it represents a relatively low resistance between ground and the junction of R_{400}, R_{418}, and R_{419}. Under these conditions, application of a positive potential to the grid of the sync amplifier tube is prevented. A positive potential at the grid of the sync amplifier on weak signals is not desirable because cathode-to-grid conduction in the sync amplifier would result in a low input impedance with an accompanying loss of signal voltage.

The control tube, in effect, is a variable in the voltage divider network which determines the potential on the grid of the sync amplifier. Thus, optimum bias is automatically applied to the sync amplifier over the full range of signal input levels.

One-half of a 12BH7 tube, with the plate and grid connected together to form a diode, serves as the noise clipper. The positive-going pulses at the plate of the sync amplifier are fed to the plate of the noise clipper *via* a .1 μfd. condenser, C_{434}. When a positive pulse is applied to its plate, the noise clipper conducts causing C_{434} to charge. After the pulse passes, C_{134} discharges slowly through the one megohm resistor R_{450}, thereby applying a negative potential to the plate of the clipper. Since the discharge time constant of C_{434} and R_{150} is long when compared to the time between pulses, the negative potential is maintained at the plate of the clipper. Therefore, the clipper conducts only slightly during the succeeding sync pulses. The current during conduction of the clipper flows through R_{405}, developing a positive voltage at the cathode of the clipper. Because the negative potential at the plate of the clipper allows conduction on only the peaks of the sync pulses, the voltage developed across R_{405} is very small and is present only when sync pulses are present.

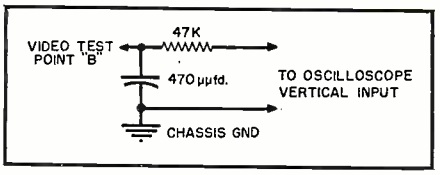
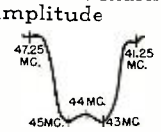


Fig. 3. Decoupling network used with oscilloscope in step 1 of Table 1.

When noise pulses having an amplitude greater than that of the sync pulses appear at the plate of the clipper, the negative potential at the plate of the clipper is overcome and the clipper conducts heavily. This develops a spike of positive voltage corresponding to the noise pulse across R_{405}, which is also the sync separator

Table 1. Alignment procedure covering the video i.f. and sound circuits of the Westinghouse V-2243-1 television chassis.

VIDEO I. F. ALIGNMENT

STEP	SIGNAL GENERATOR FREQUENCY	SIGNAL GENERATOR CONNECT TO	OUTPUT INDICATOR	CONNECT TO	ADJUST	REMARKS
1	44 mc. center frequency 10 mc. sweep	Pin 1 of 3rd i.f. amplifier (6CB6)	Oscilloscope	Video test point "B" (see Fig. 5) through the decoupling network shown in Fig. 3	T_{302} primary (top) for maximum pattern height. T_{302} secondary (bottom) for symmetrical response curve	Connect detuning alligator clips to 1st and 2nd i.f. plates (pin 5).
2	47.25 mc. unmodulated	Pin 1 of 1st i.f. amplifier	Oscilloscope	Same as above	L_{302} for minimum response	Remove detuning clips
3	44 mc. center frequency 10 mc. sweep	Pin 1 of 2nd i.f. amplifier	Oscilloscope	Same as above	T_{301} primary for maximum height. T_{301} secondary for symmetrical curve	Connect detuning alligator clip to 1st i.f. plate
4	44 mc. center frequency 10 mc. sweep	Pin 1 of 1st i.f. amplifier	Oscilloscope	Same as above	T_{300} primary for maximum pattern height. T_{300} secondary for symmetrical curve. L_{103} for "hump" at 44 mc.	Detune L_{103} before adjusting T_{300}
5	213 mc. center frequency 10 mc. sweep 41.25 mc. unmodulated marker	Antenna terminals through a matching network. Pin 1 of 1st i.f. amplifier	Oscilloscope	Same as above	L_{306} for curve below. L_{307} for minimum 41.25 mc. marker amplitude 	Replace 6BZ7. Set fine tuning adjustment to mid-range
6	4.5 mc. unmodulated	Video test point "B" through .001-μfd. condenser	V.T.V.M.	Test point "C" through r.f. probe	L_{303} for minimum	Use strong signal from generator

SOUND I. F. ALIGNMENT

7	4.5 mc. FM. 7.5 kc. deviation or tune in local TV station	Test point "B"	V.T.V.M.	Across R_{206} (volume control)	L_{200}, L_{201}, for maximum	Use a weak signal
8			V.T.V.M.	Same as above	L_{202} for maximum	Use a strong signal
9	4.5 mc. AM	Test point "B"	V.T.V.M.	Same as above	R_{202} for minimum	

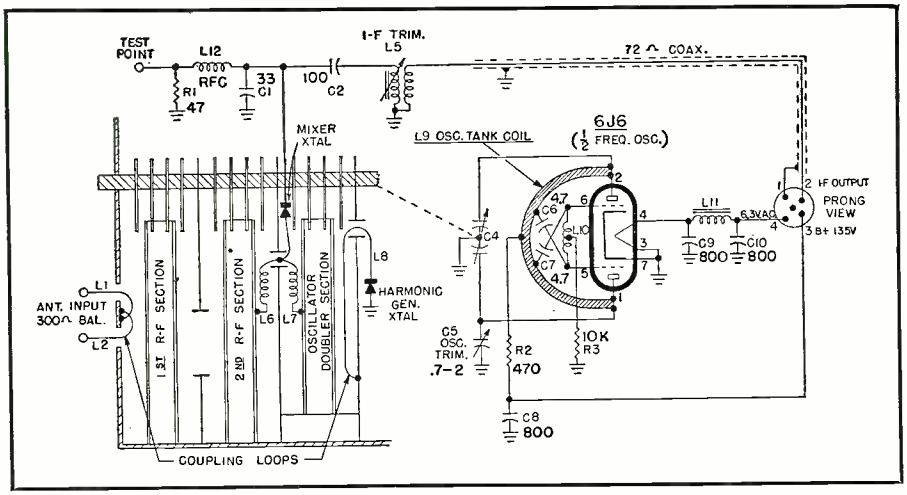


Fig. 4. Schematic diagram of the model H-804 all-channel u.h.f. tuner.

cathode resistor. Since, at the same time, the noise pulse appears as a positive spike at the grid of the sync separator, and with almost equal amplitude as at the cathode, the two voltages cancel and the noise pulse becomes ineffective.

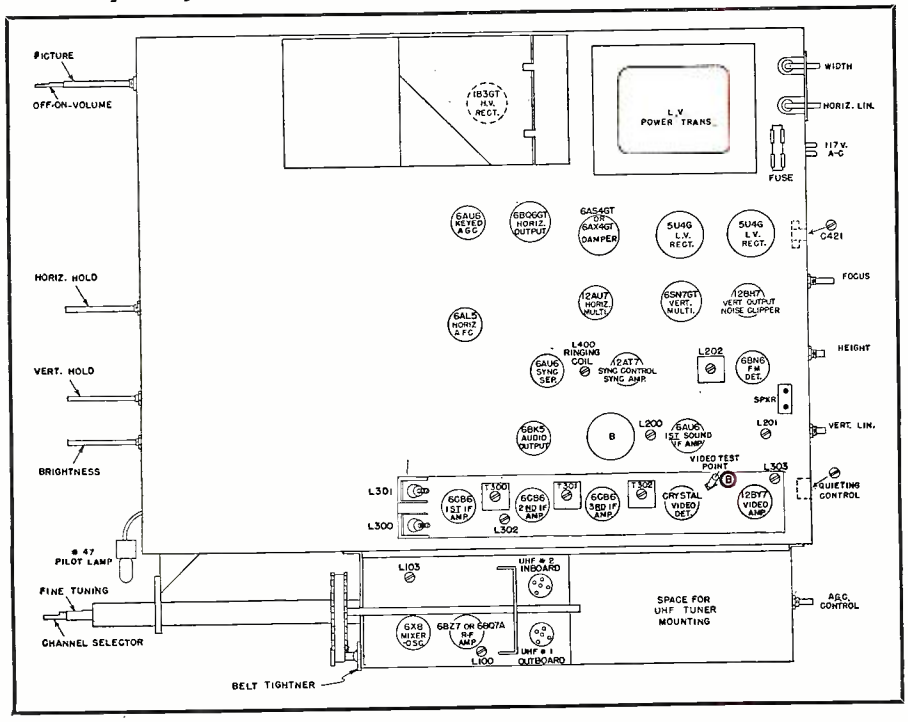
U.H.F. Adaptability

Westinghouse television receivers that contain the letter "U" in their model designation contain a built-in all-channel u.h.f. tuner. All others have provision for the installation of u.h.f. channel strips, receptors, or an all-channel u.h.f. continuous tuner in the field.

The design of the V-2243-1 chassis, like most other *Westinghouse* chassis, provides for the installation of an all-channel u.h.f. continuous tuner without removing the chassis from its cabinet. All mechanical and electrical parts required to mount and connect the u.h.f. tuner and provide channel selection are contained on the chassis. Installation is simple. The u.h.f. tuner is set in place on the v.h.f. tuner mounting bracket and secured by two ¼" self-tapping screws. The connecting cable for heater, a.g.c., and "B+" voltages, and coupling to the v.h.f. tuner is inserted in a socket provided on the top of the receiver chassis. A tab is removed from the v.h.f. channel indicator exposing the u.h.f. channel numbers. The u.h.f. tuning is accomplished by means of the v.h.f. fine-tuning control, which acts as a vernier drive for the u.h.f. tuner. For installation in the field, the u.h.f. tuner is furnished as a kit and includes a calibrated dial for u.h.f. channel indication.

The u.h.f. television tuner (see Fig. 4) contains the r.f. preselector, oscillator, and mixer circuits. In the u.h.f. tuner, the u.h.f. signal is converted to the intermediate frequency of the television receiver (center i.f. is 44 mc.), and this i.f. output is fed into the v.h.f. tuner. When the channel selector of the receiver is set to the u.h.f. position, the v.h.f. oscillator is disabled and the r.f. amplifier and mixer circuits serve as i.f. amplifier stages at 44 mc. Thus, the output of the u.h.f. tuner is amplified in the v.h.f. tuner and fed to the i.f. strip in the receiver.

Fig. 5. Top view of the V-2243-1 chassis showing the tube and parts layout.



The common i.f. system uses overcoupled i.f. transformers to obtain the required bandwidth. To align this type of system, the visual stage-by-stage method is used. A sweep generator is used to develop the response curve on the oscilloscope. An unmodulated signal generator (marker) provides spot frequency indications on the response curve.

Before proceeding to the alignment instructions given in Table 1, do the following:

a. Remove the 6BZ7 r.f. tube.

b. Turn the channel selector to channel 13

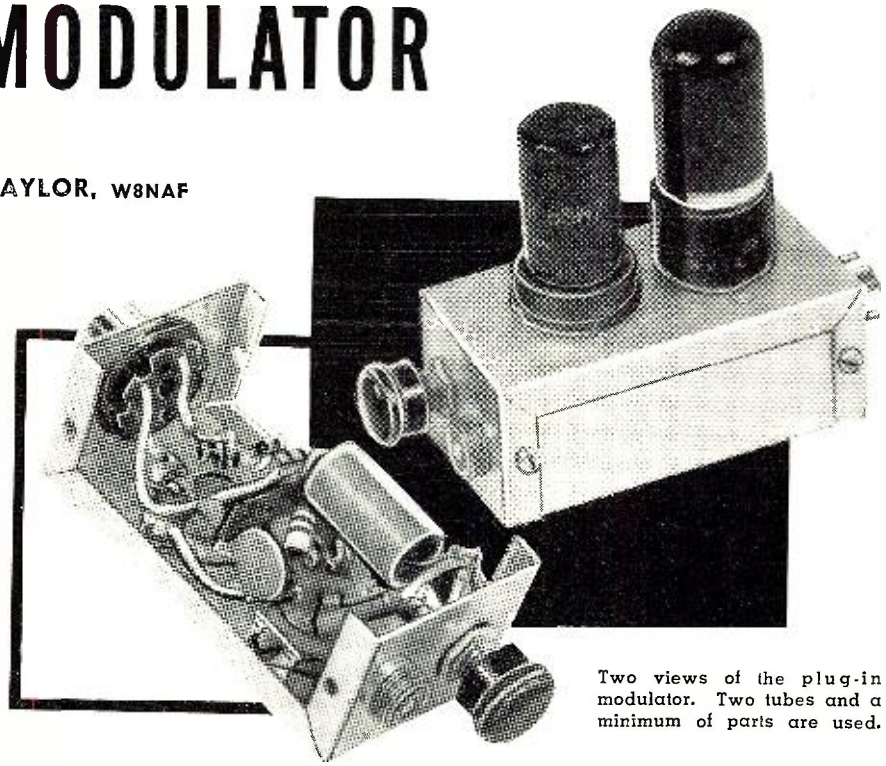
c. Connect a 9-volt bias battery to the a.g.c. line with the negative side to the junction of resistor R_{326} and condenser C_{324} (point A on Fig. 2).

d. Bond the chassis and test equipment together with braided copper ribbon.

e. Loosely couple the output of a marker generator to the output of the sweep generator. —30—

A PLUG-IN MODULATOR

By **EVERETT G. TAYLOR, W8NAF**



Two views of the plug-in modulator. Two tubes and a minimum of parts are used.

A compact clamp-tube circuit which can be used to transform any c.w. transmitter into a phone rig neatly and efficiently.

THIS article describes a simple "clamp modulator" that may be plugged into any available c.w. transmitter to permit phone operation. It should prove attractive to the code operator if he wishes to operate phone without having the operating position cluttered up with the usual amount of modulator equipment.

It is a well-known fact that a clamp modulator will not permit the class "C" stage being modulated to operate as efficiently as some other types of modulation but it is an inexpensive way of modulating a c.w. transmitter. Properly adjusted, it has good speech quality and is easily read by the operator receiving the signal.

This little packaged unit is simple and easy to construct. It uses few parts and is inexpensive to build. It is designed to plug into an octal socket on the rear of the chassis of any c. w. transmitter with the filament and "B" voltages being supplied through the plug-in octal socket. It may be used to modulate an 807, 2E26, or practically any beam power type of final. It may also be used to modulate the SCR-274-N series of transmitters, which is one of the more popular pieces of surplus equipment in use on the medium frequency ham bands.

The parts are mounted on an *ICA* 29337 "Flexi-Mount" aluminum case. Only two tubes are used, namely, a 6SH7 as a speech amplifier and a 6U6 as the modulator tube. A 6AU6 may be used in place of the 6SH7 if further miniaturization is required.

The external parts are mounted as follows: the tube sockets are placed on top of the chassis and the mike input and gain control are mounted on the front while the male octal plug is placed on the back.

The internal components are almost all mounted point-to-point therefore only a small amount of hook-up wire is required. An *Amphenol* 75-CL-PC1M microphone connector is used for the mike input. The gain control, R_1, is a 500,000 ohm *Centralab* type "R" unit. The sockets for the tubes are *Cinch* type 8EM. The male socket connecting the modulator to the transmitter chassis is an *Amphenol* type 86-CP8. The remainder of the resistors and condensers are of the common USA-manufactured variety.

C_1 is used to isolate, d. c.-wise, the gain control from the 2.7 megohm resistor which supplies the bias to the 6SH7. The reason for this condenser is that if you use a dynamic type of microphone, the d. c. resistance of the secondary of the input transformer would effectively short out the bias to the input tube.

The values specified for R_1, C_2, and R_3 should remain unaltered as they are correct for voice frequencies between 300 and 2500 cycles. This combination of parts will give more pronounced modulation.

The choice of the modulator tube, the 6U6, was dictated by the fact that its plate voltage more nearly approaches the needed value of the screen voltage of the tubes, mentioned earlier, which it modulates.

When modulating a 2E26 or 807, the screen should be reduced to about 100 volts or so by increasing the value of the screen dropping resistor. This resistor is common with the screen of the pentode being modulated and likewise with the plate and screen of the 6U6.

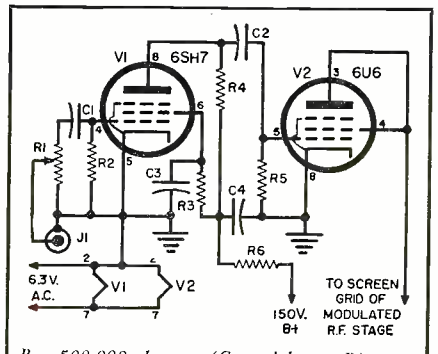
During the process of modulation, the screen of the r. f. tube will vary at an audio rate which is determined by the mode of the audio signal applied to the screen of the r. f. tube.

Just a word of caution, the screen bypass condenser in the circuit of the r.f. tube being modulated should not exceed .002 microfarads. If it is any larger, it will bypass the audio component, particularly at the high-frequency end. This would result in a signal sound level that is much lower in amplitude than desired and an apparently greater bass response.

The 150 volts for the 6SH7 circuit may be obtained from a VR-150 which should be used to supply the voltage needed in case you use a v.f.o. in the r.f. portion of the transmitter.

We feel sure that you will be pleased with this little modulator as it is quite versatile. The basic idea of the clamp-tube has been used by a number of hams in both mobile and home operation. It saves weight, size, and money if you are interested in an occasional phone contact. —30—

Complete schematic of plug-in modulator.



R_1—500,000 ohm pot (Centralab type R)
R_2—2.7 megohm, ½ w. res.
R_3—2 megohm, ½ w. res.
R_4—100,000 ohm, ½ w. res.
R_5—220,000 ohm, ½ w. res.
R_6—47,000 ohm, ½ w. res.
C_1, C_2—.002 μfd. ceramic cond.
C_3—.01 μfd. disc ceramic cond.
C_4—8 μfd., 150 v. elec. cond.
J_1—Mike input jack
V_1—6SH7 tube
V_2—6U6 tube

The ELECTRONORGAN

By
RICHARD H. DORF
Audio Consultant

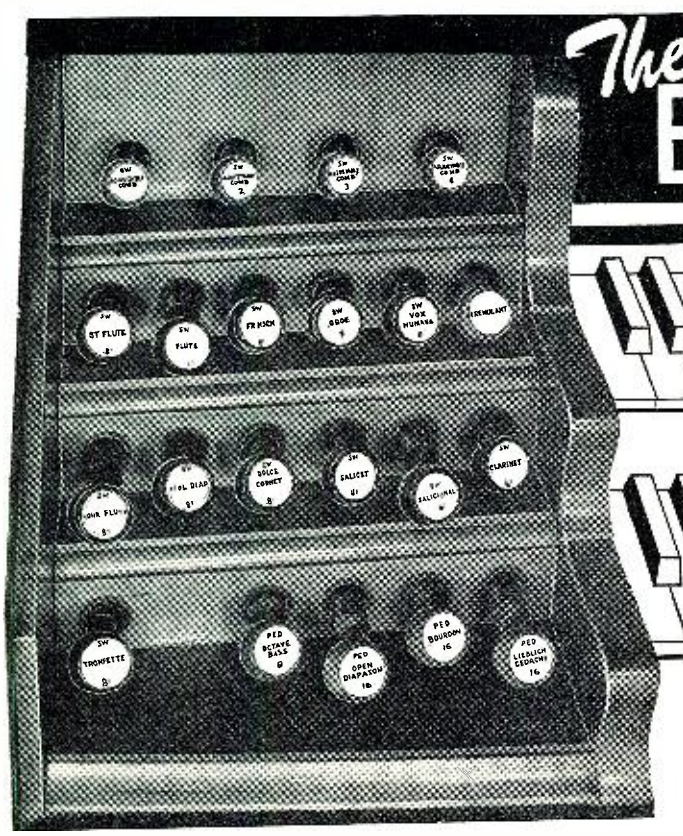


Fig. 14. Close-up view of some of the stops.

Part 2. Selecting a suitable console to house the organ and details on the necessary conversion. Construction data on the plugboard and the organ's key switches.

THE console or housing for the "Electronorgan" will determine, to a large extent, the physical layout of the electronic parts. The writer's console, shown in Fig. 1 (Part 1), is a standard pipe-organ unit purchased from an organ repairman. Organ repairmen or builders can be found in every good-sized city and they almost always have, or can locate, a suitable console. Agencies for electric and electronic organs are also good bets, since when a church or organization installs a new electronic unit, the seller is often given the job of removing and disposing of the old organ.

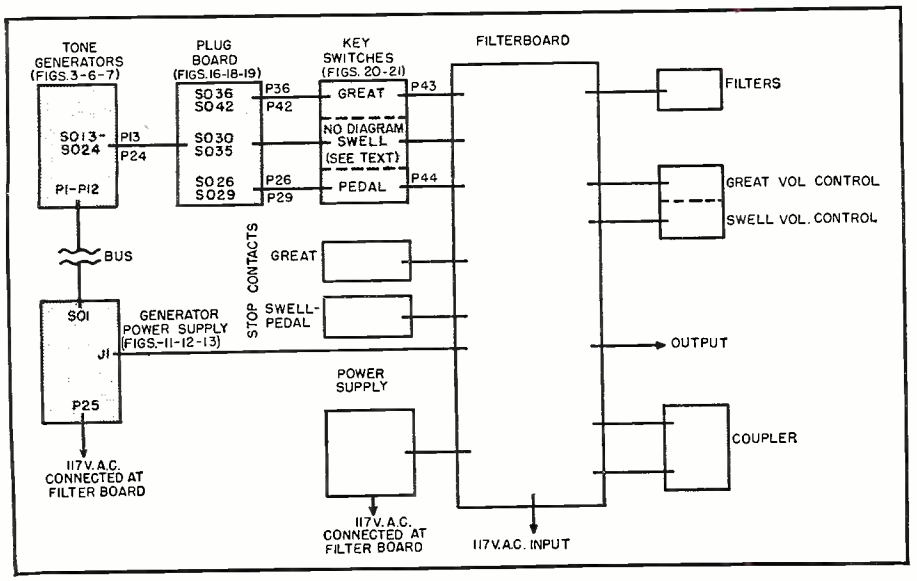
For convenience and the least number of alterations, the console selected should have certain basic features. It should, of course, have two manuals (unless the constructor will be satisfied with one—musically not nearly so satisfactory) and the manuals should be in good condition as far as the action is concerned. The ivories can be badly chewed up, for they are easily replaced with either pieces of "ivory" sold for the purpose or ivories salvaged from discarded manual.

The console should also include a pedal clavier in good condition. Good condition is, of course, a relative term and ingenious constructors can readily repair actions in almost any state of disrepair short of actual or incipient disintegration. Fifty to sixty dollars is about the maximum price you should have to pay for a console, depending on condition and elaborateness.

Since the organ will have to have at least one swell shoe (expression pedal) the console should have one in such condition that it at least pivots freely. Two pedals are more satisfactory. Stop and coupler controls exist on all organ consoles but the buyer should make sure either that the number of controls is sufficient or that additional ones can be added without making a hodgepodge of the final product. The actual contacts may or may not be in working order just as long as the mechanical actions are intact. Try to get a pipe-organ console rather than one from a reed organ, since the latter will be unnecessarily bulky. Also make sure that whatever console is selected can be disassembled so that it can be moved around.

The following description of the writer's console is given merely as a guide and an example. The case itself is 60½ inches wide and 48½ inches high by 24 inches deep. It is a plain box. Originally it contained eight pneumatic pistons on the floor of the box for the adjustable stop combinations, but these were removed. The remaining case was a simple box with the three pedals.

Fig. 15. Chassis interconnection diagram. Only the chassis that have been covered so far are shown "shaded". The rest will be detailed next month.



The manual unit is separate and extends 16 inches from the front of the case. Originally the two manuals were removable, but time and expansion of the wood made it impossible to separate them without the possibility of damage. The manual unit also contains the stop knobs; the swell knobs on the left side are shown in Fig. 14. These control long wooden bars with spring-wire contacts at the rear ends. The four knobs at the top are part of the combination action which is not used at present. The console the writer selected had the required number of stop knobs, so no alterations were necessary.

Above the upper (swell) manual the original console had a wooden board carrying some coupler tablets in very poor condition. The tabs were removed and some of the writer's own construction substituted, as will be described.

The pedal clavier, shown in Fig. 4 (Part 1), extends 34 inches from the front of the case and is standard in every way. The original console had a hinged manual cover with a music rack; the cover was unsightly and unnecessary so it was removed and the music rack set in place permanently with wooden supports. The bench was good but needed refinishing. After the cabinet was cleaned up, the entire console and the separate pedal clavier were mounted on heavy casters. This paid off since it was necessary to move the assembly around frequently to get at the various parts during the installation of the electronic gear.

Fig. 16 shows the rear of the console, illustrating how the twelve tone generator chassis and the filter board are mounted. Fig. 17 is a drawing of the chassis support assembly and the plugboard. The bottom chassis support is a piece of wood which runs along the bottom of the console. The plugboard assembly is fabricated of aluminum strip with two pieces of wood supporting it, as shown in Fig. 17. All the wooden pieces are fastened by their ends to the inside walls of the organ case so that the entire assembly stands as shown in Fig. 17. Each chassis is fastened in place by one wood screw at the top and another at the bottom. Six busses run along the inside of the bottom chassis support board carrying power from the generator power supply (SO_1 of Fig. 11, Part 1). At each chassis a cable is tapped from the busses, run through a hole in the board, and terminated in a connector which connects into the power plug on a tone generator chassis (P_1-P_{12}, Fig. 6, Part 1).

The edge of the plugboard can be seen just above the generator chassis in Fig. 16, with all of the connectors sticking out from its top. A view of these generator chassis, from the front of the organ, is shown in Fig. 18, and the plugboard diagram in Fig. 19. P_{13} through P_{24} connect to the 12 generator chassis (SO_{13} to SO_{24}, Fig. 6, Part 1), bringing the tones into the plugboard. The remainder of the connectors are chassis-mounting females, mounted on the aluminum strip. The board rearranges the tones so that each of the output connectors, SO_{25} through SO_{42}, supplies one complete octave of twelve tones. Three sets of output connectors are furnished—for great and swell manuals and pedals. The octaves are numbered, in Fig. 19, beginning with the lowest number for the lowest frequency octave. The pedals require only four octaves (actually 3½) and the swell has no 16-foot register and, therefore, requires no tones from octave 1.

The plugboard may be eliminated by individual constructors and the same rearrangement of tones carried out at the key switches themselves. The wiring is bulky and the plugboard does provide a centralized distribution point and in the long run will simplify the over-all assembly operation.

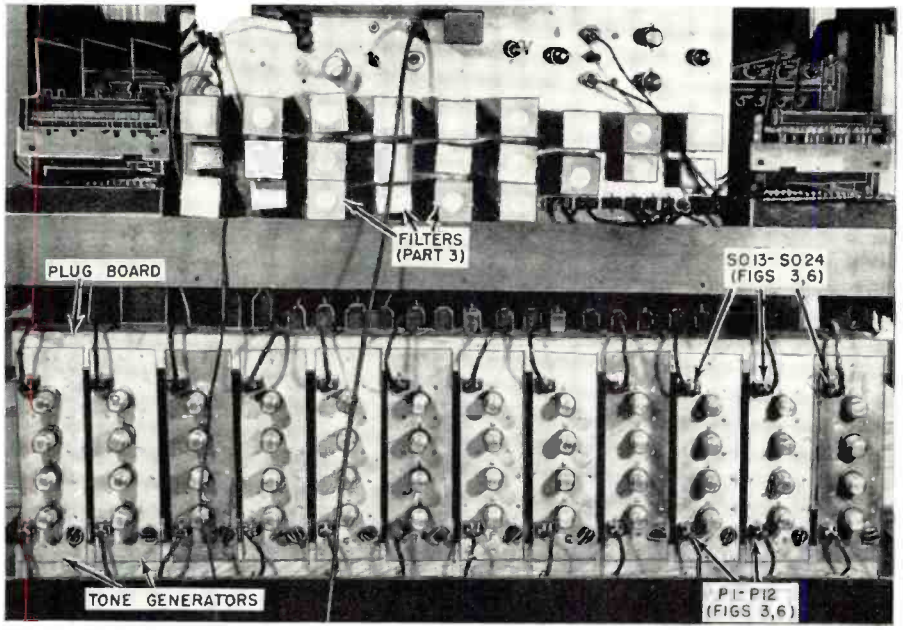


Fig. 16. Rear view of console showing how generator chassis and plugboard are mounted.

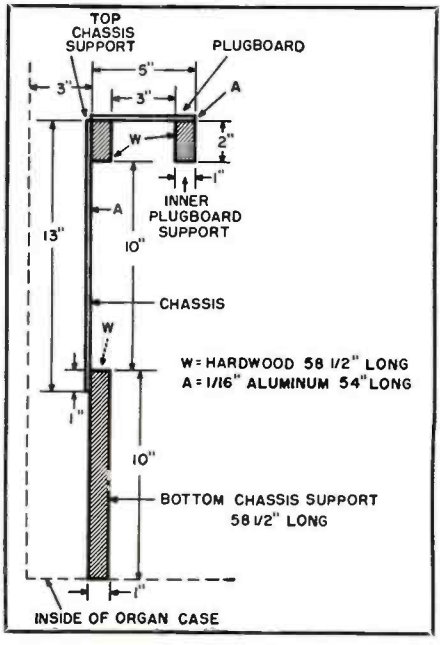
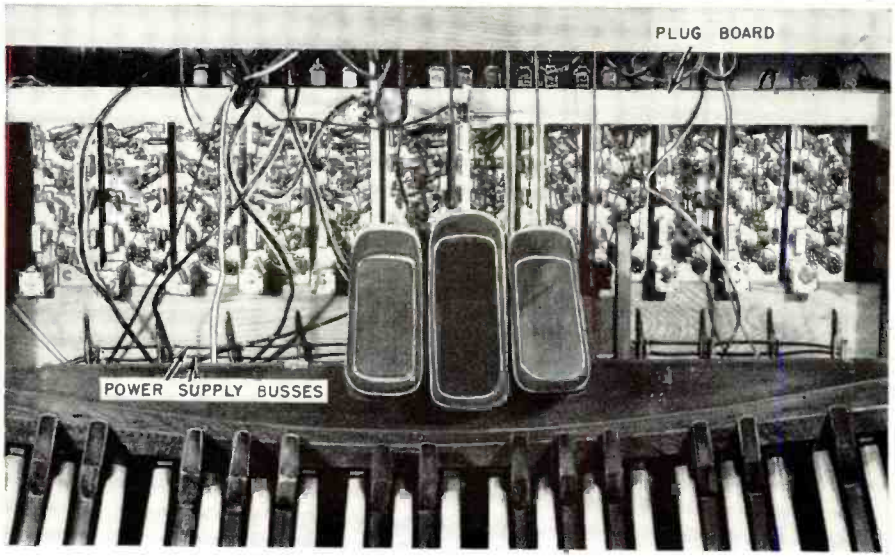


Fig. 17. Mechanical details of the chassis support assembly and of plugboard.

Fig. 18. Front view of the organ showing the tone generator chassis in their places.



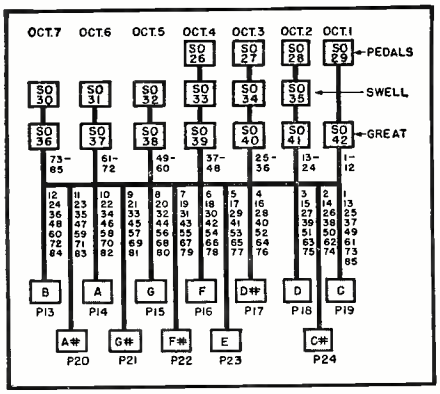


Fig. 19. Interconnection diagram of the plugboard. See text for full details.

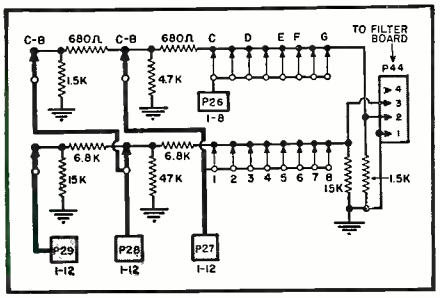


Fig. 20. Wiring of the pedal key-switch assembly for the 8 and 16 foot registers.

Key-Switch Assemblies

Fig. 21 is a schematic of the great manual key-switch wiring. Each key operates three s.p.s.t. normally-open contacts as shown in the diagram. Let us trace one or two and see how they operate.

P_{40}, Fig. 21, plugs into SO_{40} on the plugboard shown in Fig. 19. SO_{40} has one pin connected to the octave 3 output of each of the twelve tone generators so that SO_{40} and P_{40} carry a complete octave of tones between 130.8 and 246.9 cps. The lowest note, C, is on pin 1—the uppermost note, B, is on pin 12.

Pin 1 of P_{40}, Fig. 21, carries tone to the arm of the 16-foot key switch for the note C in the third octave of the great manual. It also carries the same tone to the 8-foot C in the second octave of the manual and to the 4-foot C in the first octave. Thus, the same note will be heard when any of these three C keys is pressed. However, the note is channeled to a different output in each case and to different stops.

Looking at it from the standpoint of a single key—if the second C on the manual is pressed, the 8-foot output will carry 130.8 cycles. The 4-foot output will carry 261.7 cycles, an octave higher, and the 16-foot output will carry 65.41 cycles, an octave lower.

The outputs of each octave of keys are commoned and a voltage divider is interposed between this octave and the next higher one. All the outputs go to pins of P_{43}. Because of the voltage dividers, the output levels of the octaves are graduated, with the highest frequency octaves giving the most output. This is done to compensate for the stop filters which will follow (Part 3), most of which have a low-pass characteristic which would suppress the higher-octave fundamentals if this levelling action were not taken. One great stop filter, however, has a high-pass action, so a special 4-foot output is taken for its benefit from the bass end of the 4-foot line and fed out through pin 2 of P_{43}. This system of key switching is suggested by the one used in the *Baldwin* organ where the same problem exists.

The swell key switches are wired in the same way except that there is no 16-foot register and each key is only required to operate two sets of contacts. In wiring the swell use the following plan: Eliminate P_{12}; P_{11} to SO_{35} of the plugboard; P_{40} to SO_{34}; P_{39} to SO_{33}; P_{38} to SO_{32}; P_{37} to SO_{31}; and P_{36} to SO_{30}.

The output connector, P_{43}, of the swell assembly is a 4-pin male connected as follows: Pin 1 to ground; pin 2 to treble end of 4-foot output; pin 3 to treble end of 8-foot output, and pin 4 unused.

In each case bond the ground line used for terminating the divider resistors to the chassis of the power supply and to every other major chassis in sight.

Fig. 20 shows the wiring of the pedal key-switch assembly which includes only 8- and 16-foot registers.

No directions can be given for constructing the key-switch assemblies themselves. It is a matter for individual ingenuity. The main reason is that the actions of various organs differ so that the scheme will depend on the key pivot points, the length of the bars, the fastening facilities, space, etc. The writer went to the trouble of having shallow metal troughs made, each the length of the manual. In this were placed plastic mounting boards and each assembly was made up of a series of *Guardian* relay contacts. These contacts are sold for making up odd relay contact combinations and are available as catalogue No. 200-3. A large number of these is necessary. Other constructors may use spring-wire contacts employing phosphor bronze wire or something similar. Nichrome wire is said to be excellent for this application as it does not form an oxide which tends to make for clicking contacts.

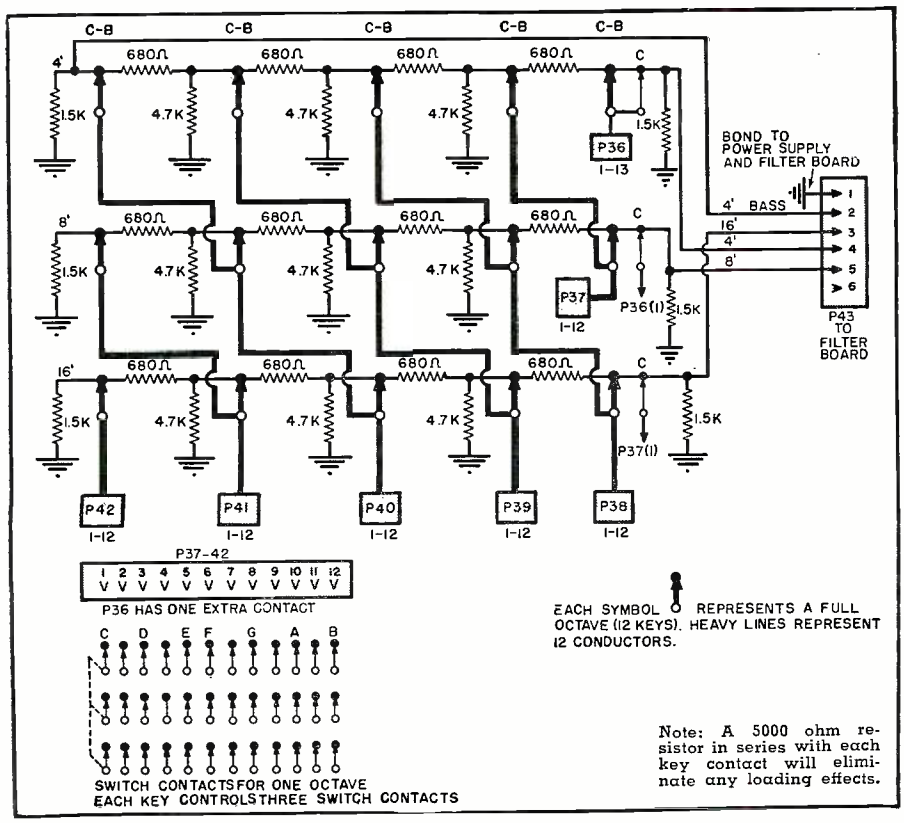
Key clicks are not a particular problem in this design, due largely to the low-pass nature of most of the stop filters. If the assembly tends to give clicks after it is built, experiment with condensers across the 4700 ohm and 1500 ohm resistors in Fig. 21 and the other assemblies. Use the smallest capacity which will reduce clicking satisfactorily as larger values will cause undue loss of brilliance in the organ. Experiment separately with each octave for the right value as permissible values will decrease with rising frequency.

As is obvious to those that have read this far, this organ is no toy and its construction involves both time and money—from two-to three-hundred hours' time and between 150 and 400 dollars.

In Part 3, appearing next month, we will cover all of the rest of the circuits used in the "Electronorgan" including complete details on the filterboard setup.

(To be continued)

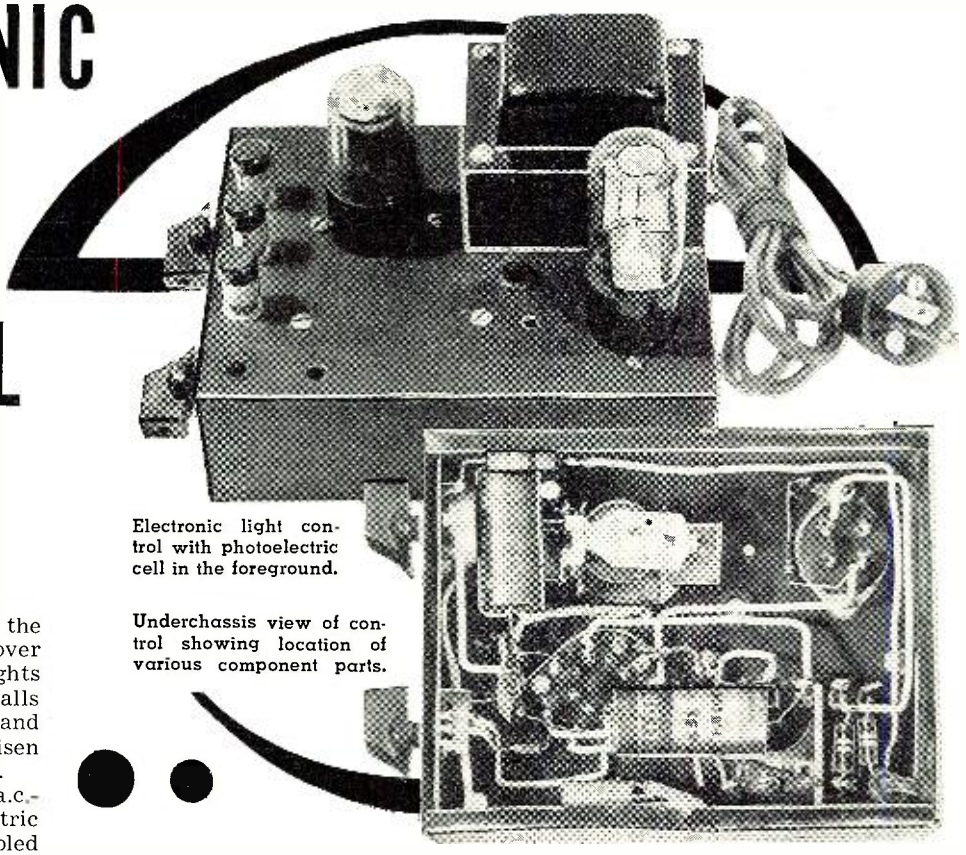
Fig. 21. Complete schematic diagram of the great manual key-switch wiring. See text.



ELECTRONIC LIGHT CONTROL

By

HENRY A. SETZKE, W9LFZ
Instructor, De Forests Training Inc.



Electronic light control with photoelectric cell in the foreground.

Underchassis view of control showing location of various component parts.

An a.c.-operated device that uses a photoelectric cell and a two-stage direct-coupled amplifier to control a relay.

THE job of turning on and off the lights has largely been taken over by electronic equipment. The lights can be turned on when daylight falls below some predetermined level and turned off when daylight has risen above another predetermined level.

The light control unit is an a.c.-operated device having a photoelectric cell and a two-stage, direct-coupled amplifier to control the relay. The phototube must be mounted high so that it has an unobstructed view of the north sky. During the daytime the bright light, striking the photoelectric tube, causes the relay to pick up and shut off the controlled lights. As night approaches, the sky grows darker until the light is unable to make the relay "hold in." When the relay drops, the lights are turned on.

The photoelectric cell must be mounted and shielded in such a way that very little or none of the light from the controlled lights can fall on the phototube. If this occurs the unit will turn the lights on and off, or "cycle" as it is called.

The photocell may be pointed at a street light, if one is available. When the street light is turned on or off the controlled lights will also be turned on or off. If a street light is used the normally-open contacts of the relay must be connected in series with the controlled lights.

Construction

All grounds should be connected to a common bus bar but insulated from the chassis. This is to prevent electrical shock and accidental shorts. The normally-closed contacts of the relay should be connected in series with the circuit to be controlled. Almost any type of photoelectric cell may be used in the circuit. As shown, the circuit is designed for a gas-type photoelectric cell. If a high vacuum type photoelectric cell is used it will require more operating voltage which can easily be obtained by moving the one photocell lead from point D to point C.

Phasing of the power supply transformer is very important. If, after completing the wiring, the circuit does not function properly, the difficulty probably lies in the phasing of the power transformer. To reverse the phase reverse the connections on the secondary of the supply transformer at points A and B.

The relay may be any type that will pull in at 8 to 12 ma. or less.

Potentiometer R_9 is the sensitivity control and R_4 is adjusted to give proper bias for tube V_{1B}.

Explanation of Circuit

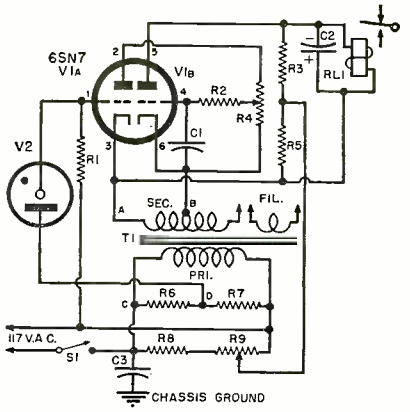
When no light is striking the photocell, no current will flow through the photoelectric cell and the load resistor R_1. The voltage developed across the phototube load resistor is used as the bias voltage on the first amplifier tube V_{1A}. Since, under the conditions of no light, no voltage has been developed, the first amplifier tube has no bias.

Under these conditions the first amplifier tube, V_{1A}, will be passing a large plate current. The plate current flowing through the plate load resistor R_3 causes a voltage drop, which in this case is rather large. The direction of current flow is such that the

(*Continued on page* 191)

Complete schematic diagram of the a.c.-operated electronic light control unit.

R_1, R_2—5 megohm, ½ w. res.
R_3, R_5, R_6, R_7—20,000 ohm, ½ w. res.
R_4—500,000 ohm pot
R_8—100,000 ohm, ½ w. res.
R_9—50,000 ohm pot
C_1—.5 μfd., 100 v. cond.
C_2—8 μfd., 150 v. elec. cond.
C_3—.1 μfd., 400 v. cond.
RL_1—2000 ohm, 12 ma. d.c. relay
S_1—S.p.s.t. switch
T_1—Any small power transformer of receiving type
V_1—6SN7 tube
V_2—Photoelectric cell and socket (Cetron CE-22 was used—see text)



THE TRANSISTOR D. C. AMPLIFIER

By
HERBERT F. STARKE
Receiving Tube Division
Raytheon Manufacturing Company

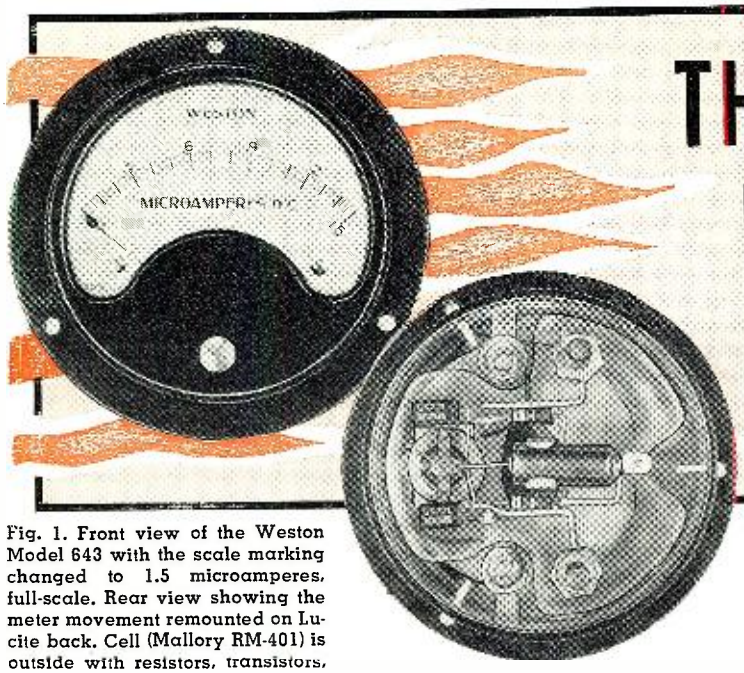


Fig. 1. Front view of the Weston Model 643 with the scale marking changed to 1.5 microamperes, full-scale. Rear view showing the meter movement remounted on Lucite back. Cell (Mallory RM-401) is outside with resistors, transistors, etc. shown mounted inside case.

A new and interesting application of transistors in the instrumentation field. Increased sensitivity is obtained.

THERE appears to be no sensible reason why transistors should not find their way very quickly into various applications associated with the field of measurement and electronic instrumentation. In view of a definite trend toward miniaturization and low power consumption in this as well as other fields, transistorized versions of familiar laboratory devices should constitute an early, logical step in the development of transistor applications. With this idea in mind, the writer undertook to determine what could be done to increase the sensitivity of a small d.c. meter with a simple and compact circuit using components small enough to permit mounting on the back of the meter.

Several years ago it was thought that the desired result might be achieved with subminiature tubes but a critical survey of the requirements turned out to be rather discouraging. A 20 microampere, 2000 ohm meter may be thought of as having a transconductance of 500 micromhos and if this is to be translated back to the input of a tube circuit, the circuit transconductance must also be 500 micromhos if the device is to introduce a voltage drop no greater than that of the meter alone. For either single-ended or balanced circuits, this means, in practical terms, a tube transconductance of at least 1000 micromhos which becomes very difficult with subminiature tubes operating at low filament currents and "B" voltages.

Fundamentally, the meter is a power device and if we wish to increase its effective sensitivity we must supply power amplification. A 20 microampere, 2000 ohm meter requires 0.8 microwatt for full-scale deflection and if (*a.*) 2 microamperes at 20,000 ohms, *i.e.,* the same voltage drop is desired the power gain must be 10 db or (*b.*) 2 microamperes at 2000 ohms (for the same circuit resistance) requires a power gain of 20 db. These gains are of the sort that may be readily achieved in one stage using junction transistors, a single cell, and a few resistors, with the entire package being of a size that can be mounted in back of the meter case or, for that matter, partly inside the case. (The word "partly" is included only because it does not seem very practical to periodically open a meter case for the purpose of replacing a cell.)

Fig. 2 represents the first attempt at a circuit showing promise of obtaining at least a ten-fold increase in current sensitivity. The evolution to Fig. 3, with the elimination of four resistors out of six, requires some explanation. This, in turn, depends upon the temperature characteristics of the transistors and the need for a high degree of zero stability in the meter amplifier under consideration.

Under certain circuit conditions, transistors make better thermistors than thermistors. That is to say, the temperature coefficient of the cut-off current of the transistor is nearly double the temperature coefficient of resistance of the thermistor. In a circuit intended to be highly responsive to temperature changes (such as the basic form shown in Fig. 4) these coefficients would combine to produce an over-all coefficient on the order of 12% per degree Centigrade provided, of course, both elements were associated with the same thermal circuit. Since in Fig. 4 these effects appear in amplified form in the collector circuit, it should not be particularly difficult to obtain full-scale deflection on a 20 microampere meter for a temperature change of one degree Centigrade with operating collector currents on the order of 150 or 200 microamperes.

In the case at hand, however, it is desired to make the temperature response as low as possible because here temperature response is the same as zero drift. In a d.c. amplifier using transistors in a grounded emitter circuit (necessary here because the grounded base circuit has current amplification less than unity) the direct first-order cause of collector current drift is the temperature coefficient of the cut-off current and the two are related according to:

$$I_c = (I_{co} + \alpha I_b)/(1 - \alpha)$$

where:

I_c = collector current
I_b = base current
I_{co} = cut-off current (the collector-to-base current with open emitter)
α = short-circuit current amplification (grounded base).

The foregoing points immediately, of course, to a balanced circuit which allows us to proceed at once to an examination of second- and third-order effects upon zero drift and response. In the circuit of Fig. 2, if the transistors can be matched for cut-off current, temperature coefficient of the cut-off current, and *alpha,* the residual zero-drift over the ordinary range of "room temperature" ($28 \pm 6°C$) should be very small. In addition, it is quite likely that a transistor of higher-than-average cut-off current can be paired with one of lower-than-average temperature coefficient and *vice versa.* This latter technique could resolve itself into a simple matching of collector currents (at either a fixed or zero base current) with a maximum permissible mis-division of the collector-to-collector load as the sole criterion of temperature behavior, although the effectiveness of the test would be greatly increased if the original balance were followed by checking the shift in zero caused by shorting the input (base-to-base). This, in turn, results in the elimina-

tion of the electrical zero adjustment as shown in Fig. 3 which, as a design feature, would be somewhat more practicable with a meter having a greater range of adjustment of the mechanical zero.

The choice of battery capacity, collector current, and load resistors are all interrelated. If these are chosen with an eye to convenience in the matter of battery replacements, the use of the *Mallory* RM-12 (also RM-1200) with collector currents of 75 to 100 microamperes will result in operation requiring a new battery only once a year without the inclusion of an "on-off" switch. Collector currents below 100 microamperes, on the other hand, will show some increase in sensitivity with rising temperatures. This can be circumvented by at least two methods: (1.) Choose an operating collector current high enough (about 200 microamperes) so that any small further increase in current amplification is largely offset by compensating changes in other transistor parameters or (2.) use a temperature sensitive meter shunt as shown in Fig. 6. Proper proportions of R and T will allow the use of rather low collector currents without causing an unduly large response error over a reasonable range of operating temperature.

Since some degree of matching appears to be inevitable, it seems logical to use only those transistors whose open-base collector currents fall within the desired range. This leads to the elimination of the base resistors and, while the circuit of Fig. 3 seems almost too good to be true, its performance may be seen in Fig. 5 which shows voltage gain, current gain, and power gain as functions of source impedance. These plots, which are typical for the CK721, point out immediately the chief operational defect of the circuit: it cannot measure either current or voltage accurately unless the source impedance is much higher (for current) or much lower (for voltage) than the base-to-base impedance at the transistor input. This means (oddly enough) that the meter is virtually useless for quantitative measurements at the point which gives maximum power gain. This involves an operational concept which is somewhat unusual but it should not trouble us too much if we recall that the original objective was to realize a substantial increase in the current sensitivity of a microammeter with an absolute minimum of components.

Although the meter is of some potential value as a millivoltmeter for use with thermocouples, bolometers, and other low impedance sources, an extra word of caution may be interjected at this point: If the designer elects to use the same meter for current and voltage measurements, the most careful matching of transistor characteristics will be necessary; otherwise there may be a substantial zero shift in going from a high source impedance (0.1 or 1 megohm) to a low impedance (10 or 100 ohms) and *vice versa*.

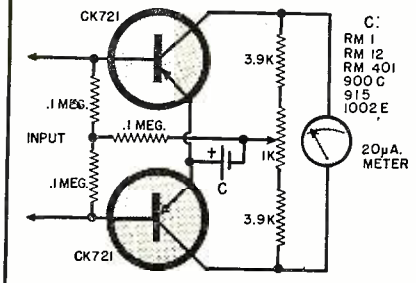


Fig. 2. An early circuit using six resistors, a condenser, two transistors.

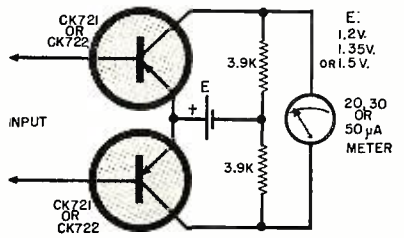


Fig. 3. A simplification of the circuit of Fig. 2 eliminating four of six resistors.

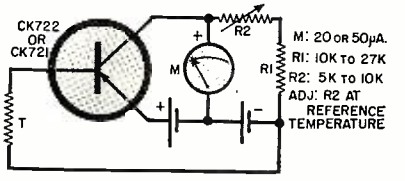


Fig. 4. Basic temperature-sensitive circuit.

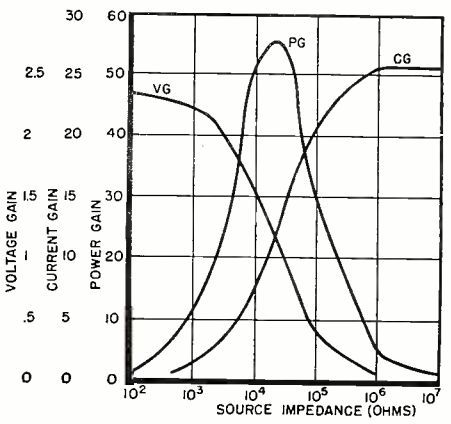


Fig. 5. Performance of the circuit of Fig. 3 shown graphically. Voltage gain, current gain, and power gain are shown as functions of source impedance. All of the values are expressed as factors, not in db.

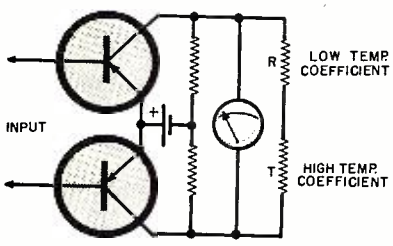


Fig. 6. Temperature-sensitive meter shunt.

The curves shown in Fig. 5 are intended to illustrate only one particular operating point using typical CK721's, which were matched in *alpha*. With a battery current of 150 microamperes (in the open-base circuit) the corresponding collector current of 75 microamperes to each transistor yielded characteristics as indicated in Table 1.

The resulting high input impedance leads, in this case, to rather serious errors if the current source impedance falls very much below 1 megohm. If this is too high for the application at hand, the only remedy is to operate at higher collector current with the im-

(*Continued on page* 148)

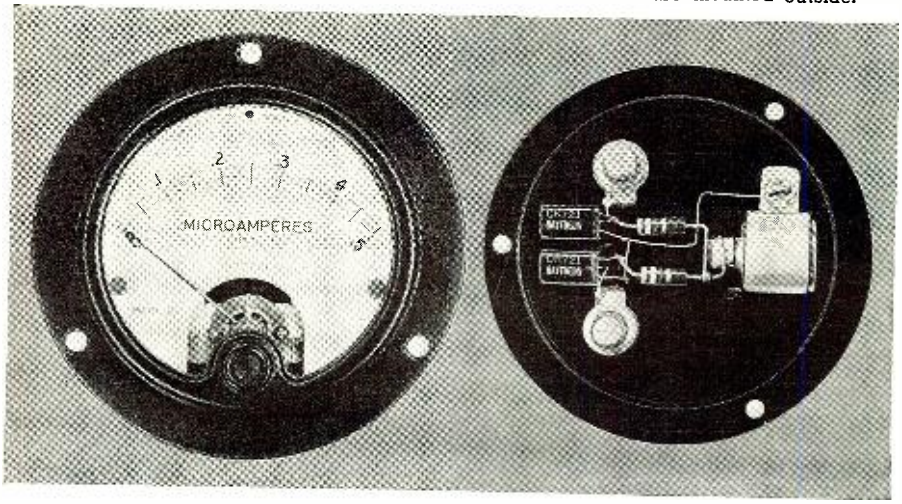
	α	R_c	R_b	R_e
#1	.966	2.7 meg.	1900 ohms	335 ohms
#2	.966	2.8 meg.	1740 ohms	340 ohms

Table 1. Matched transistor characteristics.

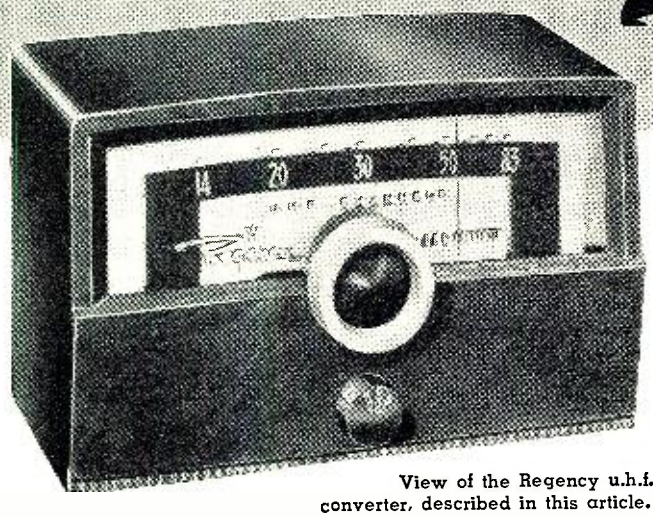
CELL	CAPACITY (ma. hours)
1002-E (Eveready)	1000
RM-1000 (Mallory)	1000
RM-1200 (Mallory)	3600
915 (Eveready)	800
RM-401 (Mallory)	800
RM-625 (Mallory)	250

Table 2. Life expectancy, in milliampere-hours, of various available battery cells which could be used in the construction of transistorized d.c. amplifiers for meters.

Fig. 7. Front and rear view of Weston Model 301 with the scale marking changed to .5 microampere, full-scale. All parts, including RM-1000 cell are mounted outside.



The Regency U.H.F. CONVERTER



View of the Regency u.h.f. converter, described in this article.

By
R. A. MORRIS
Chief Engineer, I.D.E.A. Inc.

Here is a popular converter widely used in u.h.f. areas. Read how it works and how to service it.

AT THE TIME u.h.f. stations were allocated, in the summer of 1952, there were approximately 16 million v.h.f. television receivers in operation. Since then the number has increased to over 22 million, and most of these receivers have no way of receiving u.h.f. signals except through the use of new tuning strips or converters. Of the two, converters are by far the more flexible. A completely self-contained converter can be used with any television receiver, irrespective of the type of tuner it possesses. Furthermore, a converter will, in general, tune over the entire u.h.f. band while a strip is designed essentially for single-channel reception. Last, but not least, converters can be installed by a layman, while a technician is needed to install any unit that must be internally combined with a television receiver.

There are a number of approaches to converter design, but if these are examined with a view toward keeping the final product simple in construction, easy to operate and service, and simple to align, then the field narrows down considerably. Major emphasis is on the tuner and the one finally evolved for the *Regency* converter is only 4 inches in diameter and 3 inches in depth. The unit tunes continuously with a dial drive shaft covering the 70 channels in 340° of rotation, permitting the use of a small direct drive scale. Included in the tuner are two stages of i.f. amplification.

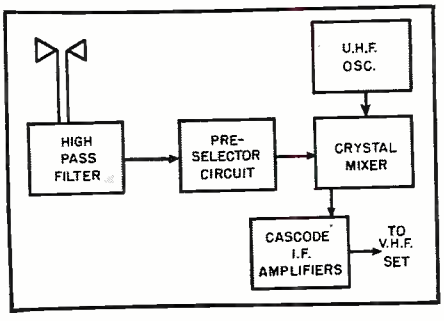
A block diagram of the circuits in this tuner is shown in Fig. 1; the schematic diagram is given in Fig. 2. The input circuit from the u.h.f. antenna is balanced and designed to match a 300-ohm line. This circuit consists of a high-pass filter which serves to reduce oscillator radiation from the converter, response of the unit to image signals, and the reception of spurious responses, especially those produced by high-powered v.h.f. TV or FM broadcast stations.

Beyond the high-pass filter is the preselector circuit. This consists of a balanced transmission line antenna coupling loop which is inductively coupled to a tunable transmission line. The function of the preselector circuit is the same as that of the r.f. circuit in any receiver, namely, to permit one station to be received, and to reject all others.

A shorting slider varies the frequency of the parallel-wire tuning elements. In covering the u.h.f. band from 470 to 890 mc., the line shorting slider has a 4-inch travel. The slider is noiseless during operation.

Due to the fact that the antenna coupling loop and the crystal mixer (which follows the preselector) are placed at opposite ends of the tuning line, direct coupling between the antenna and mixer circuits is avoided. The tracking problem between preselector and oscillator tuning circuits is simplified by the employment of two trimmer condensers on the preselector lines. One trimmer condenser is used for setting the high-frequency end and the other is used for setting the low-frequency end of the range. This arrangement allows the electrical tracking of the oscillator and preselector circuits to be a simple and positive alignment operation. The trimmers are a special u.h.f. balanced type which were developed for this tuner.

Fig. 1. Block diagram of the basic circuit of the Regency u.h.f. converter.



Once the desired signal has been chosen by the preselector, it is next fed to a crystal mixer. Also reaching the mixer is the oscillator signal.

The oscillator circuit is of the ultraudion type widely used in present v.h.f. receivers. A 6AF4 miniature triode is capacity-coupled to a quarter-wave, short-circuited transmission line. The oscillator operates at a lower frequency than the signal, in order that the relative position of the sound and video carriers in the incoming signal is not reversed. Coming into the v.h.f. receiver, the video carrier frequency must be below the sound carrier frequency as in a v.h.f. signal.

In order to receive u.h.f. stations between 470 and 890 mc., the local oscillator tunes from 275 to 695 mc. The v.h.f. set is tuned to channel 10. The oscillator generates adequate injection voltage over the entire frequency range (275 to 695 mc.) without any frequency skips. Oscillator tuning is accomplished by a sliding silver contact which varies the active portion of the line. A trimmer condenser across the oscillator plate tank circuit allows the frequency range to be set to the desired frequency at the low end of the range. Oscillator tuning is mechanically ganged with preselector tuning.

The frequency of the local oscillator stabilizes after approximately five minutes' operation. The maximum deviation due to line voltage drift (within the range of 95 to 125 volts), is approximately 70 kc.

The signal at the output of the crystal mixer is fed to a cascode i.f. amplifier. This i.f. amplifier operates

over the frequency range of the r.f. amplifier in the v.h.f. television receiver when the latter is set for channel 10. Actually, any of the v.h.f. channels, 8, 9, 10, 11, or 12 can be chosen, permitting the set owner to use the channel which, in his location, is interference-free.

Little need be said about the cascode amplifier other than that it was chosen because of its high gain and low-noise qualities. The output of this stage is balanced, presenting an impedance of 300 ohms to match the v.h.f. receiver unit.

Three views of the tuner are shown in Figs. 3, 4, and 5. In Fig. 3, the tuner is shown as a complete unit with all the covers and shields in place. Fig. 5 is a top view of the tuner with the outer shields removed. The preselector tuning line with its slider and trimmer condensers can be seen at the top of the unit. Back of the line is the antenna coupling loop. In the center of the assembly is the double-triode i.f. amplifier tube.

The bottom side of the tuner, shown in Fig. 4, contains the oscillator circuitry. The oscillator tube rests on its side at the left-hand side of the illustration.

Service Hints

In general, alignment will rarely have to be performed on this converter if it receives normal care in use. When servicing is required, the stage at fault can be detected quickly by following the procedures to be outlined:

Oscillator tube: The oscillator tube can be checked for oscillation by several methods. One means consists of checking the cathode current and, at the same time, touching the oscillator lines with a screwdriver. The current should rise, indicating that the tube was oscillating and the screwdriver stopped the oscillations.

Another method of checking for oscillation consists of using a vacuum-tube voltmeter with a 1-megohm resistor probe and very short leads to read d.c. voltage on the grid of the 6AF4. This reading should be approximately —3 to —10 volts d.c.

In order to gain access to the oscillator tube, remove the perforated cover on the side of the tuner. In removing the 6AF4, reasonable care should be exercised not to disturb any of the components. It may be necessary to try several tubes in the oscillator circuit, inasmuch as certain tubes will operate better than others for optimum alignment and injection. Usually, changing of the oscillator tube does not require realignment.

Amplifier tube: Changing the 6BK7 i.f. amplifier tube should not require any change, other than a touch-up of the converter output adjustment, which extends through the tuner case and can be turned conveniently with the fingers for maximum performance. This adjustment is also made when different v.h.f. channels are selected for the double conversion.

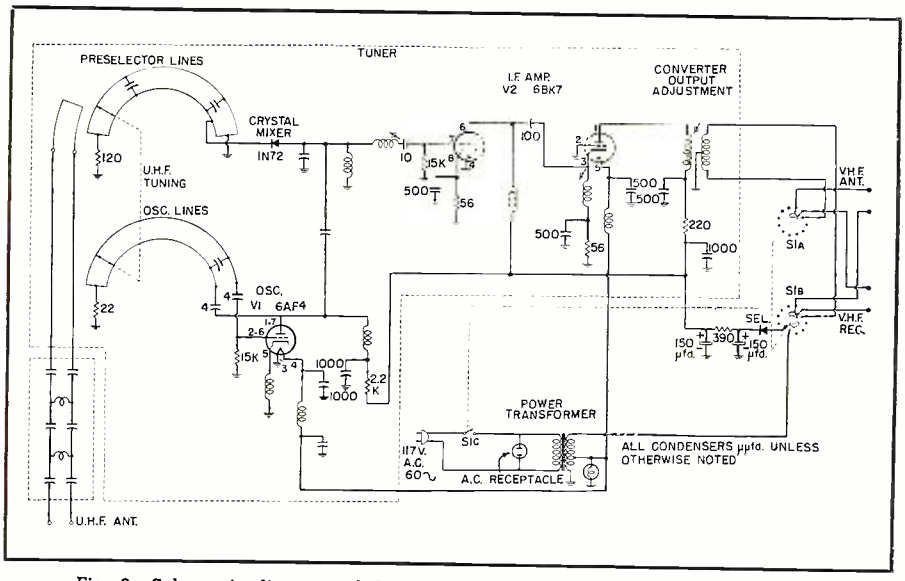


Fig. 2. Schematic diagram of the converter; dotted boxes indicate shielding.

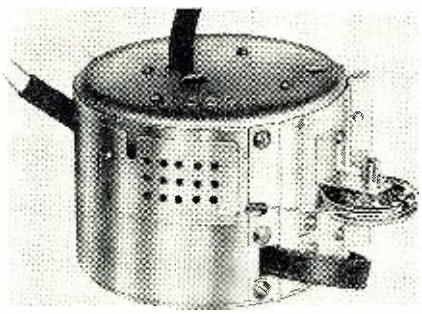


Fig. 3. The completely shielded tuner assembly of the Regency converter.

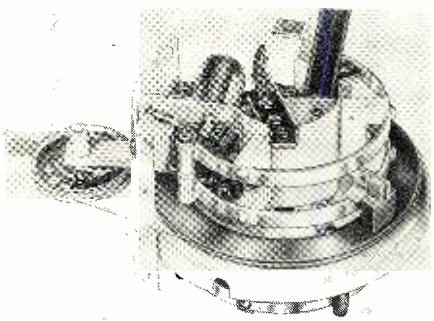
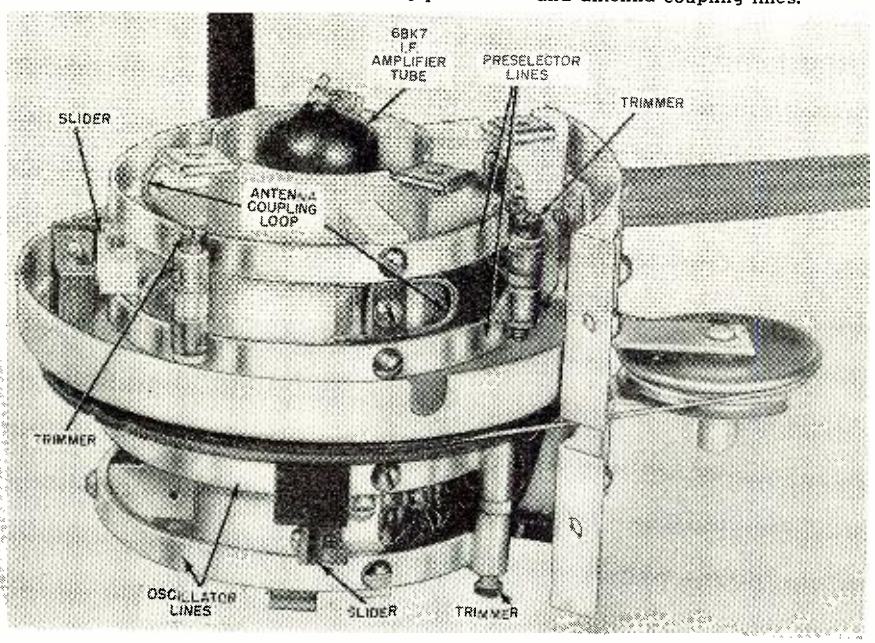


Fig. 4. The bottom view of the tuner showing oscillator tube on its side.

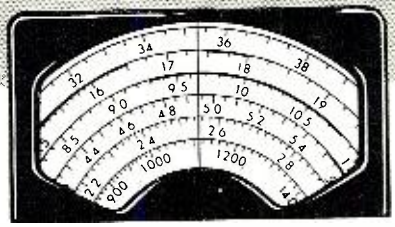
Crystal diode 1N72: A defective crystal can be established by the lack of rectified injection voltage, providing the oscillator tube is definitely working. Should a crystal require changing, it is important that the leads be kept the same length and that the position of the new crystal is identical to the defective crystal. Care should be taken not to overheat the crystal with the soldering iron, and it is advisable to hold the crystal with a pair of pliers back of the soldering point.

All components replaced should be wired into the circuit as near to the original physical placement as possible, with the same size leads. —30—

Fig. 5. Top view of the tuner showing preselector and antenna coupling lines.



International SHORT-WAVE



Compiled by KENNETH R. BOORD

YOUR *ISW DEPARTMENT* editor, Ken Boord, will play a program of Christmas organ music, by tape transcription, in a special DX broadcast from HCJB, Quito, Ecuador, Thursday, December 17, at 0330 (0830 *GMT*) with beam to Europe on 15.115, 11.915, 9.745, and *repeated* the same day at 1600 (2100 *GMT*) with beam to the South Pacific on 17.890, 15.115, 11.915. Reception reports will be welcomed, especially since by that time HCJB's transmitting facilities should have been completely moved to the new site at Pifo, and new antennas should be in use. HCJB verifies *correct* reports 100 per-cent; an IRC is appreciated but is not required. Any and all reports on the special program will be appreciated by your editor.

At press time, an official of the station flashed to me that work was progressing on the new European curtain beams, and that both the European and South Pacific beams would be in use in the near future. The North-South beams were put into effect some time ago. Current over-all schedules of HCJB include 700 kc. at 0540-2300; 6.050 at 0540-2400; 9.745 at 1400-1200; 11.915 at 1900-0900; 15.115 at 1200-1000; 17.890 at 1200-1900. The station now broadcasts on *Monday mornings* to 0900, then is silent until 0540 on *Tuesday mornings—except* that on the *first Monday of each month* there is a special greetings program on 9.745, 11.915, and 15.115 from approximately 1800 to 2200.

* * *

Radio Club Notes

England—Congratulations go to the International Short Wave Club which just observed its 24th anniversary; Arthur E. Bear, London, is secretary of the group. ISWC was founded in the United States.

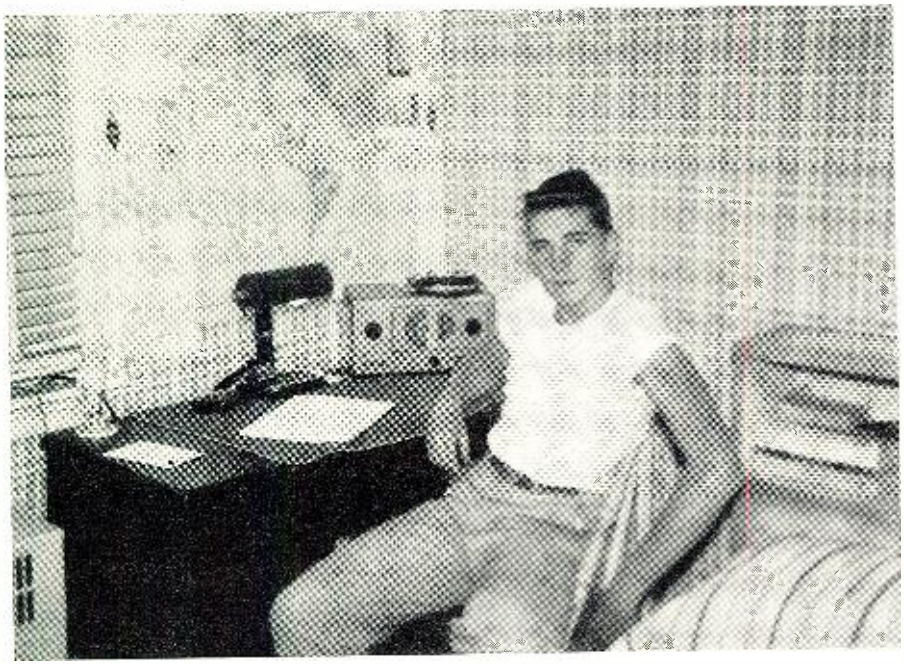
USA—QRA for United 49'ers Radio Society is now given as 413 Pershing Ave., Collingdale, Pa.; president is Edward I. Broome, Box 31, Medford, N. J.; editor is William C. Peters, Collingdale; short-wave editor is the former chief editor, Anson Boice, 28 Eisenhower Drive, New Britain, Conn.

Leslie Bannon (WN9TZD), 6260 N. Chester, Indianapolis 20, Ind., has replaced Marvin Robbins as short-wave editor of the Universal Radio DX Club. Marvin is now serving in the U.S. Armed Forces. This club recently issued a fine short-wave station log, compiled by Robbins and Bannon, which is a *service for members only.*

* * *

(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 approx mate

This young DX-er, John C. Karrer, Philadelphia, uses a Hallicrafters S-38C, and a single wire lead-in to a straight-wire antenna for his station spotting.



This Month's Schedules

(Note: At the time this material was compiled, some stations were still in the process of changing from summer to winter schedules and frequencies; in some cases, hence, schedules may now be *one hour later* than listed herein.—K. R. B.)

Andorra—Radio Andorra, 5.997, noted 1720-1800 on this *measured* channel. (Ferguson, N. C.)

Anglo-Egyptian Sudan—At times lately, *Radio Omdurman* has been heard on 7.100A instead of 7.600A. (Skoog, Sweden) Noted near 7.090 at 1400 with Arabic music; closed 1430; with *English Sun., Wed.* 1115. (Pearce, England)

Argentina—LRY1, 9.760A, Buenos Aires, noted closing 2258 in Spanish when announced for LR3 and LRY. (Ferguson, N. C.) LRX, 9.66, noted in Spanish 2200 and later. (Morgan, Calif.)

LRA, 15.345, is still noted with news 1815 for North America. (Zerosh, Pa.) Might replace this channel at that time with 17.720 for *winter.* Roberts, Conn., notes LRA1, *measured* 9.69, at 2255-2330 in Spanish, good level.

Australia—VLC9, 9.715, is good level 0700-0845 to Eastern North America; news 0715, 0815. (Morrison, R.I.; Kuhnert, Mass.; Granrose, Fla., others) VLA9, 9.58, is good signal around 0300. (Boyce, N.J.)

Azores—By this time, CSA92, 11.090, Ponta Delgada, should be on *winter* schedule of 1500-1600. (Ferguson, N.C.; Niblack, Ind.) CSA93, 4.865, has news in Portuguese 1630, strong level in Ireland. (ISWL, England)

Brazil—A Brazilian station has been noted on 9.685 at 1733 carrying "A Voz do Brasil" relay. (Bellington, N.Y.) *Radio Tamoio,* 9.610, noted with music and commercials, comments in Portuguese, good level in Ind. around 1800. (Diaz)

Recife, 9.565, noted like a local weekdays 2005-2030 when has "Brazil Calling" (*English*). (Jensen, N.J.) A Brazilian 6.165A is believed *Radio Cultura,* Sao Paulo, *probably moved* from 9.745. (Stark, Texas; Bellington, N.Y.) *Radio Nacional,* 9.72, noted 2130 through heavy CWQRM; Portuguese.

(*Continued on page* 108)

WHY SYLVANIA PRODUCTS MEAN BETTER BUSINESS!

YOU'RE really on board the *better-profit* special when you feature Sylvania Picture Tubes and Receiving Tubes.

Your customers know Sylvania as a pioneer in the development of fine radio and television products. From the very beginning, the name Sylvania has stood for the highest possible quality. And, as the industry has progressed and expanded, Sylvania has taken great care to maintain its recognized leadership.

Now, due to advanced manufacturing techniques and precision testing methods, Sylvania tubes can point to outstanding records, both in long life and fine performance. Today 7 of the 10 leading set manufacturers use Sylvania Picture Tubes and Receiving Tubes.

So, if you want *recognized quality* working on your side . . . *sell Sylvania!* Call your local Sylvania Distributor for the latest fall prices and money-making promotion offers, or write to: Sylvania Electric Products Inc., Dept. 3R-2112, 1740 Broadway, New York 19, N. Y.

Television keeps telling about Sylvania quality

Sylvania's popular nation-wide television show "Beat the Clock" continues to tell millions of your customers week after week, all through the year, about the unbeatable quality of Sylvania products.

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In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., St. Catherine Street, Montreal, P. Q.

Technical BOOKS

"TELEVISION AND F-M RECEIVER SERVICING" by Milton S. Kiver. Published by *D. Van Nostrand Company, Inc.,* New York. 316 pages. Price $4.20. Third Edition. Paper bound.

Mr. Kiver has revised his basic and definitive text to keep pace with the burgeoning television industry.

As is the case with all of this author's writings, this book is hardhitting, clear, and concise. Explanatory material is offered freely so that the student or novice technician may derive maximum benefit from this text.

The book is divided into eighteen chapters covering antennas, TV receiver installation, TV test equipment, r.f. stages, video i.f. and detector stages, video amplifiers and a.g.c. systems, CR picture tubes, servicing intercarrier receivers, using TV test patterns, deflection systems, power supplies, TV receiver alignment, u.h.f. fundamentals, FM fundamentals, commercial FM receiver circuits, and FM receiver alignment and servicing.

Service technicians who have come to depend on Mr. Kiver's books as reference sources will welcome the availability of this new edition.

* * *

"LEARNING THE RADIOTELEGRAPH CODE" by the ARRL Staff. Published by the *American Radio Relay League,* West Hartford, Conn. 32 pages. Price 25 cents. Paper bound.

This is the Sixth Edition of a handy text which outlines a simple, thoroughly usable method of learning the code with a minimum of time and effort.

The book is divided into six main sections which deal with the learning process, transmission techniques, high-speed operation, operating on the air, code practice, and exercises in receiving and sending for group use.

The chapter on code practice includes circuit diagrams for simple code practice sets which the student can build himself.

Those who have used this handbook in the past will undoubtedly wish to recommend this new edition to newcomers in the field.

* * *

"TELEVISION FUNDAMENTALS" by Kenneth Fowler and Harold B. Lippert. Published by *McGraw-Hill Book Co., Inc.,* New York. 520 pages. Price $7.00.

This book fulfills a long-felt need for a truly basic text dealing with the subject of television theory, circuitry, and servicing. Too often the authors of such "elementary" works, like Don Quixote, "ride off in all directions" under the faulty assumption that their readers are "with them."

The authors of the subject book of this review have assumed nothing except that the reader has some knowledge of basic radio circuitry. The coverage of television is thorough and fundamental.

The writing is clear, concise, and admirably "readable." The use of mathematics has been avoided like the plague with verbal descriptions of mathematical processes being used instead.

The text also includes practical installation procedures, the television antenna, servicing and test equipment, and troubleshooting television receivers by picture analysis.

* * *

"PRINCIPLES OF TRANSISTOR CIRCUITS" edited by Richard F. Shea. Published by *John Wiley & Sons, Inc.,* New York. 526 pages. Price $11.00.

This is a book for which the industry has been waiting as it presents most of the basic research material extant on the subject of transistors and transistor circuitry.

Representing a collaboration by ten *General Electric Company* engineers, this text covers all facets of the transistor application problem. Introductory material deals with semiconductor principles and forms, types and characteristics of transistors. The balance of the book is divided into applications for low-frequency circuits, in high-frequency circuits, and special circuits. In order to make the subject matter as easy to grasp as possible the authors have used vacuum-tube analogies as well as similarities and dissimilarities between the two components.

We believe that this definitive work will soon be known as the "bible" of the transistor engineer. Its appearance will offer, between two covers, a single source for the cream of current thinking on the subject.

* * *

"INTRODUCTION TO VALVES" by R. W. Hallows and H. K. Milward. Published by *Iliffe & Sons Ltd.,* London. 149 pages. Price $6.75. Available in the U. S. from *The British Book Centre,* 122 E. 55th St., New York 22, N. Y.

This is a basic work which covers the fundamental concepts of tube operation in various types of circuits.

The lavishly illustrated text covers thermionic tubes, diodes as rectifiers and detectors, triodes and their applications, tetrodes and pentodes, multigrid tubes for frequency changing, power output tubes, and special tubes for u.h.f. and v.h.f. A separate chapter is devoted to a discussion of the modern miniature tube.

Another valuable feature of this text is the complete explanation of the British standard for designating tube types. This standard, adopted in 1947, is used throughout the book.

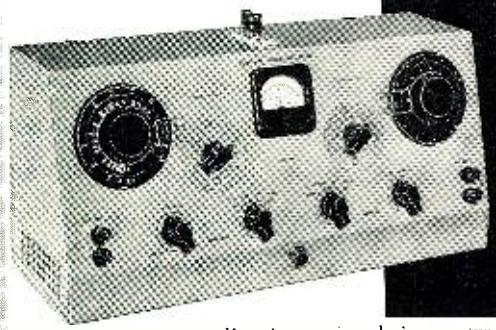
While some knowledge of mathematical processes would be helpful to the reader, the text is clearly and simply written so that the student may gain the maximum benefit from his studies. Although the terminology is British, the United States reader should have no difficulty in making the transition. —30—

Heathkit
IMPEDANCE BRIDGE KIT

MODEL IB-2

$59.50

SHIPPING WT. 15 LBS.



Features

- Simpson 100-0-100 microampere meter.
- Completely AC operated.
- Built-in phase shift generator and amplifier.
- Battery type tubes, no warm-up required.
- Newly designed two section CRL dial.
- Single knob D, Q, and DQ functions.
- Special impedance matching transformer.
- New modern cabinet styling.
- ½% precision resistors and silver mica condensers.

Another new, outstanding instrument design so typically characteristic of Heathkit operation in producing high quality instrument kits at the lowest possible price. A new, improved model Impedance Bridge kit featuring modern cabinet styling, with slanted panel for convenience of operation and interpretation of scales at a $10.00 price reduction over the preceding model. Built-in adjustable phase shift oscillator and amplifier with all tubes of the battery operated type completely eliminates warm-up time. The instrument is entirely AC line operated. No bothersome battery replacements.

The Heathkit IB-2 Impedance Bridge Kit actually represents four instruments in one compact unit. The Wheatstone Bridge for resistance measurements, the Capacity Comparison Bridge for capacity measurements, Maxwell Bridge for low Q, and Hay Bridge for high Q inductance measurements. Read Q, D, DQ all on one dial thereby eliminating possible confusion due to the incorrect dial reference or adjustment. Only one set of instrument terminals necessary for any measurement function. Panel provisions provided for external generator use.

A newly designed two section CRL dial provides ten separate "units" switch settings with an accuracy of .5%. Fractions of units are read on a continuously variable calibrated wire-wound control. A special minimum capacity, shielded, balanced impedance matching transformer between the generator and the bridge. The correct impedance match is automatically switch selected to provide constant load operation of the generator circuit. The instrument uses ½% precision resistors and condensers in all measurement circuits.

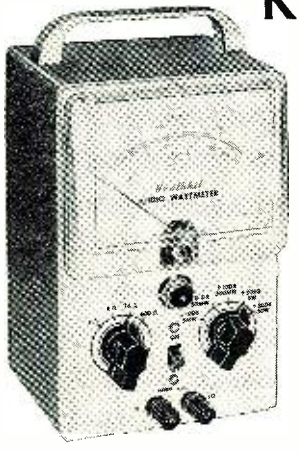
The new Heathkit IB-2 provides outstanding design features not found in any other kit instrument. The single low price includes the power supply, generator, and amplifier stages. No need to purchase separate instrument accessories in order to obtain the type of operation desired.

Heathkit
AUDIO WATTMETER KIT

MODEL AW-1

$29.50

SHIPPING WT. 6 LBS.



A new Heathkit design for the audio engineer, serious hi fi enthusiast, recording studio, or broadcast station; the Heathkit Audio Wattmeter Kit. This specialized instrument instantly indicates the output level of the equipment under test without requiring the use of external load resistors. All readings are taken directly from the calibrated scales of a 4½" 200 microampere Simpson meter.

The Heathkit Audio Wattmeter features five full scale power measurement ranges from 5 milliwatts up to 50 watts with db ranges of −15 db to +48 db. The instrument has a power measurement rating of 25 watts continuous and 50 watts maximum for intermittent operation. Non-inductive resistance load impedances of 4, 8, 16, and 600 ohms are provided through a panel impedance selector switch. Frequency effect is negligible from 10 cycles to 250 kc. A conventional VTVM circuit utilizes a 12AU7 twin triode tube. The meter bridge circuit uses four germanium diodes for good linearity.

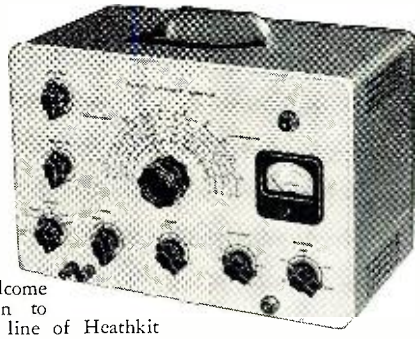
With the Heathkit AW-1 desired information can be obtained instantly and conveniently without bothering with the irksome setups and calculations usually required. Useful for power curve measurements, frequency response checks, monitoring indicator, etc. Convenient calibration directly from 110 volt AC line source. This new instrument will help to supply the answers to your audio operating or power output problems.

Heathkit
LABORATORY GENERATOR KIT

MODEL LG-1

$39.50

SHIP. WT. 16 LBS.



Another welcome new addition to the popular line of Heathkit instruments, the Heathkit Laboratory Generator. Specifically designed for flexibility of operation, accuracy and versatility beyond the performance level provided by the conventional service type generator. Frequency coverage of the Colpitts oscillator is 150kc to 30mc in five convenient ranges with provisions for internal or external modulation up to 50%, and .1 volt RF output throughout the frequency range. Panel mounted 200 microampere Simpson meter for RF "set reference level" to provide relative indication of RF output. Individually shielded oscillator and shielded variable and step attenuator provide flexible control of RF output.

The circuit features a 6AF4 high frequency oscillator, a 6AV5 amplifier with grid modulation, 12AU7 400 cycle oscillator and modulator, OB2 voltage regulator tube, and a selenium rectifier for the transformer operated power supply. The smart professional instrument appearance and over-all flexibility of operation will prove a decided asset to any industrial or educational laboratory. The Heathkit Laboratory Generator sets a new level of operation, far superior to any instrument in this price classification.

HEATH COMPANY • Benton Harbor 15, Mich.

CHECK THESE *Features*

- ✓ New 5UP1 CR tube
- ✓ Re-trace blanking
- ✓ Voltage regulation
- ✓ Extended band width
- ✓ Peak-to-peak calibrating provisions
- ✓ Good square wave response
- ✓ Astigmatism control
- ✓ New heavy duty shielded power transformer

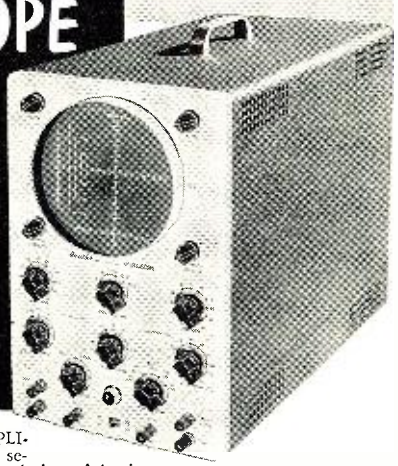
NEW 5" *Heathkit*

OSCILLOSCOPE KIT

MODEL O-9

$59.50

SHIPPING WT. 28 LBS.



Announcing the latest addition to a brilliant series of Heathkit Oscilloscopes, the new Model O-9. This outstanding instrument incorporates all of the features developed and proven in the production of well over 30,000 kits, in addition to a host of many new design features for truly outstanding performance. This new scope features a brand new (no surplus) commercially available 5UP1 cathode ray tube for fine focusing, high intensity, and freedom from halation. The 5" CR tube is the standard size for design and industrial laboratories, development engineers, and service men. The only size CR tube offering a wide range of types, colors, phosphors, and persistence. The answer to good oscilloscope performance lies in improved basic design and operating characteristics, and not in the use of larger CR tubes.

VERTICAL AMPLIFIER — New extended band width vertical amplifier with sensitivity of .025 volts per inch, down 3 db at 2 mc, down only 5½ db at 3 mc. Three step vertical input attenuator, quality ceramic variable capacitors for proper input compensation, provisions for calibrated 1 volt peak-to-peak reference, with calibrated screen for direct reading of TV pulses.

HORIZONTAL AMPLIFIER — New input selector switch provides choice of horizontal input, 60 cycle sweep input, line sync, internal sync, and external sync. Expanded horizontal sweep produces sweep width several times the cathode ray tube diameter. New blanking amplifier for complete retrace blanking and new phasing control.

POWER SUPPLY — New high voltage power supply and filtering circuit for really fine hairline focusing. New heavy duty power transformer with adequate operating reserve. Voltage regulated supply for both vertical and horizontal amplifiers for absolutely rock steady traces and complete freedom from bounce and jitter due to line variations.

The acid test of any oscilloscope operation is the ability to reproduce high frequency square waves and the new Heathkit O-9 will faithfully reproduce square waves up to 500 kc. This is the ideal all around, general purpose oscilloscope for educational and industrial use, radio and TV servicing, and any other type of work requiring the instantaneous reproduction and observation of actual wave forms and other electrical phenomena.

NO. 342

$3.50 SHIP. WT. 1 LB.

Heathkit LOW CAPACITY PROBE KIT

Oscilloscope investigation of high frequency, high impedance, or broad bandwidth circuits encountered in television work requires the use of a low capacity probe to prevent loss of gain, distortion, or false service information. The Heathkit Low Capacity Probe features a variable capacitor to provide the necessary degree of instrument impedance matching. New probe styling with bright polished aluminum housing and polystyrene probe ends.

NO. 337-B

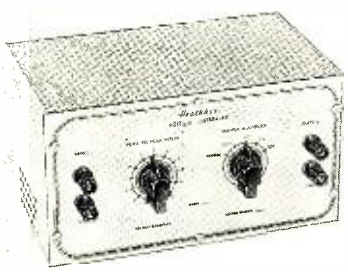
$3.50

SHIP. WT. 1 LB.

Heathkit SCOPE DEMODULATOR PROBE KIT

In applications such as trouble shooting or aligning TV, RF, IF, and video stages, the frequency ranges encountered require demodulation of signals before oscilloscope presentation. The newly-styled Heathkit Demodulator Probe in polished aluminum housing will fulfill this function and readily prove its value as an oscilloscope service accessory. Detailed assembly sheet provided, including instructions for probe operation.

Heathkit VOLTAGE CALIBRATOR KIT



MODEL VC-2

$11.50

SHIPPING WT. 4 LBS.

The Heathkit Voltage Calibrator provides a convenient method of making peak-to-peak voltage measurements with an oscilloscope by establishing a relationship on a comparison basis between the amplitude of an unknown wave shape and the known output of the voltage calibrator. Peak-to-peak voltage values are read directly on the calibrated panel scales. To offset line voltage supply irregularities, the instrument features a voltage regulator tube.

With the Heathkit Voltage Calibrator, it is possible to measure all types of complex wave forms within a voltage range of .01 to 100 volts peak-to-peak. A convenient "signal" position on the panel switch by-passes the calibrator completely and the signal is applied to the oscilloscope input thereby eliminating the necessity for transferring test leads.

Heathkit ELECTRONIC SWITCH KIT

The basic function of the Heathkit S-2 Electronic Switch Kit is to permit simultaneous oscilloscope observation of two separate traces which can be either separated or superimposed for individual study. A typical example would be observation of a signal as it appears at both the input and output stages of an amplifier. It will also serve as a square wave generator over the range of switching frequencies, often providing the necessary wave form response information without incurring the expense of an additional instrument.

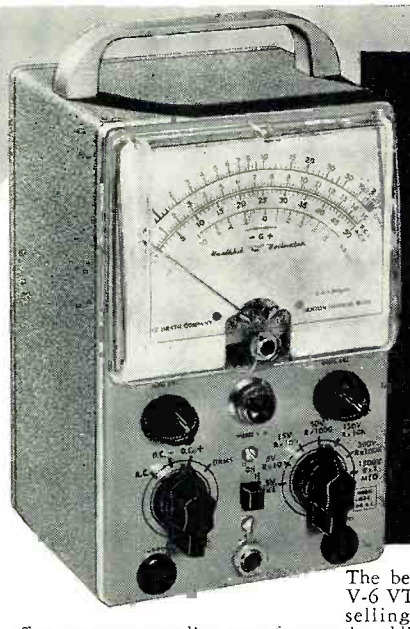
Continuously variable switching rates in three ranges from less than 10 cps to over 2,000 cps. Individual controls for each input channel and a positioning control. The five tube transformer operated circuit utilizes two 6SJ7, two 6SN7, and one 6X5 tubes. Buy this kit and enjoy increased versatility of operation from your oscilloscope.

MODEL S-2

$23.50

SHIP. WT. 11 LBS.

HEATH COMPANY · Benton Harbor 15, Mich.



Heathkit VACUUM TUBE VOLTMETER KIT

MODEL V-6

$24.50

SHIPPING WT. 6 LBS.

Features

- New 1½ volt full scale low range
- 1,500 volt upper limit DC range
- Increased accuracy through 50% greater scale coverage
- High impedance 11 megohm input
- Center scale zero adjust
- Polarity reversal switch
- 1% precision resistors
- Clearly marked db scales

The beautiful Heathkit Model V-6 VTVM, the world's largest selling kit instrument, now offers many outstanding new features in addition to retaining all of the refinements developed and proven in the production of over 100,000 VTVM's. This is the basic measuring instrument for every branch of electronics. Easily meets all requirements for accuracy, stability, sensitivity, convenience of ranges, meter readability, and modern styling. It will accurately measure DC voltages, AC voltages, offers tremendous ohmmeter range coverage, and a complete db scale for a total of 35 meter ranges.

New 1½ volt full scale low range provides well over 2¼" of scale length per volt. Upper DC scale limit 1,500 volts. DC ranges 0-1.5, 5, 15, 50, 150, 500, 1,500 volts full scale. AC ranges 0-1.5, 5, 15, 50, 150, 500, 1,500 (1,000 volts maximum). Seven ohmmeter ranges from .1 ohm to 1,000 megohms. For added convenience a DC polarity reversing switch and a center scale zero adjustment for FM alignment.

The smartly styled, compact, sturdy, formed aluminum cabinet is finished in an attractive gray crackle exterior. The beautiful two-color, durable, infra-red, baked enamel panel further adds to the over-all professional appearance.

Top quality components used throughout. 1% precision resistors — silver contact range and selector switches — selenium rectifier — transformer operated power supply. Individual calibration on both AC and DC for maximum accuracy. DB scale printed in red for easy identification, all other scales a sharp, crisp black for easy reading. A variety of accessory probes shown on this page still add further to over-all instrument usefulness.

Heathkit 30,000 VOLT DC PROBE KIT

No. 336

$4.50

SHIP. WT. 2 LBS.

For TV service work or any similar application where the measurement of high DC voltage is required, the Heathkit Model 336 High Voltage Probe Kit will prove invaluable. A precision multiplier resistor mounted inside the two-color, sleek, plastic probe body provides a multiplication factor of 100 on the DC ranges of the Heathkit 11 megohm VTVM. The entire kit includes precision resistor, two-color plastic probe, tip connector spring, test lead, phone plug panel connector, and complete assembly instructions.

No. 338-B

$5.50

SHIP. WT. 2 LBS.

Heathkit PEAK-TO-PEAK PROBE KIT

Now read peak-to-peak voltages on the DC scales of the Heathkit 11 megohm VTVM. Readings can be directly made from the VTVM scale without involved calculations. Measurements over the frequency range of 5 kc to 5 mc. Use this probe to extend the usefulness of your VTVM in radio and TV service work. The Peak-to-Peak Probe Kit features the new polished aluminum housing with two-color polystyrene probe ends. Detailed assembly sheet including instructions for probe operation.

Heathkit RF PROBE KIT

The Heathkit RF Probe used in conjunction with any 11 megohm VTVM will permit RF measurements up to 250 mc, ± 10%. A useful, convenient accessory for those occasions when RF measurements are desired. The RF probe body is housed in the new, smartly-styled polished aluminum probe body featuring two-color polystyrene probe ends and a low capacity flexible shielded test lead. The kit is complete with all necessary material and a detailed assembly sheet as well as instructions for probe operation.

No. 309-B

$3.50

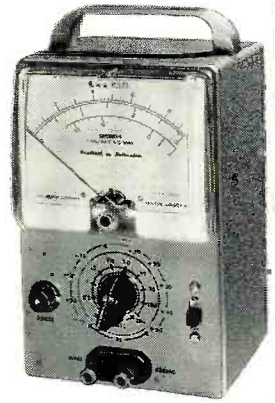
SHIP. WT. 2 LBS.

Heathkit AC VACUUM TUBE VOLTMETER KIT

MODEL AV-2

$29.50

SHIPPING WT. 5 LBS.



The new Heathkit AC VTVM that makes possible those sensitive AC measurements required by laboratories, audio enthusiasts, and experimenters. Especially useful for hum investigation, sensitive null detection, phono pick-up output measurements, making frequency response runs, gain measurements, ripple voltage checks, etc. Low level measurements are easy to make because of the complete voltage coverage of the instrument and the one knob operation.

The large 200 microampere Simpson meter has clearly marked and easy to read meter scales. Ten voltage ranges covering from .01 rms full scale to 300 volts rms full scale, with frequency response ± 1 db from 20 cycles to 50,000 cycles. Instrument input impedance 1 megohm, ten db ranges from −52 db to +52 db. For stability and good linearity characteristics the meter bridge circuit features 4 germanium diodes. Attractive instrument styling, a companion piece for the popular Heathkit VTVM and the new AW-1 Audio Wattmeter.

HEATH COMPANY • Benton Harbor 15, Mich.

CHECK THESE *Features*

- 20,000 ohms per volt DC sensitivity, 5,000 ohms per volt on AC
- Polarity reversal switch
- 1% precision multiplier resistors
- 50 microampere 4½" Simpson meter
- Meter ranges for service convenience
- New resistor ring-switch assembly
- Total of 35 meter ranges
- New Modern cabinet styling

NEW *Heathkit*

MULTIMETER KIT

MODEL MM-1

$26.50

SHIPPING WT. 6 LBS.

The most important Heathkit announcement of the year, the new 20,000 ohms per volt Heathkit Multimeter, Model MM-1. The universal service measuring instrument, accurate, sensitive, portable, and completely independent of AC line supply. Particularly designed for service use incorporating many desirable features for the convenience of the service man. Full 20,000 ohms per volt sensitivity on DC ranges — 5,000 ohms per volt sensitivity on AC — polarity reversal switch, no bothersome transferring of test leads — 1% precision multiplier resistors — large 4½" recessed non-glare 50 microampre Simpson meter — conveniently slanted control panel — recessed safety type banana jacks — standard universally available batteries — rugged practical sized cabinet with plastic carrying handle, and a total of 35 calibrated meter ranges.

RANGES

Voltage ranges selected entirely for service convenience. For example 1½ volt full scale low range for measuring portable radio filament voltages, bias voltages, etc., 150 volt full scale range for AC-DC service work, 500 volt full scale range for conventional transformer operated power supply systems. Complete voltage ranges AC and DC, 0-1.5—5—50—150—500—1,500—5,000 volts. DC current ranges, 0-150 microamperes—15 milliamperes—150 milliamperes—500 milliamperes—15 amperes. Resistance measurements from .2 ohms to 20 megohms x 1 x 1,000 x 10,000. DB coverage from −10 db to +65 db.

CONSTRUCTION

Entirely new design permits assembly, mounting and wiring of precision resistors on a ring-switch assembly unit. The major portion of instrument wiring is completed before mounting the ring-switch assembly to the panel. No calibration procedure is required, all precision resistors readily accessible in event of replacement.

CABINET

Strikingly modern cabinet styling featuring two piece construction, durable black Bakelite cabinet, with easy to read panel designations. Cabinet size 5½" wide x 4" deep x 7½" high. Good cabinet physical stability when operated in vertical position.

The Heathkit MM-1 represents a terrific instrument value for a high quality 20,000 ohms per volt unit using all 1% deposited carbon type precision resistors. Here is quality, performance, functional design, and attractive appearance, all combined in one low priced package.

Heathkit

BATTERY TESTER KIT

MODEL BT-1

$8.50

SHIP. WT. 2 LBS.

The Heathkit Battery Tester measures all types of dry batteries between 1½ volts and 150 volts under actual load conditions. Readings are made directly on a three color Good-Weak-Replace scale. Operation is extremely simple and merely requires that the test leads be connected to the battery under test. Only one control to adjust in addition to a panel switch for "A" or "B" battery types. The Heathkit Battery Tester features compact assembly, accurate meter movement, and a three deck wire-wound control, all mounted in a portable rugged plastic cabinet. Checks portable radio batteries, hearing aid batteries, lantern batteries, etc.

Heathkit

HANDITESTER KIT

MODEL M-1

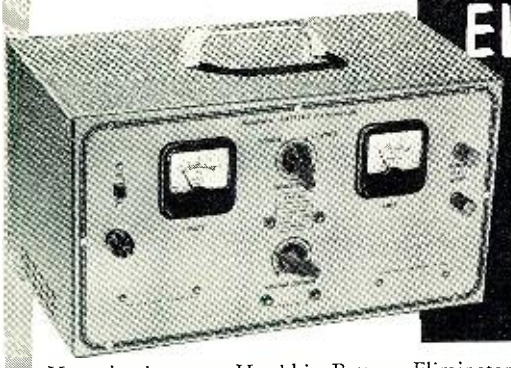
$14.50

SHIPPING WT. 3 LBS.

The Heathkit Model M-1 Handitester readily fulfills major requirements for a compact, portable volt ohm milliammeter. Despite its compact size, the Handitester is packed with every desirable feature required in an instrument of this type. AC or DC voltage ranges full scale, 0-10—30—300—1,000—5,000 volts. Two ohmmeter ranges, 0-3,000 and 0-300,000. Two DC current measurement ranges, 0-10 milliamperes and 0-100 milliamperes. The instrument uses a Simpson 400 microampere meter movement, which is shunted with resistors to provide a uniform 1 milliampere load on both AC and DC ranges. Special type, easily accessible, battery mounting bracket — 1% deposited carbon type precision resistors — hearing aid type ohms adjust control. The Handitester is easily assembled from complete instructions and pictorial diagrams. Necessary test leads are included in the price of this popular kit.

HEATH COMPANY • Benton Harbor 15, Mich.

New *Heathkit* 12 Volt BATTERY ELIMINATOR KIT



MODEL BE-4

$31.50

SHIPPING WT. 18 LBS.

CHECK THESE *Features*

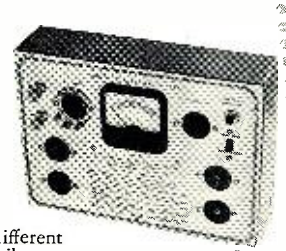
- Either 6 or 12 volt operation
- Continuously variable voltage output
- Constant ammeter and voltmeter monitoring
- Automatic overload relay — self-resetting
- Two 10,000 mf condensers
- New 18 disc split type heavy duty rectifier unit
- Fuse protection

Here is the new Heathkit Battery Eliminator necessary for modern, up-to-date operation of your service shop. The Heathkit Model BE-4 furnishes either 6 volts or 12 volts output which can be selected at the flick of a panel switch. Use the BE-4 to service the new 12 volt car radios in addition to the conventional 6 volt radios.

This new Battery Eliminator provides two continuously variable output ranges, 0-8 volts DC at 10 amperes continuously, or 15 amperes maximum intermittent; 0-16 volts DC at 5 amperes continuously or 7.5 amperes maximum intermittent. The output voltage is clean and well filtered as the circuit uses two 10,000 mf condensers. The continuously variable voltage output feature is a definite aid in determining the starting point of vibrators, the voltage operating range of oscillator circuits, etc. Panel mounted meters constantly monitor voltage and current output and will quickly indicate the presence of a major circuit fault in the equipment under test. The power transformer primary winding is fuse protected and for additional safety an automatic relay of the self-resetting type is incorporated in the DC output circuit. The heavy duty rectifier is a split type 18 plate magnesium copper sulfide unit used either as a full wave rectifier or voltage doubler according to the position of the panel range switch.

Here is the ideal battery eliminator for all of your service problems and as an additional feature, it can also be used as a battery charger. Another new application for the Heathkit Battery Eliminator is a variable source of DC filament supply in audio development and research. More than adequate variable voltage and current range for normal applications.

Heathkit VIBRATOR TESTER KIT



Your repair time is valuable, and service use of the Heathkit Vibrator Tester will save you many hours of work. This tester will instantly tell you the condition of the vibrator being checked. Checks vibrators for proper starting and the easy to read meter indicates quality of output on a large Bad-?-Good scale. The Heathkit VT-1 checks both interrupter and self rectifier types of vibrators. Five different sockets for checking hundreds of vibrator types.

The Heathkit Vibrator Tester operates from any battery eliminator capable of delivering continuously variable voltage from 4 to 6 volts DC at 4 amperes. The new Heathkit Model BE-4 Battery Eliminator would be an ideal source of supply.

MODEL VT-1

$14.50

SHIPPING WT. 6 LBS.

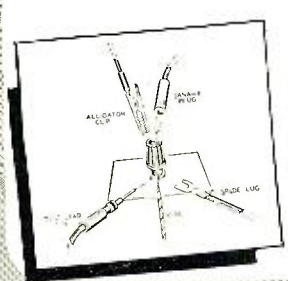
NEW *Heathkit* VARIABLE VOLTAGE ISOLATION TRANSFORMER KIT

The new Heathkit Isolation Transformer Kit provides line isolation for AC-DC radios (not an auto transformer), thereby eliminating shock hazard, hum problems, alignment difficulties, etc. The output voltage is variable from 90 to 130 volts AC and is constantly monitored by a panel mounted AC volt meter. Use it to increase AC supply voltage in order to induce breakdown of faulty components in circuits thereby saving service time. Use it also to simulate varying line voltage conditions and to determine the line voltage level at which oscillator circuits cease functioning, particularly in three-way portable radios. Rated at 100 watts continuous operation and up to 200 watts maximum intermittent operation. A useful radio and TV service tool.

MODEL IT-1

$16.50

SHIP. WT. 9 LBS.



Heathkit BINDING POST

Binding post kit now available so that standardization of all instrument connectors is possible. This new, five-way binding post will accommodate an alligator clip, banana plug, test lead pin, spade lug, or hook-up wire. Sold in units of 20 binding post assemblies. Each assembly includes binding post, flat and shoulder fiber washers, solder lug, and nut. 120 pieces in all. Kit 362, $4.00.

Heathkit TECHNICAL APPLICATION BULLETINS

An exclusive Heathkit service. Technical application bulletins prepared by recognized instrument authorities outlining various combinations of instrument applications. Available now with 40 four-page illustrated bulletins and an attractive flexible loose-leaf binder. Only $2.00. (No c.o.d. on this item, please.)

HEATH COMPANY · Benton Harbor 15, Mich.

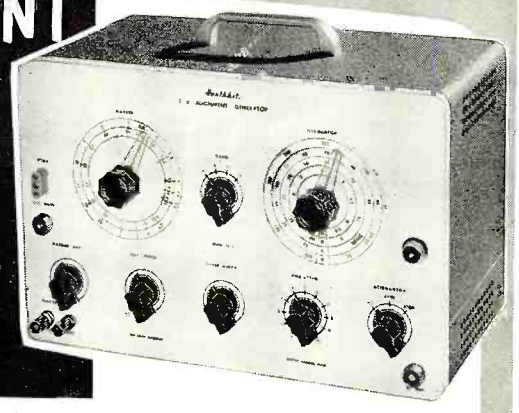
NEW *Heathkit*

TV ALIGNMENT GENERATOR KIT

MODEL TS-3

$44.50

SHIPPING WEIGHT
18 POUNDS



CHECK THESE *Features*

- INCREDUCTOR controllable inductor sweep
- TV and IF sweep deviation 12-30 mc
- 4 mc- 220 mc continuous frequency coverage
- Oscillator operation entirely on fundamentals
- Output in excess of 100,000 microvolts
- Automatic amplitude circuit
- Voltage regulation
- Simplified operation

Proudly announcing an entirely new, advanced model TV and FM Sweep Generator, the Heathkit Model TS-3. This new design provides features and combinations of functions not found in any other service type instrument. Every design consideration has been given to the requirements of the TV service man to provide a flexible, variable sweep source with more than adequate RF output and complete frequency coverage throughout the TV and FM spectrum.

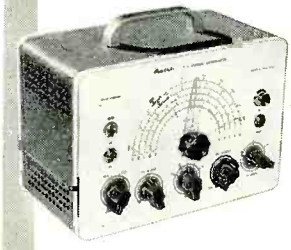
The frequency range of the TS-3 is from 4 mc to 220 mc in four switch selected ranges. All frequency ranges are overlapping for complete coverage. A particularly important feature of the instrument is that the oscillator operates entirely on fundamentals, thereby providing complete freedom from spurious oscillation and parasitics normally encountered in beat frequency type oscillators. This circuitry assures a much higher total RF output level and simplifies attenuation problems.

The new TS-3 features an entirely new principle of sweep operation. Sweep action is entirely electronic with no moving parts or electro-mechanical devices so commonly used. The heart of the sweep system is a newly-developed INCREDUCTOR controllable inductor. With this system, the value of inductance of each oscillator coil is electrically varied with an AC control current, and the inductance variation is achieved by a change in the magnetic state of the core on which the oscillator coils are wound. This system provides a sweep deviation of not less than 12 mc on all TV frequencies, and up to a maximum of 30 mc on TV IF frequencies. The high RF output level throughout the instrument frequency range overcomes the most common complaint of the older type sweep generators. A new, automatic amplitude control circuit maintains the output level flat to ± 2 db throughout the instrument range. For convenience of operation a low impedance 50 ohm output is used.

Operation of the instrument has been simplified through the reduction of panel controls and separate panel terminals provide for external synchronization if desired. The circuit uses a voltage regulator tube to maintain stable instrument operation. A built-in variable oscillator marker further adds to flexibility of instrument operation. Provisions are also made for the use of an external marker, such as your service type signal generator, if desired. Use the Heathkit TS-3 for rapid, accurate TV alignment work, and let it help you solve those time consuming, irksome problems so frequently encountered.

NEW *Heathkit*

SIGNAL GENERATOR KIT



MODEL SG-8

$19.50

SHIPPING WEIGHT
8 POUNDS

Announcing the new Heathkit Model SG-8 service type Signal Generator, incorporating many design features not usually found in an instrument in this price range. The RF output is from 160 kc to 100 mc in five ranges, all on fundamentals, with useful harmonics up to 200 mc. The RF output level is in excess of 100,000 microvolts throughout the frequency range.

The oscillator circuit consists of a 12AT7 twin triode tube. One half is used as a Colpitts oscillator, and the other half as a cathode follower output which acts as a buffer between the oscillator and external load. This circuitry eliminates oscillator frequency shift usually caused by external circuit loading.

All coils are factory wound and adjusted, thereby completely eliminating the need for calibration and the use of additional calibrating equipment. The stable low impedance output features a step and variable attenuator for complete control of RF level. A 6C4 triode acts as a 400 cycle sine wave oscillator and a panel switching system permits a choice of either external or internal modulation.

The transformer operated circuit is easy to assemble, requires no calibration, and meets every service requirement for an adjustable level variable frequency signal source, either modulated or un-modulated.

NEW *Heathkit*

BAR GENERATOR KIT

MODEL BG-1

$14.50

SHIPPING WEIGHT
6 POUNDS

The Heathkit BG-1 Bar Generator represents another welcome addition to the fast growing line of popular Heathkits. The station transmitted test pattern is rapidly disappearing, and the bar generator is the logical answer to the TV service man's problem in obtaining quick, accurate adjustment information without waiting for test patterns.

The Heathkit BG-1 produces a series of horizontal or vertical bars on a TV screen. Since these bars are equally spaced, they will quickly indicate picture linearity of the receiver under test. Panel switch provides "stand-by position" — "horizontal position" — "vertical position." The oscillator unit utilizes a 12AT7 twin triode for the RF oscillator and video carrier frequencies. A neon relaxation oscillator provides low frequency for vertical linearity tests. The instrument will not only produce bar patterns but will also provide an indication of horizontal and vertical sync circuit stability, as well as overall picture size.

Instrument operation is extremely simple, and merely requires connection to the TV receiver antenna terminal. The unit is transformer operated for safety when used in conjunction with universal or transformerless type TV circuits.

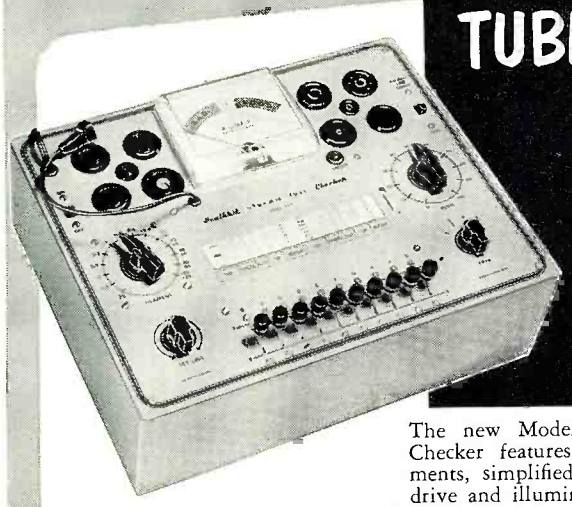
HEATH COMPANY • Benton Harbor 15, Mich.

NEW *Heathkit* TUBE CHECKER KIT

MODEL TC-2

$29.50

SHIP. WT. 12 LBS.



CHECK THESE NEW *Features*

- Simplified harness wiring
- Improved, smooth, anti-backlash roll chart action
- Optional roll chart illumination
- Individual element switches
- Portable or counter style cabinet
- Spare blank socket
- Contact type pilot light test socket
- Simplified test set-up procedure
- Line adjust control
- 4½" three-color meter

The new Model TC-2 Heathkit Tube Checker features many circuit improvements, simplified wiring, new roll chart drive and illumination of roll chart. The instrument is primarily designed for the convenience of the radio and TV service man and will check the operating quality of tubes commonly encountered in this type of work. Test set-up procedure is simplified, rapid, and flexible. Panel sockets accommodate 4, 5, 6, and 7 pin tubes, octal and loctal, 7 and 9 pin miniatures, 5 pin Hytron and a blank socket for new tubes. Built-in neon short indicator, individual three-position lever switch for each tube element, spring return test switch, 14 filament voltage ranges, and line set control to compensate for supply voltage variations, all represent important design features of the TC-2. Results of tube tests are read directly from a large 4½" Simpson three-color meter, calibrated in terms of Bad-?-Good. Information that your customer can readily understand. Checks emission, shorted elements, open elements, and continuity.

The use of closer tolerance resistors in critical circuits assures correct test information and eliminates the possibility of inaccurate test interpretation. Improvement has been made in the mechanical roll chart drive system, completely eliminating diagonal running, erratic operation, and backlash. The thumb wheel gear driven action is smooth, positive, and free running. As an additional feature, the roll chart is illuminated for easier reading, particularly when the tube checker is used on radio or TV home service calls.

Wiring procedure has been simplified through the extended use of multicable, color coded wires, providing a harness type installation between tube sockets and lever switches. This procedure insures standard assembly and imparts that "factory built" appearance to instrument construction. Completely detailed information is furnished in the new step-by-step construction manual, regarding the set-up procedure for testing of new or unlisted tube types. No delay necessary for release of factory data.

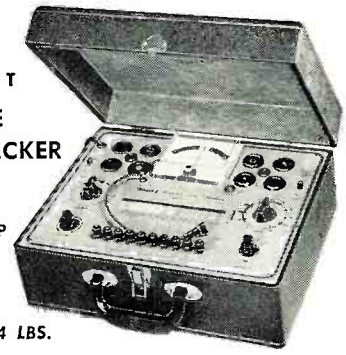
The new Heathkit Tube Checker will prove its value in building service prestige through usefulness — simplified operation — attractive professional appearance. Don't overlook the fact that the kit price represents a savings of $40.00 to $50.00 over the price of a comparable commercially built instrument. At this low price, no service man need be without the advantages offered by the Heathkit Tube Checker.

New HEATHKIT PORTABLE TUBE CHECKER KIT

MODEL TC-2P

$34.50

SHIP. WT. 14 LBS.



The portable model is supplied with a strikingly attractive two-tone cabinet finished in rich maroon, proxylin impregnated, fabric covering with a contrasting gray on the inside cover. Detachable cover, brass-plated hardware, sturdy plastic handle help to impart a truly professional appearance to the instrument.

PORTABLE TUBE CHECKER CABINET as described above will fit all earlier Heathkit TC-1 Tube Checkers. Shipping weight 7 lbs. Cabinet only, 91-8, $7.50.

Heathkit TV PICTURE TUBE TEST ADAPTER

No. 355
Ship. Wt. 1 Lb.
$4.50

The Heathkit TV Picture Tube Test Adapter used with the Heathkit Tube Checker will quickly check for emission, shorts, etc., and determine picture tube quality. Consists of standard 12 pin TV tube socket, four feet of cable, octal socket connector, and data sheet.

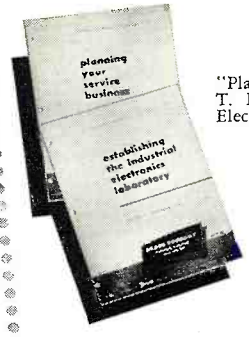
Heathkit POWER SUPPLY KIT

MODEL PS-2

$33.50

SHIPPING WT. 17 LBS.

The Heathkit Laboratory Power Supply features continuously variable, regulated voltage output with good stability under wide load variations. A 4½" Simpson plastic enclosed panel mounted meter provides accurate meter output information of voltage or current. All panel terminals completely isolated from the cabinet. Separate 6.3 volt AC supply at 4 amperes for filament requirements. Ripple component exceptionally low, stand-by switch provided to eliminate warm-up time of the five tube circuit.



LABORATORY AND SERVICE SHOP BOOKLETS

"Planning Your Service Business" by John T. Frye, and "Establishing the Industrial Electronics Laboratory" by Louis B. Garner, Jr., are booklets available to Heathkit customers at no charge. These booklets, written by nationally recognized authorities, outline the various requirements and considerations for establishing your own service business or for setting up an industrial electronics laboratory. Full attention is given to various details that are frequently overlooked when projects of this nature are undertaken. Just write in to the Heath Company requesting your free copy, or attach a memo to your next order.

HEATH COMPANY • Benton Harbor 15, Mich.

CHECK THESE *Features*

- Visual and aural signal tracing
- Two channel input
- High RF sensitivity
- Unique noise locater circuit
- Calibrated wattmeter
- Substitution test speaker
- Utility amplifier
- RF, audio probes and test leads included

Heathkit VISUAL-AURAL SIGNAL TRACER KIT

MODEL T-3

$23.50

SHIPPING WEIGHT 10 POUNDS

An entirely new type of signal tracer incorporating a combination of features not found in any other instrument. Designed expressly for the radio and TV service man, particularly for the servicing of AM, FM, and TV circuits. Here in a five tube, transformer operated instrument are all of the useful functions so necessary for speedy, accurate isolation of service difficulty.

This new signal tracer features a special high gain RF input channel, used in conjunction with a newly-designed wide frequency range demodulator probe. High RF sensitivity permits signal tracing at the receiver antenna input. A separate low gain channel and probe available for audio circuit exploration. Both input channels are constantly monitored by an electron ray beam indicator, so that visual as well as aural signal indications may be observed. The instrument can also be used for comparative estimation of gain per stage.

A decidedly unusual feature is a noise localizer circuit in conjunction with the audio probe. With this system, a DC potential is applied to a suspected circuit component and the action of the voltage in the component can be seen as well as heard. Invaluable for ferreting out noisy or intermittent condensers, noisy resistors, controls, coils, IF and power transformers, etc. A built-in calibrated wattmeter circuit is very useful for a quick preliminary check of the total wattage consumption of the equipment under test. Separate panel terminals provide external use of the speaker or output transformer for substitution purposes. Saves valuable service time by eliminating the necessity for speaker removal on every service job. The terminals also permit the utilization of other shop equipment, such as your oscilloscope or VTVM. The T-3 Signal Tracer can be used as a high gain amplifier for checking tuners, record changers, microphones, phono crystals, etc.

Don't overlook the interesting service possibilities provided through the use of this new instrument and let it work for you by saving time and money. The kit is supplied complete with all tubes, circuit components, demodulator probe, audio probe, and additional test leads.

Heathkit DECADE RESISTANCE KIT

MODEL DR-1

$19.50

SHIP. WT. 4 LBS.

The Decade Resistance Kit provides individual switch selection of resistance values using twenty 1% resistors providing a choice of 1 to 99,999 ohms in 1 ohm steps. Ceramic wafer switches, silver-plated contacts, smooth, positive detent action, baked enamel panel, and handsome, polished birch cabinet.

Heathkit DECADE CONDENSER KIT

The Heathkit Decade Condenser Kit features silver mica, precision condensers with a rated accuracy of ± 1%. Capacity values are arranged in three decades from 100 mmf to .111 mf in steps of 100 mmf. Ceramic wafer switches with silver-plated contacts and smooth detent action. Useful in laboratory work, for circuit development.

MODEL DC-1

$16.50

SHIP WT 4 LBS.

Heathkit RESISTANCE SUBSTITUTION BOX KIT

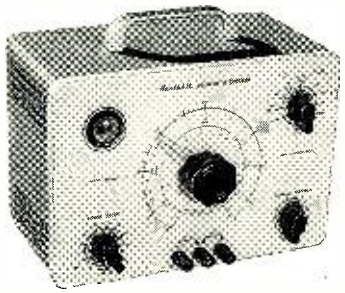
MODEL RS-1

$5.50

SHIP. WT. 2 LBS.

The Heathkit Resistance Substitution Box provides individual switch selection of any one of 36 RTMA 1 watt 10% standard value resistors, ranging from 15 ohms to 10 meghoms. Many applications in circuit development work, and also in radio and TV service work. Ideal for experimentally determining resistance values and for quickly altering circuit operating characteristics. Entire unit housed in attractive Bakelite cabinet, featuring the new universal type Heathkit binding posts to simplify circuit connections.

Heathkit CONDENSER CHECKER KIT



MODEL C-3

$19.50

SHIPPING WT. 8 POUNDS

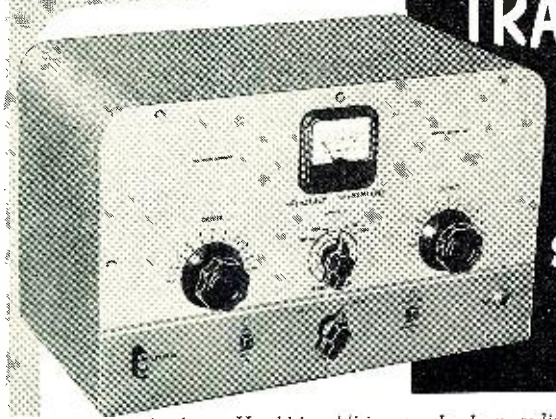
Use the Heathkit C-3 Condenser Checker to quickly and accurately measure those unknown condenser and resistor values. All readings are taken directly from the calibrated panel scales without requiring any involved calculation. Capacity measurements in four ranges from .00001 mf to 1,000 mf. Checks paper, mica, ceramic, and electrolytic condensers. A power factor control is available for accurate indication of electrolytic condenser measurements. A leakage test switch with switch selection of five polarizing voltages, 25 volts to 450 volts DC, will indicate condenser operating quality under actual load condition. The spring return leakage test switch automatically discharges the condenser under test and eliminates shock hazard to the operator.

Resistance measurements can be made in the range from 100 ohms to 5 megohms. Here again all values are read directly on the calibrated scale. Increased circuit sensitivity coupled with an electron beam null indicator increases overall instrument usefulness.

For safety of operation the circuit is entirely transformer operated and the instrument is housed in the attractive, newly-styled Heathkit cabinet, featuring rounded corners, and drawn aluminum panel. The outstanding low kit price for this surprisingly accurate instrument includes necessary test leads. Good service shop operation requires the use of this specialized instrument, designed for the express purpose of determining unknown condenser values and operating characteristics.

HEATH COMPANY • Benton Harbor 15, Mich.

Heathkit AMATEUR TRANSMITTER KIT



MODEL AT-1

$29.50

SHIPPING WEIGHT 16 POUNDS

CHECK THESE NEW *Features*

- ✓ Single knob band switching
- ✓ Pre-wound coils
- ✓ Metered operation
- ✓ 52 ohm coaxial output
- ✓ Crystal or VFO excitation
- ✓ Built-in power supply
- ✓ Rugged, clean construction

Here is the latest Heathkit addition to the ham radio field, the AT-1 Transmitter Kit, incorporating many desirable design features at the lowest possible dollar-per-watts price. Panel mounted crystal socket, stand-by switch, key click filter, AC line filtering, good shielding, etc. VFO or crystal excitation — up to 35 watts input. Built-in power supply provides 425 volts at 100 ma.

This kit features pre-wound coils, single knob band switching, 52 ohm coaxial output, plug in chassis provisions for VFO or modulator and rugged clean construction. Frequency range 80, 40, 20, 15, 11, and 10 meters. Tube line-up 6AG7 oscillator-multiplier, 6L6 amplifier-doubler, 5U4G rectifier. Physical dimensions 8⅛" high x 13⅛" wide x 7" deep.

This amazingly low kit price includes all circuit components, tubes, cabinet, punched chassis, and detailed construction manual. The ideal kit for the novice just breaking into ham radio. It can be used later on as a stand-by rig or an all band exciter for higher powered transmitter.

NEW *Heathkit* ANTENNA COUPLER KIT

New Heathkit Antenna Coupler, specially designed for the Heathkit AT-1 Transmitter. The Antenna Coupler can be used with any 52 ohm coaxial input — up to 75 watts power. Low pass filter with cut-off frequency of approximately 36 mc — L section tuning network — neon tuning indicator — rugged, compact construction — transmitter type variable condenser, and high Q coil are all outstanding features. The AC-1 has both inductance and capacity tuning for maximum operating versatility. Dimensions 8⅛" wide x 4⅜" high x 4⅞" deep.

MODEL AC-1

$14.50 SHIP. WT. 3 LBS.

Heathkit ANTENNA IMPEDANCE METER

Use the Heathkit Antenna Impedance Meter for measuring antenna impedance for line matching purposes — adjustment of beam antennas — phone monitor, etc. It will determine antenna resistance at resonance, match transmission line for minimum SWR, determine receiver input impedance, and provide a rough indication of SWR. Precision resistors, germanium diode, 100 microampere Simpson meter. Dial calibrated from 0-500 ohms. Shielded aluminum cabinet. 7" long x 2½" wide x 3¼" deep.

$14.50 SHIP. WT. 3 LBS.

MODEL AM-1

Heathkit COMMUNICATIONS RECEIVER KIT

MODEL AR-2

$25.50 SHIP. WT. 12 LBS.

Here is the new receiver kit you have repeatedly asked for, the Heathkit Communications Receiver. The perfect companion piece for the AT-1 Transmitter kit. Many outstandingly desirable features have been incorporated in the design of the AR-2; such as, electrical bandspread for logging and tuning convenience — high gain miniature tubes — IF transformers for high sensitivity and good signal to noise ratio — separate RF gain control with optional automatic volume control or manual volume control, in addition to the conventional audio gain control. Noise limiter — stand-by switch — stable BFO oscillator circuit — headphone jack — transformer operation, etc., all contribute to a high performance standard.

Frequency coverage is continuous from 535 kc to 35 mc in four ranges. For added convenience, various ham bands have been separately identified in respect to their relative placement on the slide rule tuning scale. A chassis mounted, 5½" PM speaker is included with this kit. Tube line up 12BE6 mixer oscillator, 12BA6 IF amplifier, 12AV6 detector AVC audio, 12BA6 BFO oscillator, 12A6 beam power output, 5Y3GT rectifier.

RECEIVER CABINET

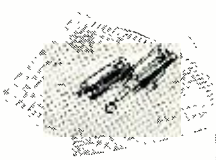
Proxylin impregnated, fabric covered, plywood cabinet with aluminum panel designed expressly for the AR-2 Receiver. Part 91-10, shipping weight 5 lbs., $4.50.

IMPROVED *Heathkit* GRID DIP METER KIT

$19.50 SHIP. WT. 4 LBS.

MODEL GD-1B

The invaluable instrument for service men, hams, and experimenters. Useful in TV service work for alignment of traps, filters, IF stages, peaking compensation networks, etc. Locates spurious oscillation, provides a relative indication of power in transmitter stages, use it for neutralization, locating parasitics, correcting TVI, measuring C, L, and Q of components, and determining RF circuit resonant frequencies. With oscillator energized, useful for finding resonant frequency of tuned circuits. With the oscillator not energized, the instrument acts as an absorption wave meter. Variable meter sensitivity control, head phone jack, 500 microampere Simpson meter. Continuous frequency coverage from 2 mc. to 250 mc. Pre-wound coil kit and rack, new three prong coil mounting, 6AF4 high frequency triode.



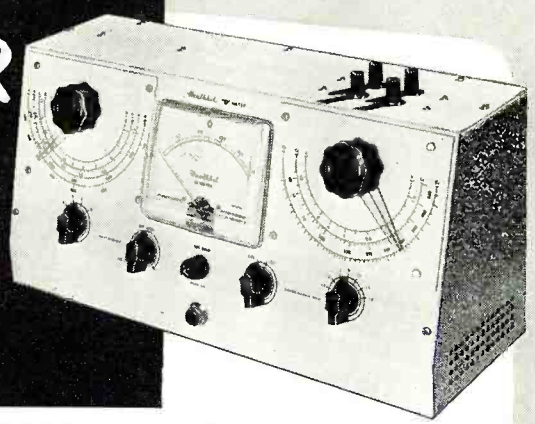
Two additional plug-in coils are available and provide continuous extension of low frequency coverage down to 355 kc. Dial correlation curves included. Shipping weight 1 lb., kit 341, $3.00.

HEATH COMPANY • Benton Harbor 15, Mich.

CHECK THESE *Features*

- First popular priced Q Meter
- Reads Q directly on calibrated scale
- Oscillator supplies RF frequencies of 150 kc to 18 mc
- Calibrate capacitor with range of 40 mmf to 450 mmf with vernier of ± 3 mmf
- Measures Q of condensers, RF resistance, and distributed capacity of coils
- Many applications in design and development work
- Useful in TV service work for checking deflection yokes, coils, chokes, etc.

Heathkit "Q" METER KIT



MODEL QM-1

$44.50

SHIPPING WT. 14 POUNDS

Another outstanding example of successful Heathkit engineering effort in producing a Q Meter Kit within the price range of TV service men, schools, laboratories, and experimenters. This Q Meter meets RF design requirements for rapid, accurate measurement of capacity, inductance, and Q at the operating frequency and all indications of value can be read directly on the meter calibrated scales. Oscillator section supplies RF frequencies of 150 kc to 18 mc. Calibrate capacitor with range of 40 mmf to 450 mmf, with vernier of ± 3 mmf.

Particularly useful in TV service work for checking peaking coils, wave traps, chokes, deflection coils, width and linearity coils, etc. At this low kit price research laboratory facilities are within the range of service shops, schools, and experimenters.

Heathkit INTERMODULATION ANALYZER KIT

MODEL IM-1

$39.50

SHIPPING WT. 17 POUNDS

The Heathkit IM-1 is an extremely versatile instrument specifically designed for measuring the degree of inter-action between two signals in any portion of an audio chain. It is primarily intended for making tests of audio amplifiers, but may be used in other applications, such as checking microphones, records, recording equipment, phonograph pick-ups, and loud-speakers. High and low test frequency source, intermodulation unit, power supply, and AC vacuum tube volt meter all in one complete instrument. Per cent intermodulation is directly read on the calibrated scales, 30%, 10%, and 3% full scale. Both 4:1 and 1:1 ratios of low to high frequency easily set up. With this instrument the performance level of present equipment, or newly developed equipment can be easily and accurately checked. At this low price, you can now enjoy the benefits of intermodulation analysis for accurate audio interpretation.

Heathkit AUDIO GENERATOR KIT

A Heathkit Audio Generator with frequency coverage from 20 cycles to 1 mc. Response flat ± 1 db from 20 cycles to 400 kc, down 3 db at 600 kc, and down only 8 db at 1 mc. Calibrated, continuously variable, and step attenuator output controls provide convenient reference output level. Distortion is less than .4% from 100 cps through the audible range. The ideal controllable extended frequency sine wave source for audio circuit investigation and development.

MODEL AG-8

$29.50

SHIP. WT. 11 LBS.

Heathkit AUDIO OSCILLATOR KIT

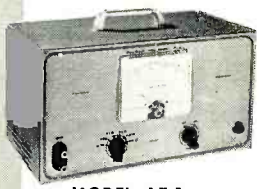
Sine or square wave coverage from 20 to 20,000 cycles in three ranges at a controllable output level up to 10 volts. Low distortion, 1% precision resistors in multiplier circuits, high level output across entire frequency range, etc., readily qualify this instrument for audio experimentation and development work. Special circuit design consideration features thermistor operation for good control of linearity.

MODEL AO-1

$24.50

SHIP. WT. 11 LBS.

Heathkit AUDIO FREQUENCY METER KIT



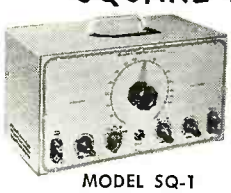
MODEL AF-1

$34.50

SHIP. WT. 12 LBS.

The Heathkit Audio Frequency Meter provides a simple and convenient means of checking unknown audio frequencies from 10 cycles to 100 kc at any voltage level between 3 and 300 volts rms with any non-critical wave shape. Instrument operation is entirely electronic. Just set the range switch, feed an unknown frequency into the instrument, and read the frequency directly on the calibrated scale of the Simpson 4½" meter.

Heathkit SQUARE WAVE GENERATOR KIT



MODEL SQ-1

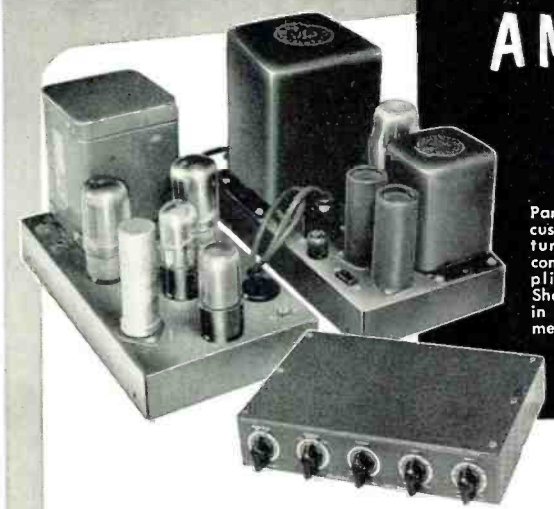
$29.50

SHIP. WT. 12 LBS.

The Heathkit Square Wave Generator provides an excellent square wave frequency source with completely variable coverage from 10 cycles to 100 kc. This generator features low output impedance of 600 ohms and the output voltage is continuously variable between 0 and 20 volts, thereby providing the necessary degree of operating flexibility. An invaluable instrument for those specialized circuit investigations requiring a good, stable, variable square wave source.

HEATH COMPANY · Benton Harbor 15, Mich.

Heathkit
WILLIAMSON TYPE
AMPLIFIER KIT
MODEL W-2



Particularly designed for custom installations, featuring separate cable connected units for simplicity of installation. Sheet metal work finished in attractive gray hammertone for smart appearance. All control shafts of the adjustable length break-off type.

$69.50

When selecting an amplifier for the heart of your high fidelity audio system, investigate the outstanding advantages offered by the Heathkit Williamson Type Amplifier. Meets every high fidelity audio requirement and makes listening to recorded music a thrilling new experience.

This outstanding amplifier is offered with optional output transformer operation, providing either the conventional triode output circuit or the new extended power circuity in which the screen supply voltage is obtained from separate transformer primary taps. Frequency response within ± 1 db from 10 cycles to 100 kc. Tube complement — 6SN7 cascade amplifier and phase splitter, 6SN7 push pull driver, two 5881 push pull power amplifiers, one 5V4G cathode type rectifier.

Matching preamplifier available providing three switch selected inputs, correct compensation, and individual bass and treble tone controls. Uses 12AY7 (or 12AX7) preamplifier — 12AU7 tone control amplifier.

Particularly designed for the novice kit builder and requires no specialized knowledge or equipment for successful assembly and operation.

PRICES OF COMBINATIONS

W-2 Amplifier Kit including main amplifier, power supply, and WA-P1 Preamplifier Kit. Shipping Weight 37 lbs. Shipped Express only. **$69.50**

W-2M Amplifier Kit includes main amplifier and power supply. Shipping Weight 29 lbs. Shipped Express only. **$49.75**

WA-P1 Preamplifier Kit only. Shipping Weight 6 lbs. Shipped Express or Parcel Post. **$19.75**

NEW *Heathkit* 20 WATT
High Fidelity AMPLIFIER KIT
MODEL A-9A

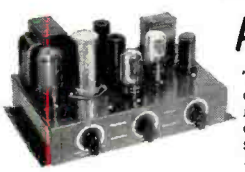
$35.50

SHIP. WT. 18 LBS.

A new 20 watt high fidelity amplifier, designed especially for custom audio installations demanding clean reproduction, adequate power, and flexibility to meet individual requirements. Separate treble and bass tone controls provide up to 15 db boost or cut. Four switch selected inputs, each with the necessary compensation for the service desired. Output transformer impedances of 4, 8, and 16 ohms.

Preamplifier, tone control, and phase splitter circuits utilize 9 pin twin triode miniature tubes for low hum and noise level. Two 6L6 push pull power output tubes provide full 20 watts power. Frequency response ± 1 db, 20-20,000 cycles. Total harmonic distortion 1% (at 3 db below rated output). Tube line-up: 12AX7 preamplifier, 12AU7 voltage amplifier and tone control, 12AU7 voltage amplifier and phase splitter, two 6L6 push pull pentode power output, 5U4G rectifier. Truly outstanding amplifier performance coupled with low cost.

Heathkit ECONOMY 6 WATT
AMPLIFIER KIT



MODEL A-7B

$15.50

SHIP. WT. 10 LBS.

The new Heathkit Model A-7B Amplifier offers many unusually fine features not normally expected in this low price range. Either of the two input circuits may be individually switch selected for phono or tuner operation. Separate bass and treble tone controls. Output impedances of 4, 8, and 15 ohms. Push pull beam power output stage for balanced reproduction. Excellent voltage gain characteristics, good frequency response, and full 6 watts power output. 12J5 amplifier, 12SL7 second amplifier and phase splitter, two 12A6 beam power output, one 5Y5 GT rectifier.

A-7C incorporates preamplifier stage with special compensated network to provide necessary gain for operation with variable reluctance or low output level phono cartridge. Circuit is properly compensated for microphone operation. $17.50.

NEW *Heathkit*
BROADCAST BAND
RECEIVER KIT

MODEL BR-2

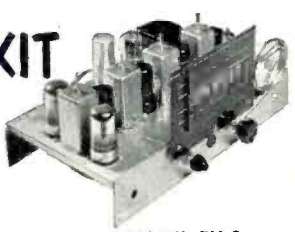
$17.50 SHIP. WT. 11 LBS.

Another new Heathkit for the student, beginner, or hobbyist. If you have ever had the urge to build your own radio receiver, this kit warrants your attention.

New high gain miniature tubes and IF transformers provide excellent sensitivity and good signal to noise ratio. A built-in ferrite core rod type antenna has been provided. A chassis mounted 5½" PM speaker provides excellent tone and volume. Convenient phono input. Can be operated either as a receiver or tuner. Simplified construction manual outlines circuit theory. Ideal for students. Tube line-up: 12BE6 mixer oscillator, 12BA6 IF amplifier, 12AV6 detector-AVC-first audio, 12A6 beam power output, 5Y3GT rectifier.

CABINET — Proxylin impregnated fabric covered plywood cabinet. Shipping weight 5 lbs. Part number 91-9, $4.50.

Heathkit
FM TUNER KIT



MODEL FM-2

$22.50

SHIP. WT. 9 LBS.

The Heathkit FM-2 Tuner was specifically designed for simplified kit construction. Can be operated through the "phono" portion of your radio or with a separate amplifier. The kit features a pre-assembled and adjusted tuning unit, three double tuned IF transformers, and a discriminator transformer in an 8 tube AC operated circuit. Frequency coverage 88 to 108 mc. Experience the thrill of building your own FM tuner and at the same time enjoy all of the advantages of true FM reception.

Free CATALOG

Write for free catalog containing latest price information, schematics, specifications, and descriptions of all Heathkits.

HEATH COMPANY · Benton Harbor 15, Mich.

CHECK THESE NEW *Features*

- Plays all record sizes, all speeds
- Newly developed ceramic cartridge
- Automatic shut-off for both changer and amplifier
- Acoustically correct cabinet enclosure
- Modern attractive styling
- Two 6" PM matched speakers
- Compensated volume control
- Easy to assemble

HEATHKIT *Dual* RECORD PLAYER KIT

MODEL RP-1

$59.50

SHIPPING WT. 30 LBS.

An entirely new introduction to quality record reproduction, a simple to operate, compact, table top model with none of the specialized custom installation problems usually associated with high fidelity systems. Two matched, synchronized speakers mounted in an acoustically correct enclosure reproduce all of the music on the record. Musical reproduction with the unique sensation of being surrounded by a halo of glorious sound. This spectacular characteristic is possible only because of the diffused non-directional properties of the matched dual speakers. The Heathkit Dual makes listening to fine recorded music a thrilling new experience through naturally clear, life-like reproduction of sound at all levels throughout the tonal system. The performance level is vastly superior to that of the ordinary phonograph or console selling for many, many times the price of the Dual.

Record Changer plays all sizes – all speeds – automatic shut-off for changer and amplifier after the last record is played. A wide tonal range ceramic cartridge features an ingenious turn-under twin sapphire stylus for LP or 78 records without turning the cartridge.

Simplified, easy to assemble, four tube amplifier features compensated volume control and separate tone control. Proxylin impregnated fabric covered cabinet supplied completely assembled. You build only the amplifier from step-by-step construction. No specialized tools or knowledge required, as full recognition has been given to the fact that many purchasers of this kit enjoy good musical reproduction on a purely non-technical basis, and the construction manual has been simplified to the point where even the complete novice can successfully construct the Heathkit Dual. The price of the Heathkit Dual includes cabinet, — Record Changer, two 6" PM speakers, tubes, and all circuit components required for amplifier construction.

HEATH COMPANY • Benton Harbor 15, Mich.

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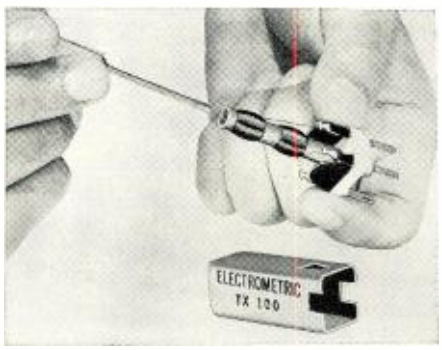
WHAT'S *New in Radio*

The products described in this column are for your convenience in keeping up-to-date on the new equipment being offered by manufacturers. For more complete information on any of these products, write direct to the company involved.

MINIATURE I.F.

The ability to tune both coils from the same end is one of the unique features of a new miniature i.f. transformer now available from *Electrometric Company* of Woodstock, Illinois.

Known as the Type TX100, the new unit permits both coils to be tuned



either from the top or from the bottom. This permits faster set alignment, reducing set production costs. It also results in greater freedom of radio chassis design.

The new unit can be used for any application requiring a ¾" i.f. transformer. It is available in a wide range of inductances and *"Q's"* for AM, FM, TV, and military applications.

SUBMINIATURE LIGHTS

A new subminiature indicator or warning light for use on either standard or edge-lighted panels and featuring wide-angle visibility is now being marketed by *Hetherington, Inc.* of Sharon Hill, Pa.

Requiring only ½" depth behind the panel exclusive of contact, the new lamp is known as the Series L6000. It uses a standard AN-3140 lamp which extends farther into the long plastic lens than is the case with conventional indicator lights. A unique inside bevelling of the plastic serves to "pipe" the light through the lens so that its periphery is illuminated.

Bulletin L6000 giving complete details is available on request.

NEW V.T.V.M.

Freed Transformer Company, 1718 Weirfield St., Brooklyn 27, New York is now offering a new a.c. vacuum-tube voltmeter, the Model 1040.

The unit has a high input impedance and wide frequency range, and can be used at audio and ultrasonic frequencies. It is particularly well adapted to making vibration studies involving low frequencies, frequency characteristic and gain measurements on amplifiers, measuring transmission losses in telephone circuits, and making acoustic measurements such as determination of frequency response of microphones and loudspeakers. It can also be used as a null detector in a.c. bridge measurements.

The Model 1040 weighs 12 pounds, stands 4⅞" high, is 5⅝" wide and 9⅞" long. It operates on 100-125 volts, 50-60 cycles. It has a logarithmic voltage scale calibrated from 1 to 10 plus a linear decibel scale calibrated from zero to 20 db.

8½" SCOPE

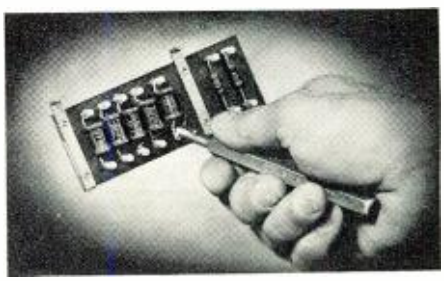
Precise Development Corp., 999 Long Beach Road, Oceanside, N. Y. is now offering an 8½" oscilloscope which is available in either kit or wired form.

The Model #308 uses an 8CP1 tube, is voltage regulated, and uses a higher accelerating potential than the company's previous 7" model. The instrument features a "low-normal-high frequency synchronization circuit" which enables the user to select between high and low frequency. The circuit itself is switch controlled.

PRODUCTION TOOL

Contact, Inc., 238 Main Street, Cambridge, Mass. is now in production on a new tool for wrapping wire around terminals.

The "Wire-Wrench" can be used for wrapping either stranded or solid wire around terminals on a board or hermetic seals. One or more wires can be wrapped with a single twist of the wrist. The unit also has, as an auxiliary feature, a drilled hole and a



milled flat to be used for putting a hook in a wire whenever needed.

Sizes for miniature, medium-size, and large terminals are currently available.

DIODE TEST SET

Electronics Production Service Co., 871 Washington St., Canton, Mass. has recently developed a new instrument for testing and evaluating miniature and power germanium or selenium rectifiers.

The Model D102 is capable of testing these units under actual operating

NO INTEREST!!

Buy on our radically new

Time Payment Plan

NO CARRYING CHARGES!!

Measures 6¼" x 9½" x 4½"

Superior's new Model 670-A SUPER METER

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

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: −6 to +18 +14 to +38 +34 to +58

ADDED FEATURE:

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

The Model 670-A comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40 NET

Superior's new Model TV-11 TUBE TESTER

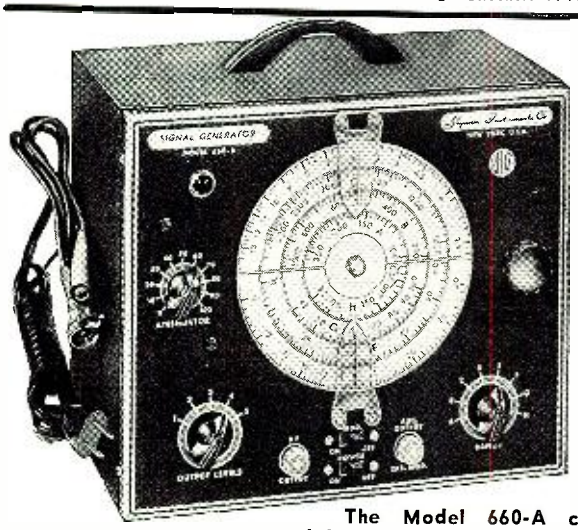
SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron, Miniatures, Sub-Miniatures, Novals, Sub-minars, Proximity fuse types, etc.
★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.
★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
★ Free-moving built-in roll chart provides complete data for all tubes.
★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.
★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRA SERVICE—The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover

$47.50 NET



The Model 660-A comes complete with coaxial cable test lead and instructions.

Superior's New Model 660-A AN AC OPERATED SIGNAL GENERATOR

PROVIDES COMPLETE COVERAGE for AM-FM & TV Alignment

SPECIFICATIONS:

• Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 220 Megacycles on powerful harmonics. • Accuracy and Stability are assured by the use of permeability trimmed Hi-Q coils. • R.F. available separately or modulated by the internal audio oscillator. — Built in 400 cycle sine wave audio oscillator used to modulate the R.F. signal also available separately for audio testing of receivers, amplifiers, hard of hearing aids, etc. • R.F. Oscillator Circuit: A high transconductance heptode is used as an R.F. oscillator, mixer and amplifier. Modulation is effected by electron coupling in the mixer section thus isolating the oscillator from load changes and affording high stability. • A.F. Oscillator Circuit: A high transconductance heptode connected as a high-mu triode is used as an audio oscillator in a High-C Colpitts Circuit. The output (over 1 Volt) is nearly pure sine wave. • Attenuator: A 5 step ladder type of attenuator is used.

Tubes used: 1—6BE6 as R.F. Oscillator, mixer and amplifier. 1—6BE6 as Audio Oscillator. 1—6H6 as Power Rectifier.

$42.95 NET

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. B-87, 38 Murray St., New York 7, N. Y.

Please send me the units checked. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

Name.....

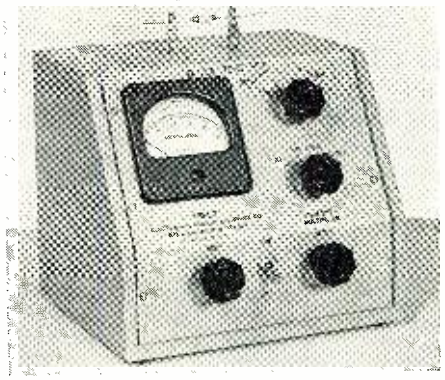
Address.....

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

☐ MODEL 670-A.....Total Price $28.40 $7.40 down payment. Balance $3.50 monthly for 6 months.
☐ MODEL TV-11.....Total Price $47.50 $11.50 down payment. Balance $6.00 monthly for 6 months.
☐ MODEL 660-A.....Total Price $42.95 $12.95 down payment. Balance $5.00 monthly for 6 months.
☐ I enclose $.....as down payment.
☐ Ship C.O.D. for the down payment.

conditions and is useful not only for testing germanium or selenium rectifiers but also for determining transistor parameters.

It consists of variable voltage and current sources, a precision metering unit, and a versatile switching arrangement which permits rapid selection of any operating test condition and then high-speed determination of diode forward and backward characteristics.



A data sheet describing the Model D102 in detail is available on request.

PENCIL SOLDERING IRON

Hexacon Electric Company, 213 W. Clay Ave., Roselle Park, N. J. has added a new soldering iron to its line that combines the advantages of a pencil iron and an industrial soldering iron.

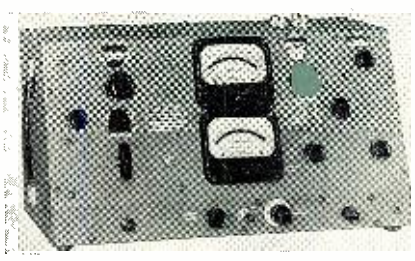
The new iron features the tip and element as separate parts both of which are replaceable independently. The handle of this 2 ounce iron is held like a pencil only 3 inches from the solder joint. The iron is available in 25 watts with a ⅛" tip or 30 watts with a 3/16" tip.

The unit operates on a.c. or d.c., any cycle. The irons are available 110 or 220 volts.

"Q" METER

Boonton Radio Corporation, Boonton, N. J. is in production on a new *"Q"* meter, Type 260-A.

The new and completely redesigned instrument has a frequency coverage of 50 kc. to 50 mc. and replaces the Type 160-A. The low *"Q"* scale permits *"Q"* readings down to a value of



10; a delta *"Q"* scale gives an accurate reading of the difference in *"Q"* resulting from changes in test circuit parameters and covers the range from 0 to 125. All indications are registered on large meters which have parallax correction and an accuracy of ±1% of full scale. A new oscilla-

(*Continued on page* 120)

SERVICEMEN THE WORLD OVER ACCLAIM THE

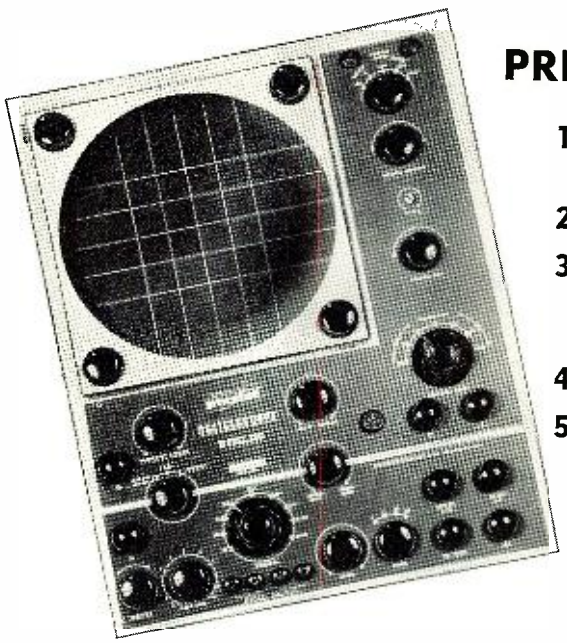
NEW Precise OSCILLOSCOPE

A FULL 7½" or 8½" SCOPE

NO OTHER KIT IN THE WORLD LIKE IT

THE OSCILLOSCOPE YOU'VE BEEN SEEKING
AVAILABLE IN *BOTH KIT AND WIRED* FORM

NO OTHER OSCILLOSCOPE AT ANY PRICE
HAS ALL THESE DESIRABLE FEATURES



PRECISE MODEL 308

1. **Full 8½" tube designed specially for this model.**
2. **Voltage regulation.**
3. **High frequency—Low frequency —Normal frequency Synchronization Circuit.**
4. **Separate intensifier anode.**
5. **Deluxe version of Model 300K.**

Precise Model 308 Specifications

VERTICAL—Vertical-flat (3db) DC through 5 megacycles with sensitivity of greater than 10 millivolts push-pull (3.94 Millivolts/cm); Con stan Resistance; Push-pull input immediately converted to single-ended normal or reverse phase by shorting bar at inputs 1 and 2; Frequency compensated vertical stepping attenuator selects AC or DC inputs; Push-pull DC amplifiers from input through output; internal electronic mixing through inputs 1 and 2; five-way binding posts.

POSITIONING—Bridge type positioning on vertical and horizontal does not vary tube characteristics.

HORIZONTAL—Frequency compensated stepping attenuator in horizontal amplifier; Push-pull Horizontal out.

BLANKING—Internal (return trace blanked), external (return trace not blanked), 60 cycle or 120 cycle Blanking through Blanking amplifier circuit.

SYNCHRONIZATION—External, Internal Positive, Internal Negative, Internal 60 cycle or Internal 120 cycle synchronization.

SWEEP RATE—Driven or non-driven lincar sweeps from 1 cycle to 80KC in five ranges (1-10 cycles uses external C circuit); Trigger potentiometer.

MAGNIFIER—Electronic magnifier and magnifier positioner allows any part of a signal to be magnified up to ten times (equivalent to 70 inches of horizontal deflection).

CALIBRATION—Internal square wave calibrator and potentiometer for using oscilloscope at a VTVM on Peak to Peak measurements.

CALIBRATION SCREEN—Edge-illuminated scale and graticule may be turned on or off; filtered screen.

OUTPUTS ON FRONT PANEL—Plus Gate output; Sawtooth output; 60 cycle phasing output; 60 cycle unphased output; Calibration output.

FOCUSING—Astigmatism, focus and intensity control.

CRT—NEW 7" Tube, normally supplied is medium persistency type 7VP1, or 7JP1 may also be used (oscilloscope green trace)—high persistency types available at additional cost.

DIRECT—Deflection plates available from rear of cabinet.

INTENSITY MODULATION—Z modulation through modulation amplifier.

GENERAL—Low loss components; Over-designed fused power supply for additional circuitry; Deeply etched aluminum panel; New parts from original manufacturers—(NO SURPLUS); Steel cabinet, 11" x 14" x 19"; complete with instruction book and all components; Accessories: Model 912T(MM) Demodulator Probe and Model 960 Capacity Attenuator Probe available at extra cost.

There are many additional features and circuits in Kit Form which may be added to Model 308. Write for descriptive literature.

308K—Kit Form $129.95
308W—Factory Wired $239.50
(2 months deliv.)
300—WB—Factory Wired $199.50
300KB—Kit Form $94.95

MODEL 300—Full 7" scope with the same features as Model 308K above except without first five features but with New Cadmium plated chassis and simplified wiring design. Size is 11" x 14" x 17".

Introducing

THE HOTTEST CONVERTERS FOR ANY UHF TERRITORY

The METROPOLITAN by SUTTON For use in the Primary or A Coverage Area only of a UHF Station. Check these features:

1. Adds all UHF Channels to every TV receiver
2. All VHF channels remain open
3. Designed for simple operation
4. Absolutely no additional adjustments required on receiver
5. To install, connect only UHF antenna and lead to receiver
6. Turns on automatically with set
7. Compactly built with attractive plastic cabinet

List price .....$29.95 ea.
Dealer Net .....$21.56 ea.

The SUTTON BOOSTER-CONVERTER No. 22B A combination VHF booster & UHF converter in one compact unit. Enables ANY TV Receiver now being manufactured to receive UHF signals and have the booster necessary for VHF in fringe areas. Has its own power supply, a crystal mixer and two tubes, a 6AF4 & 6J6. Terminals at back of unit provide connections for both VHF & UHF antenna. Unit is installed by simply connecting the antenna wire from the receiver to the terminal board at the back of the unit.

List price .....$59.50 ea.
Dealer Net .....$35.00 ea.

SEND FOR COMPLETE CATALOG on Precise Test Equipment and Sutton Converters.

Send 20% deposit with order, balance C.O.D., or, check or money order in advance.

TEE·VEE Supply Co.

3211-13 Washington Street
Jamaica Plain 30, Mass.

. . . the greatest advance ever made in ALL-CHANNEL antenna design!

Not content to bring out just another all-channel antenna, TRIO studied and tested every other model available. Months of research produced the "Twin-Six", a Zig-Zag that provides all of the desirable features indicated above. Quantitative ratings for antennas are practically meaningless because of some exaggerated claims. For this reason, the "Twin-Six" is announced without the usual gain charts. The new "Twin-Six", however, equals and, in most cases, greatly exceeds the gains of these antennas on *every* channel. For instance, the "Twin-Six" showed a 2 to 6 db higher gain than a competitive antenna which is advertised as having a 12 db gain.

MINUTE-UP ASSEMBLY

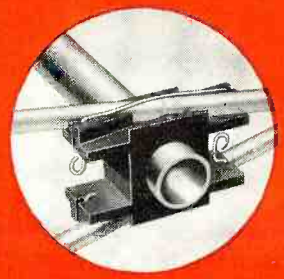
There's no antenna easier to assemble. Shipped with all hardware mounted on the boom. Complete assembly consists of matching elements to color coded insulators and snapping on spring clips. Improper assembly impossible.

NEW ZIG-ZAG "TWIN-SIX" OFFERS:

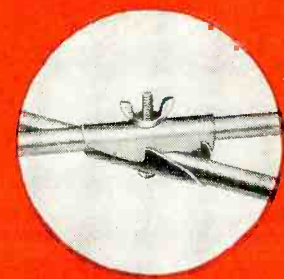
Measurable Higher Gain On All VHF Channels Than Any Other Single Bay All-Channel Antenna

PLUS

1. One Horizontal Bay Does It All!
2. Single Lead-In Operation!
3. Easy-Up, One Minute Assembly!
4. Rugged Construction Throughout — No Droop, No Sag! Light Weight — Attractive Appearance!
5. UHF Reception For All Primary Areas!
6. Low Standing Wave Ratio!
7. Built and Backed by TRIO — A Name You Can Trust!
8. Competitively Priced!



Insulators come mounted on boom and are so designed that "shorting-out" is impossible. Antenna elements mounted merely by snapping on the spring clips.



Pre-assembled high channel elements are swung into position and quickly locked by mating brackets.

Team the new Zig-Zag "Twin-Six" with the dependable TRIO rotator for the maximum in TV enjoyment!

TRIO

MANUFACTURING CO. GRIGGSVILLE, ILL.

International Short-Wave

(*Continued from page 86*)

British Guiana—ZFY, 5.981, Georgetown, noted 1630-2045, fair level. (Sawyer, Ont.; Lund, Iowa, others)

British Honduras—When this was compiled, Belize, 3.300, was being heard well in its *evening* (EST) schedule, except for CWQRM; lists schedule as 1300-1500 and 1900-2200 weekdays; *Sun.* sign-on is 1200 to include church services; news and weather at 2000, in Spanish 2010; BBC news relay from London 2100; seems to have musical programs mostly 2015-2100 and 2115V-2158; at 1930 has BBC play; for the 1900-2200 period announces 1230 kc., 3.300, and 4.950; may use 6.100 instead of 3.300 for the 1300-1500 session; identifies mostly now as "This is BHBS," and sometimes also with "The British Honduras Broadcasting Service." May remain on air longer during hurricane season to give weather forecasts. (McEwen, S.C.; Ferguson, N.C.; West, Va.; Hyson, Md., others)

British New Guinea—VLT6, 6.130, Pt. Moresby, is fair level 0410 when giving news. (Saylor, Va.)

Bulgaria—Radio Sofia, 7.671, noted with news when tuned 1640 recently; ended *English* 1643 and continued in Bulgarian; also heard 2340 in Bulgarian. (Ferguson, N.C.) Noted in Wyo, closing *English* 1945. (Brown) On *Sun. only, Radio Tirana,* is *relayed* by Sofia at 1930-2000 on 9.700; this broadcast is *not direct* from Tirana as has been reported. (Sawyer, Ont.)

Canada—CFVP, 6.030, Calgary, Alta., noted 0020. (Niblack, Ind.) VED, 7.32, and VE9AI, 9.54, both Edmonton, Alta., are usually good around 2000. (Morgan, Calif.) CHNX, Halifax, N.S., lists schedule 0600-2315 *Mon.-Sat.,* 0800-2315 *Sun.,* on 6.130. (Mitchell, N.Y.) The International Service of CBC is sending out a highly attractive *new* QSL card.

Ceylon — Colombo noted relaying VOA on 9.57 at 1100. (Patrick, England) *Radio Ceylon's* Commercial Service, 11.975, is gool level around 0950 in *English.* (Barnard, Calif.)

China—Radio Peking has been noted on 15.060A around 1930 lately with fair level in native. (Ferguson, N.C.) Heard on 7.500 at fair to good level from 0430 tune-in to 0530 when gets bad QRM; the 6.200A outlet is fair level at 0445. (Saylor, Va.) Heard weakly with *English* on 11.690A at 0840-0850. (Scheiner, N.J.) Noted 0400 with news over 10.260. (Sanderson, Australia)

Colombia—A Colombian on 5.979A, which seems to give calls of HJBO, HJBE, is noted in Spanish to around 2300 closedown; location not yet known. (Niblack, Ind.; Bellington, N.Y.) HJEX, 6.045, Cali, *Radio Pacifico,* has strong signal 1800-2200 closedown; has classical music *Sun.;* all-Spanish. (Diaz, Ind.) HJKD, 6.000, Bogota, on *Sun.* appears to have the *NBC*-transcribed program "Manhattan Merry-go-round" (*English*) at 2000-2030. (Bellington, N.Y.)

Cuba—Radio Salas, COBZ, 9.037, Havana, noted 2344-0031; all-Spanish. (Roberts, Conn.) The Cuban on 9.62A is *definitely* COJK; noted with call in Spanish at 1809. (Bellington, N.Y.) Gave location as Camaguey at 0930. (Ferguson, N.C.) *Circuito CMQ* noted 2207-2239 on 9.670 in Spanish. (Hyson, Md.)

Dominican Republic—HI8Z, 5.030, noted 2100 in Spanish. (URDXC) One of the calls of the station on 3.375 given 1959A appears to be HI4V. (Bellington, N.Y.)

Dutch New Guinea — Hollandia *moved* back to 5.045 from 4.865 and is heard in Australia at good strength 0430-0700. (Williams)

Ecuador—HCJB, 9.745 is good signal around 2130-0030. (Morrill, N.H.)

Egypt—When this was written, Cairo's *new* 100 kw. transmitter, formerly on 9.615, was *moving* around the 31-m. band and at press time had been *measured* on 9.475 with a schedule of 1320-1700, with news 1330. (Ferguson, N.C.; West., Va.; Bellington, N.Y., others) The 11.815 outlet is strong in Paris around 1600 but sometimes has CWQRM. (Buret, France)

El Salvador—QRA for Radiodifusora "La Voz Panamericana," YSAX, 11.950 and 800 kc., is 2a. Avenida Norte 25, San Salvador. (Gay, Calif.) YSC is back on 6.137 again from 6.078. (Stark, Texas)

England—BBC's European Service, 3.970, noted signing on in *English* 1330. (Pearce, England)

Fiji Islands—ZJV3, 3.980, Suva, noted 0400 with news, music; good level in Australia. (Sanderson)

Finland—OIX4, 15.190, Helsinki, still opens in *English* 1430 for North America, with news and press review. (Crowell, Pa.) Heard opening on this channel 0640 with news in Finnish; *English* news 0700. (Sanderson, Australia)

France—Paris, 15.24, noted at good level 1600 in French. (Bush, Chile) *English* for Britain noted on 6.045 at 1500-1600, news at start. (Pearce, England) Heard to Latin America 1800-1815 on 9.685, 11.700. And to Britain on 7.245 at 0145 with "The French Have a Word for It" (*English*-French lesson). (Sawyer, Ont.)

French Equatorial Africa—Radio *Brazzaville,* 11.97, 9.44, noted 1345-1400 with "The French Have a Word for It" (*English*-French lesson) for *English*-speaking listeners. (Pearce, England) Is good level on 11.97 with news 1645-1700. (Gillette, Ky.)

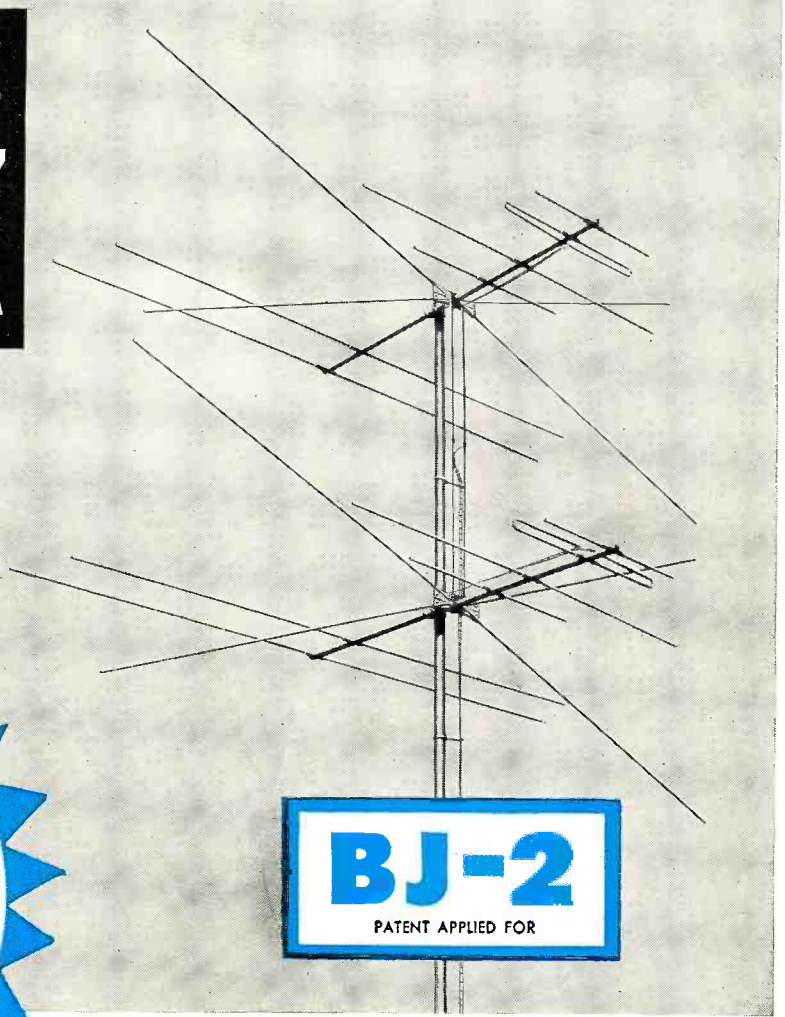
French West Africa—Radio Dakar, 9.560, noted with news in French 1700, closing with "La Marseillaise" 1717A. (Pearce, England) Heard on 4.950 parallel 11.895A at nice level from 0130 sign-on. (Saylor, Va.)

Germany—NWDR, 5.980, Hamburg, tuned 1045 when had dance music. (Pearce, England) Cologne, 7.29, noted closing 0030 in *English,* French, German; fair level in Ont. (Sawyer) Leipzig, 9.73, noted with news in Ger-

THE BEST SET IS ONLY AS GOOD AS ITS ANTENNA!

The KAY-TOWNES "BIG JACK" IS not A NEW ANTENNA

The "BIG JACK", recognized even by competitive manufacturers as the best performing VHF antenna design ever developed HAS BEEN ON THE MARKET FOR MORE THAN 1½ YEARS!



WE CHALLENGE

any other manufacturer who claims this design as *his* original idea!

HIGH GAIN ON ALL VHF CHANNELS

PREASSEMBLED

1" HEAVY ALUMINUM BOOM

CRIMPED & DOWEL REINFORCED HEAVY (7/16" O.D.) ALUMINUM TUBING

"SURE-GRIP" CAST ALUMINUM MAST CLAMP WILL NOT SPREAD, BEND OR COLLAPSE.

Kay-Townes Antennas and Accessories are sold only through selected wholesale outlets . . . Contact your jobber or write for name of nearest distributor.

KAY-TOWNES' "BIG JACK" ANTENNAS PERFORM WITH OUTSTANDING SUCCESS WHERE OTHERS FAIL!

Kay-Townes technical experience and engineering details *plus* careful manufacture, all combine to make "BIG JACK" the most advanced antenna on the market today. *As a matter of fact,* certain other manufacturers who have failed to come up with matching performance in antennas of their own design, have attempted to copy the "BIG JACK" design, *with questionable results.*

HUNDREDS OF STATEMENTS LIKE THE ONE REPRODUCED HERE, PROVE "BIG JACK'S" SUPERIORITY!

Dear Sirs:

I have one of your BJ-2 "Big Jack" Antennas, which was installed approximately 2 months ago. It has consistently proved vastly superior to any other antenna in this locality. I have nothing but praise for this well made, expertly designed antenna. We receive WSB-TV, Atlanta, channel 2, 165 miles away better than everyone else around here. WAGA-TV, Atlanta, channel 5, and WBTV, Charlotte, channel 3, also come in clear and sharp.

James R. Rule
Oak Ridge, Tennessee

KAY-TOWNES ANTENNA CO. ROME, GEORGIA

Recognized leaders in the field of fringe area antenna design

man 0100, then music. (Sanderson, Australia)

Greece—Radio Athens, 11.716, noted 1355 in Greek; identified 1415, played march number, and left the air. (Ferguson, N.C.) Heard on 9.607 with Greek songs when tuned 0255. (Pearce, England) Noted on this channel in French 1450. QSA3. (Buret, France)

Guadeloupe—Basse-Terre is now reported on 6.067A instead of 9.425A to 2000 closedown. (ISWC, London, others) Noted 1810 with bad distortion. (Bellington, N.Y.)

Guatemala—TGNB, 9.668, noted at good level 2030 in Spanish; news in that language 2100. (Morrison, R.I.) TGWA, 9.76, is good level 1900 but has QRM from LRY1, Buenos Aires, same channel. (Bush, Chile) Has *English* session now 1900-1930 on *Mon., Wed., Fri.* (Parsons, Pa.) Strong 0740-0800. (Jensen, N.J.)

Haiti—4VC, 9.485, *Radio Commerce,* Port-au-Prince, noted closing down on this channel at 1900 with National Anthem; heard opening around 0630. (Ferguson, N.C.) Has popular music around 1600. (Diaz, Ind.) In a letter to Parsons, Pa., listed schedule of 0630-0830 on 9.485 (although is reported heard much longer in this session) and 1600-2300 on 6.140; the transmitter is a 7.5 kw. rig with two 889-RA's in the final stage; antenna is of matched impedance delta type, 80 ft. high on 31 m. and 60 ft. high on 49 m.; with the exception of two *Ampex* tape recorders, all equipment has been supplied by *RCA;* QRA is Box 1143.

Radio Haiti, measured 10.074, noted in French 1700; on Thursdays has *English* musical request session 2130-2220. (Roberts, Conn.) The channel used by 4VEH on *Sun.* evenings (*EST*) was recently *measured* 9.717 at 2125. (Ballou, Calif.) This station plans a Spanish-*English* session soon on *Mon.* evening (*EST*), which will include a second broadcast of the DX program, "The Listener's Post," heard 0610 *Sat.* over 9.69. (West, Va.)

Hungary—Radio Budapest noted signing on for North America 1715 on 9.833, parallel 11.91, 7.22; stars with news; lists *English* for 1715, 1930, 2300 daily in this transmission. (Pearce, England) Heard opening 1430 on 9.833, 11.91 with relay of Moscow; has own French session 1500, *English* for Great Britain 1600. (Sawyer, Ont.)

India—AIR is noted on 6.145 at 0745-0830. (Stark, Texas) Bombay's 4.84 outlet is good level in Britain around 1200. (Patrick)

Indo-China (Vietnam)—Radio France-Asie, 11.935, Saigon, noted 1045 with light music; at 1100 woman said "Goodby to our English-speaking listeners," then had news in French; closed 1120 with "La Marseillaise" after giving program details for next day in French. (Pearce, England) Noted on 15.420 at 0430 answering listeners' letters in *English* (*Fri.*), then with music. (Sanderson, Australia) *English* is listed 1830-1900, 7.23; 2030-2045, 11.935; 0900-1100, 11.935; news at 1830, 2030, 0900. (Gade-Joergenson, Denmark) Seems to be using 6.116A now instead of 9.75A around 0600. (Balbi, Calif.) Sanderson, Australia, lists latter as a military transmitter. heard with French news and music, scheduled 0515-0615.

"Voice of Vietnam," 9.625, 7.29, heard with news 0930, best on 9.625. (Balbi, Calif.; Foster, Ore.) *Radio Hirondelle,* 7.405, Hanoi, lists schedule of 2300-0100, 0530-1000. (Williams, Australia)

Israel—Tel Aviv, 9.010A, parallel 6.830, now has news 1515-1530; the "Voice of Zion" session in *English* is now 1615-1700 closedown over 9.010A *only; English* news is *announced* for 0615 over both 9.010A and 6.830. (Pearce, England; Crowell, Pa., others)

Jamaica—Radio Jamaica noted back on 3.360 going *past* 2200. (Stark, Texas)

Kenya Colony—Nairobi, 4.855, noted closing 1500 with "God Save the Queen" after call; relays BBC news from London 1300. (Pearce, England)

Kuwait—Al Kuwait, 5.000, is often audible in Britain around 1330 through QRM from MSF, Rugby, same channel. (Patrick) Is scheduled 0000-0200, 1130-1400. (Radio Sweden)

Lebanon—Beirut, 8.036, is heard in Japan around 1400-1500 when begins to fade out. (Japanese Short Wave Club)

Libya—Forces Broadcasting Station, 4.965, Tripoli, noted 1446 with piano music, call 1500. (Pearce, England)

Luxembourg — Radio Luxembourg has *dropped* its 15.350 outlet and is now heard with strong level on 6.090; schedule is the same as Luxembourg I, 236 kc.; reports may be sent direct to the station or to 38, Hertford St., London, W1, England. (Patrick, England)

Mauritius—Malmo DX-aren, Sweden, reports V3USE, 15.070, Forest Side, is heard 1100.

Mexico—XEWW, 9.500, Mexico City, is good level with music around 1000. (Zerosh, Pa., others) The XEWA call given by this outlet refers to a 100 w. m.w. station in Mexico City. (Stark, Texas) XETW, 6.045, 0.1 kw., operates 0530-0830 *English,* 0830-1900 Spanish, 1930-0100 *English; English* sessions are for southern part of USA; location is Tampico. (*WRH*) XEBR, 11.82, Hermosillo, good signal around 1415. (Morgan, Calif.) XEHH, 11.88, is nice level around 1230. (Diaz, Ind.)

New Caledonia—Radio Noumea, 3.350, noted 0400 with music and news in French. (Sanderson, Australia)

New Zealand—Radio New Zealand, Wellington, is usually good on both 11.78 and 11.81 around 2245; has sports broadcast on *Fri.* around that time. (Ferguson, N.C.) Good over 11.78 at 0105 tune-in. (Bishop, Riggle, Ohio)

Nigeria—Lagos, 4.805A, noted 1300 with BBC news relay, then local news. (Pearce, England)

Pakistan—APK, 15.335, Karachi, noted with closing announcements at 2059, carrier off 2100. (Ferguson, N.C.) And on 11.885 at that time.

. . . put hi PROOF right into your customer's hand!

PROVE to your customer he can put his confidence in you. Lay all the facts before him. Hand him this *Certified* Quality Service Tag. The Tag he has been reading about in LIFE-POST ads sponsored for you by CBS-Hytron. The same ads (and there'll be more) that are prompting him to ask where he can find *you*, his *Certified* Quality Service dealer.

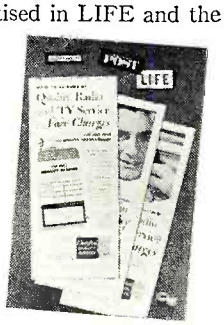
With this simple, easy-to-use Tag, *do what your customer wants. Certify* that your itemized charges are fair. *Certify* that your service . . . your ability . . . and your equipment guarantee him dependable, top-quality TV and radio repairs. Give your customer *tangible proof* that you are giving him his money's worth. Win *his* confidence. And *you* will gain more business . . . more profits. Put *your* convincing *Certified* Quality Service Tags to work right away.

GO A STEP FURTHER

Tie in with the whole *Certified* Quality Service Plan as advertised in LIFE and the POST.

Use your decal.

Use your window streamer.



Use your LIFE-POST display.

They are all part of the *Certified* Quality Service Kit. This Kit, including 250 CQS Tags imprinted with *your* name and address, is available on a special offer from your CBS-Hytron distributor. Or you can write for details on how to order direct. You can order more CQS Tags from your distributor, whenever you need them.

GO STILL FURTHER

Keep in close touch with your CBS-Hytron distributor. Watch soon for additional supporting material to identify you as a *Certified* Quality Service dealer:

1. **CQS illuminated window sign**
2. **CQS metal flange sign**
3. **CQS direct-mail postal cards**
4. **CQS newspaper mats, etc.**

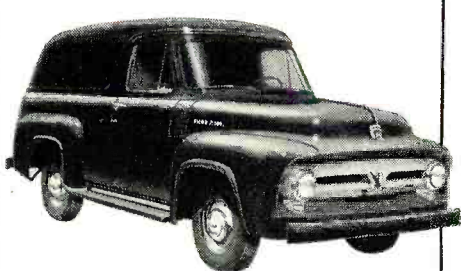
CBS-HYTRON, Main Office: Danvers, Mass.

A Division of Columbia Broadcasting System, Inc.

Manufacturers of Receiving Tubes Since 1921

A member of the CBS family . . . CBS Radio • CBS Television
Columbia Records, Inc. • CBS Laboratories • CBS-Columbia, Inc. • and CBS-Hytron

BE SURE TO ENTER THE CQS CONTEST



If you are using the CBS-Hytron *Certified* Quality Service Kit, you are eligible to enter. You simply tell in 25 words or less why you like the CQS Plan. As an eligible entrant, you get a famous CBS-Hytron Soldering Aid free. And you have a chance to win one of these 10 BIG prizes:

FIRST PRIZE: FORD PANEL TRUCK

Second Prize:	**$1000 in Savings Bonds**
Third Prize:	**600 in Savings Bonds**
Fourth Prize:	**500 in Savings Bonds**
Fifth Prize:	**400 in Savings Bonds**
Sixth Prize:	**300 in Savings Bonds**
Seventh Prize:	**200 in Savings Bonds**
Eighth Prize:	**100 in Savings Bonds**
Ninth Prize:	**50 in Savings Bonds**
Tenth Prize:	**25 in Savings Bonds**

Remember, your CBS-Hytron distributor's salesman can help you win a prize. Be sure to write his name, too, on your Contest entry. Entry blanks are available in your CQS Kit . . . or from your CBS-Hytron distributor. Beat the closing date, Dec. 15, 1953.

(Sawyer, Ont.) *Radio Pakistan* noted on 9.484 with news 1015-1030; heard 1230 with native music on 7.010, 6.235; and calling the United Kingdom on 11.65, 9.645 at 1530-1615. (Pearce, England; Buret, France)

Panama—The Panama station recently noted on 9.682 is HP5A, listed 11.70 and 11.697; relays HOC, 1440 kc. (Bellington, N.Y.) Identifies 1710A.

Paraguay—ZPAI, 6.275, is heard around 2000 with identification in Spanish. (*DX-Radio*, Sweden)

Peru—OAX4R, 15.146, Lima, noted 1530 in Spanish; still going strong 1600. (Ferguson, N.C.) At times announces in French, *English*, and Spanish; heard with *English* news 1345. (Niblack, Ind.) OAX4T, 9.562, Radio Nacional del Peru, Lima, announces 9.56 and gives schedule as 0700-2400. (Kahan, Calif.) OAX5Z is now listed 5.892. (Roberts, Conn.)

Philippines—DYH4, 6.055, Dumaguete City, sent schedule of 0500-0830. (Pearce, England) This one noted 0500 with world and local news; DZH3, 9.500, noted 0430 with church services, news, and music; DZH4, 6.000, heard 0500 with news and music; DYH2, 6.140, heard 0700 with *English* talk and music; DUH2, 6.170, noted 0545 with *English* talk, music. (Sanderson, Australia)

Portugal—Lisbon's Emissora Nacional noted signing on 1230 on 11.99, 11.83, off 1530; heard signing on 1600 on 11.962, 11.920; tuned in 1030 *near* 15.035; heard on 6.36 at 1715 with guitar music, with call 1735. (Pearce, England) Noted to North America 1900-2100 over 9.746, 6.374, 5.976. (Arnold, Bermuda)

Bjorksten, Sweden, says Lisbon transmits daily on 6.360, 7.260, 9.670, 9.740, 11.836, 11.970, 15.040, 15.125, 25.690 now, and that reports are verified with a fine *new* QSL card. *Etersvep*, Sweden, reports Parede, 12.865, heard in Sweden with music around 2105.

Reunion—Radio St. Denis is now scheduled weekdays 2130-0045, 0300-0430, 0900-1300; *Sat.* 2300-2400, 0130-0530, 0900-1300; frequencies are 3.380, 1 kw., during *local* night; 4.820, 1.5 kw., during local *day time*, and 7.170, 0.2 kw. (*WRH*)

Roumania—Radio Bucharest noted in German 1700 on 9.254, 6.210. (Pearce, England) Heard on 9.57 at poor level with *English* 2220-2230, and after piano interval went into foreign language session. (Scheiner, N.J.) And with *English* 1430. (Bellington, N.Y.)

Saudi-Arabia—Djeddah, 11.950, noted in Arabic from around 2230. (Sanderson, Australia)

South Africa—Cape Town's 5.892 is still heard occasionally around 0030. (Gay, Calif.)

South Korea—Direct from Hahn Wi Syun, chief of engineering section, Radio Bureau, Office of Public Information, Seoul (*not* Pusan now), Scheiner, N.J., learns that the s.w. outlets now are HLKA, Seoul, 2.510, 10 kw., and 3.8925, 1 kw., and HLKB, 7.935, 1 kw., Pusan; the 2.510 outlet is the *new* 10 kw. transmitter; all programs are in Korean except for "Voice of Free Korea" (presumably in *English*) at 0415 *Mon., Wed., Thur., Fri.* The end of each broadcast is concluded with "HLKA, Seoul, Korea"; future plans are to build high-powered short and medium-wave stations. Pusan lately seems on 7.91 instead of 7.935, heard at fair level *after* 0400. (Balbi, Calif.)

Spain—Radio Nacional de Espana, Madrid, now operates on 15.460 at 1100-1155, and on 9.363 at 1200-2245. (Radio Sweden) Is good level in *English* to North America 2205A-2245A on 9.363. (Steiner, Mo., others)

Surinam—PZH5, 5.752, Paramaribo, noted in Dutch with Latin American music 2045. (NNRC)

Switzerland—The programs broadcast by the United Nations Information Center, Geneva, are *Mon.-Fri.* over HED5, 9.545 now, at 1315-1330 United Nations feature (*Mon., Wed., Fri.* in *English, Tue., Thur.* in French); 1330 news in *English* followed at 1345 with news in French. (*WRH*) Berne noted on 17.784 around 0945 with interference from BBC, London. (Bishop, Ohio) Heard on 6.165, 9.535, 9.665, 11.865 with *English* for North America from 2030. (Manning, Mich.)

Syria—Bush, Chile, reports Damascus heard on 11.915 at 2000-2005 at good level, but soon mixes with HCJB, same channel. Powers, Ohio, others, have received this *new* schedule for *English* broadcasts from Damascus—7.145 at 0500-0630 to Mediterranean; 11.695 at 0945-1045 to India-Pakistan, and 11.915 at 1630-1745 to Europe.

Taiwan—Taipeh, 7,135A, noted 0445-0600 at fair to good level in native. (Saylor, Va.) Is good on 15.235 to North America from 2300, weak on 11.735 in parallel; quality has improved lately; HED24, 9.820A, noted 0530 with fairly clear signal, Western music; BED26, 10.080A, heard 1630 at good level with American music, then news in Chinese; BED32, 9.778A, heard 0400 with Western music, then news in Chinese. (Sanderson, Australia)

Thailand—HSK9, 11.680A, Bangkok, noted opening 0500 with news; heard on 6.24 recently 0830 with *English* lesson. (Balbi, Calif.) The 11.680A channel has been heard closing at varying times lately around 0715-0730. (Ferguson, N. C.; Bishop, Ohio, others)

Trieste — British Forces Station, 15.125, noted 1345 with request recordings; BBC news relay 1500. (Pearce, England)

Trinidad—Radio Trinidad, 6.085, is good around 0500-0700 with commercial programs. (Saylor, Va.) TAT, 9.515, is good level in Chile at 1800. (Bush) This one signs on in Spanish for Latin America 1730, starts with news in Spanish. (Pearce, England) Is fine level to North America daily 1815-1900. (Slater, Pa., others) TAP, 9.465, noted 1600 with news. (Mast, N. Y.)

Uruguay — CXA19, 11.835, Montevideo, good level around 1830 with

the C·D·R Rotor

sells faster...sells easier

because.....

The best line of TV Rotors money can buy

It is the complete line of quality rotors, with a model and type to best serve 'most every type application.

TV Spot Campaign

To reach the buying public, an intensive campaign on Television in key markets pre-selling CDR ROTORS for you.

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Also directed at the consumer, a supporting campaign in key city newspapers exploiting the advantages of the CDR ROTOR.

Moving Displays

It's causing excitement everywhere, this display that is an eye and traffic stopper, a silent salesman for the CDR ROTOR.

Envelope Stuffers

Here's another selling tool that may be mailed directly to your customers, selling them the CDR ROTOR in their home.

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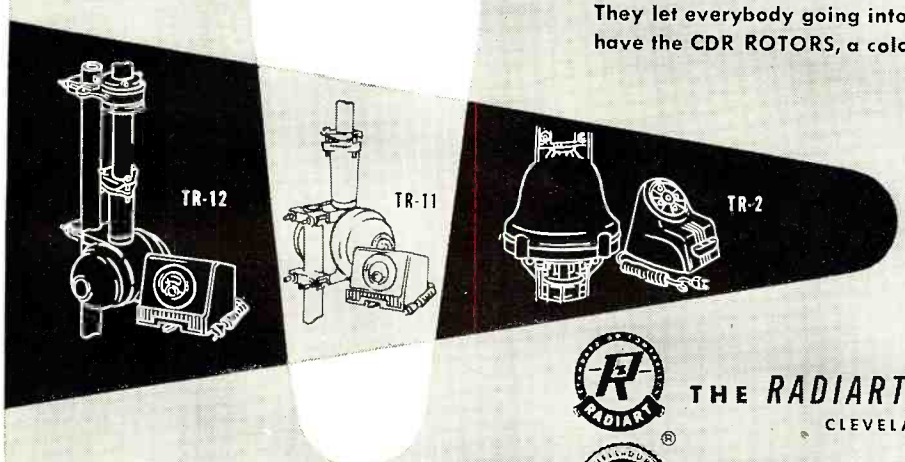
A full set of completely prepared advertisements for dealers and distributors to capture extra CDR ROTOR business.

Window Streamers

They let everybody going into and by your store know that you have the CDR ROTORS, a colorful and eye-catching streamer.



THE *RADIART* CORPORATION
CLEVELAND 13, OHIO

CORNELL-DUBILIER ELEC. CORP.
SOUTH PLAINFIELD, NEW JERSEY

music and Spanish commentary. (Diaz, Ind.) Station officials list this one as on the air daily 0600-2200. (Gay, Calif.) CXA10, 11.897, *measured,* noted with music 1823-1900. (Roberts, Conn.)

USI (Indonesia)—Djakarta verified after many months with a very "eye-catching" card. (Gay, Calif.) An Indonesian station is noted around 0600 on 4.985, probably is Coeta Radja, Sumatra. (Williams, Australia) Also heard in Sweden. (Radio Sweden) Djakarta, 9.710, noted in *English* 1000. (Foster, Ore.) YDQ2, 9.55A, Makassar, Celebes, heard signing on 0400, weak to fair. (Balbi, Calif.)

USSR—A station believed Moscow has been noted with a clock striking midnight at 1600 on *measured* 9.595. (Ferguson, N. C.) Same noted also on 11.79; evidently is beamed to Europe in German at 1530. (Balbi, Calif.) Has *English* on this channel 1700-1800.

Vatican—HVJ, 7.28, noted 1445 in German; 1500 in Portuguese. (Pearce, England) Heard at weak level some days on 11.74 in *English* 1315-1330; French 1345. (Crowell, Pa.)

Yugoslavia—Radio Yugoslavia, 6.100, Belgrade, heard 2245 to around 0030 fadeout, fair level. (Sawyer, Ont.) The *English* session 1645-1700 is over 6.100 and 7.200. (Hakansson, Sweden)

* * *

Press Time Flashes

An unidentified station on 15.095A noted around 1330 to 1400 fade-out seems to be a Near Eastern outlet from the type of program heard; has interval signal of 13 harsh-sounding notes on a stringed instrument; appears to have news in Arabic 1330. (Niblack, Ind., others)

Radio Liberation, Munich, Germany, noted on 6.175 parallel 7.130 at 0845 in Russian dialects; 0900 in Russian, then talks by man and woman with frequent calls; similar program heard 0155 and 0300. (Pearce, England) This one has been heard on 11.77A at 1545-1600. (Niblack, Ind.)

In response to requests from listeners in Australia-New Zealand, *Accion Cultural Popular,* HJKH, 5.070, Sutatenza, Colombia, now has an *English* session for New Zealand-Australia at 1030-1100 on *Sat. only;* other days comes on the air 0600. Opens with chimes, has devotional service, and then broadcasts for schools (pupils and teachers). (Sanderson, Australia)

Radio Pakistan now has its General Overseas Service (*English* news at dictation speed) 1310-1330 over 7.010, 9.614. (Radio Sweden) (Last-named channel may be 9.645 instead of 9.614. —K.R.B.)

Salisbury, Southern Rhodesia, noted *near* 3.400 at 1257 with weather forecast; 1300 BBC news relay; 1315 local and South African news. (Pearce, England)

* * *

Acknowledgment

Many thanks for the fine reports received! Keep them coming to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. . . . . K.R.B.

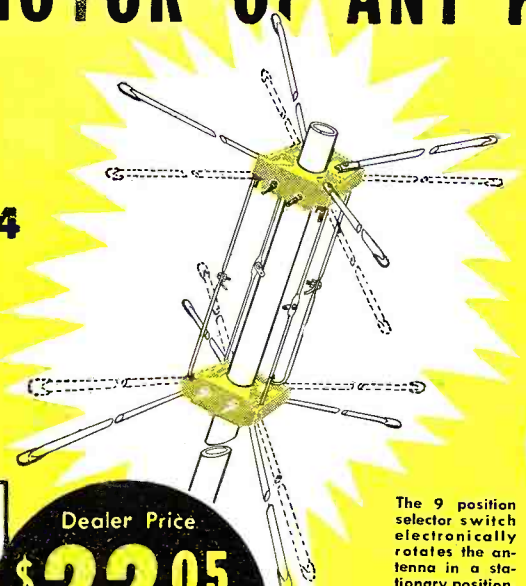
Concord Radio presents the world's most powerful UHF-VHF-FM antenna!

MONEY BACK GUARANTEED

TO RECEIVE *All* UHF and *All* VHF STATIONS IN *All* D RECTIONS FOR 60 MILES

WITHOUT A ROTORMOTOR OF ANY KIND!!

While antenna reception is guaranteed for 60 miles, perfect pictures have been consistently received as far as 160 miles from stations.



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All NEW DESIGN FOR '54

- LOW-LOSS SWITCH
- LOW-LOSS PHENOLIC INSULATORS
- USES NEW 4-CONDUCTOR MATCHED IMPEDANCE LINE
- ONLY 10 INCH SPACING BETWEEN ANTENNA BAYS

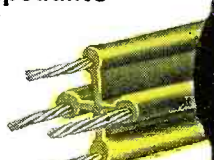
The 9 position selector switch electronically rotates the antenna in a stationary position.

NEW! POLYMICALENE 4 CONDUCTOR
Matched Impedance
TRANSMISSION LINE

Improves Both UHF and VHF Performance of any ALL-CHANNEL Antenna!

100 Ft.	$8.90
150 Ft.	$13.90
200 Ft.	$17.50

Minimum quantity 100 ft.



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PRICE INCLUDES
Complete stacked array • 4 stacking bars • 9 position switch • Switch-to-set coupler • 3 - 7½" stand offs • Individually boxed in mailable carton

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Please send me.....feet of 4 conductor tubular at
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FOOLPROOF 2-BAND TRANSMITTER

By **WILLIAM BRUCE CAMERON, W8IVJ**

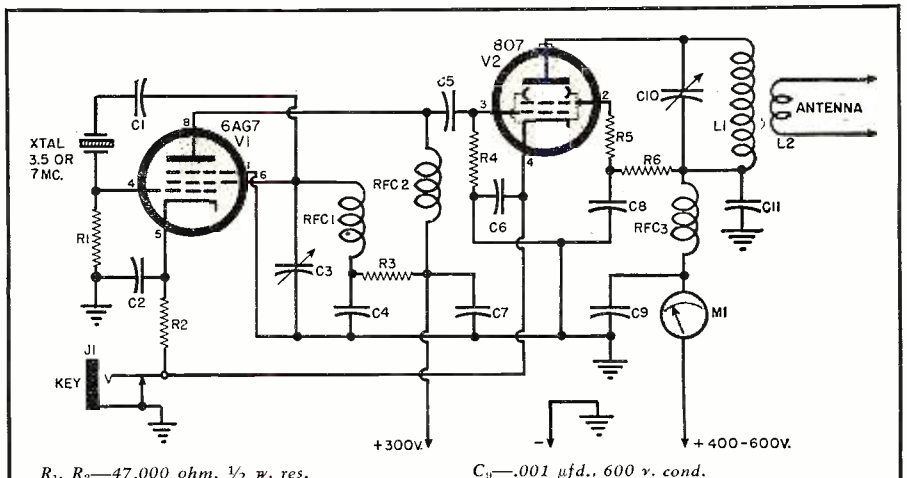
Circuit data on a simple 80-40 meter Novice or standby two-tube, crystal-controlled transmitter.

THE schematic diagram accompanying this article shows a two-tube, crystal-controlled transmitter, capable of sixty watts input on two adjacent bands, with only one tuned circuit and no coils to change, making it an ideal 80-40 meter Novice or standby rig. Since there is no tuned circuit between the plate of the modified Pierce oscillator and the grid of the final amplifier, there is no tendency toward self-excited oscillation in the final, which is a neat trick with an 807 or 1625. The same circuit has been employed also with an 829B with similar success and greater output. Keying both cathodes avoids the necessity of fixed bias on the final. Excellent isolation in the 6AG7 permits plate and screen modulation of the final for phone operation without requiring a buffer stage, if power supplies are stable and well isolated. No specific layout is shown, because placement of parts does not appear to be in the least critical, several different physical layouts having given equally good results. It may be advisable in some cases to shield the 807, although this has not been found necessary.

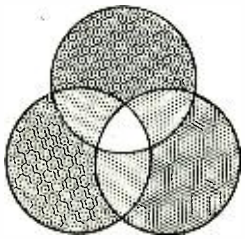
The coil indicated tunes 80 and 40 meters, with ample capacity in the condenser on both bands. Other bands could be covered with different coils, but it must be remembered that the rig is designed to operate "straight through" on the crystal frequency. This concession is made in order to avoid the instability which sometimes results when tuning the plate circuit of the 6AG7. The feedback condenser from the screen of the oscillator to ground need not be variable and could be replaced by a fixed capacity of 25 to 50 $\mu\mu$fd., but the variable feature helps utilize balky crystals which otherwise might not key well.

Coupling arrangements to antennas will vary with the type of antenna and feed-line employed. A folded dipole made of 300-ohm ribbon fed with the same kind of ribbon could be coupled with a few turns of wire around a form which could be slipped in and out of the tank coil. In one such rig, the tank coil was wound on phenolic tubing, mounted horizontally, and the coupling coil wound on a short piece of dry one-inch dowel rod, providing easy variation of coupling. —30—

Schematic diagram of the two-tube transmitter which will cover 80-40 meter bands.



R_1, R_3—47,000 ohm, ½ w. res.
R_2—330 ohm, ½ w. res.
R_4—22,000 ohm, ½ w. res.
R_5—50 ohm, ½ w. res.
R_6—20,000 ohm, ½ w. res.
C_1—.002 μfd., 400 v. cond.
C_2, C_6—.01 μfd., 200 v. cond.
C_3—100 $\mu\mu$fd. var. cond. (see text)
C_4, C_7—.006 μfd., 400 v. cond.
C_5—100 $\mu\mu$fd. mica cond.
C_8—.006 μfd., 600 v. cond.
C_9—.001 μfd., 600 v. cond.
C_{10}—350 $\mu\mu$fd. var. cond.
RFC_1, RFC_2, RFC_3—1 mhy. r. f. choke
J_1—Closed circuit type key jack
Xtal.—3.5 or 7 mc. crystal
L_1—14 t. ±14 en. wire, 1¾" dia., winding length 1½" (tunes 80-40 meters)
L_2—See text
M_1—0-200 ma. d.c. meter
V_1—6AG7 tube
V_2—807, 1625 or 829B tube



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The National Television Systems Committee has authorized IRE to publish its long awaited Monographs in the January 1954 special Color Television issue of "Proceedings of the I·R·E" — thus giving them industry-wide distribution for the first time in print.

▲ 25 additional Color TV articles –

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▲ in "Proceedings of the I·R·E" January '54

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Please place orders before December 10th.

R.F. Amplifier

(*Continued from page 69*)

if desired. This should be adjusted to around 15 ma. when the 829B is fully loaded.

It will be noticed that a shield is fabricated on one of the side covers. This arrangement provides shielding between the tube and tuning condensers and also shields the input condenser from the output condenser. It is not needed in this particular installation but that was not known until after everything was finished and tested. Its use is recommended, however, as there may be some stray coupling present, although not to the extent of causing oscillations. Plenty of ventilating holes are needed in the sides of the box. The 829B runs hot at any frequency and 220 mc. doesn't do a thing for it in the way of cooling. As mentioned earlier, if a small fan or blower is used, the input can be packed up to at least 120 watts, perhaps a little more, if one is quite careful.

Without a doubt, it would be desirable to provide shield covers for the grid and plate lines to reduce loss from radiation and to improve the output efficiency, but so far we have not bothered to do it. Small shields of soft aluminum sheet could be bent up for this purpose. TVI was absent on the channels used locally (4, 5, and 8). What the u.h.f. TV channels have in store is not known. Trouble, no doubt.

Now about that AX9903 tube again. Can't seem to get off the subject. The *"Handbook"* states that its maximum frequency is 150 mc. but this is bound to be misleading. Evidently new revised ratings will show the tube good to 450 mc. since many of the boys report good results at this frequency, and did you ever hear of an 829B tube perking away down there?

It is not known just how much the AX9903 would do for this amplifier, but we sure would like to find out. So until this little gem of a tube comes to your house and mine, the old 829B will give you a pretty nice signal on 220 mc. —30—

"OK! A technician's coming—stop acting up now—I dare you!"

COMPARE TH SE PLATT SPECIALS!

Dollar for dollar you just can't find better buys than at PLATT. All used equipment has been expertly reconditioned in Platt's large, modern plant. All new equipment is priced low for mass turnover.

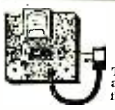
Shop at either of Platt's two bargain stores. Branch store is conveniently located at 159 Greenwich St., N. Y. C. (Just off Cortlandt St.)

REMOTE CONTROL UNIT MN-28 Y

This remote control unit contains all controls for operation of Radio Compass Equipment MN-26 Y. Frequency coverage: 150 to 695 KC. 3.4 to 7 mc in 3 bands.

BRAND NEW! **$9.75**

BC-648-A CONTROL BOX



This control box contains many valuable parts including a zero to five DC milliampere meter... **$3.95**

SPECIAL!

45 Henry 60 ma 625 ohm. **LIMITED QUANTITY OF THESE CHOKES..... $1.95**

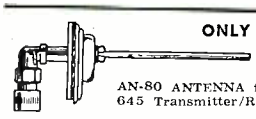
MN-26C INSTALLATION

A 12 tube remote control manual direction finder desirable for commercial type navigation on boats and planes. Has a frequency range of 150 kc to 1500 kc in 3 bands. This frequency covers the beacon and standard broadcast bands. Operates on 28 V DC input. Complete installation consists of:

MN26C Receiver—Brand New	$39.95
MN20E Rotable Loop	9.95
MN28 Remote Control Box	19.95
2 Flex Shaftings	7.00
1 Antenna Cable	3.95
2 Plugs	5.00
1 MN52 Azimuth Control Box	3.95
COMPLETE INSTALLATION	**$89.75**

BC-357 RADIO BEACON RECEIVER

UHF Aircraft Receiver with frequency range from 62 to 80 mc for receiving 75 mc marker beacon signals. Power requirements are 24 volts DC at .158 amps and 220 volts at 4.5 milliamperes. Used **$9.95**



ONLY 49c

AN-80 ANTENNA for the 470 mc BC-645 Transmitter/Receiver.

MULTI-TESTER FOUNDATION BIAS METER I-97A

Complete, Brand New. Special!..... $5.95

LIMITED QUANTITY

SPECIAL! TU-10 TRANSMITTER TUNING UNIT for BC-375 or BC-191—Freq. Range 10,000 to 125,000 Kc. 75% complete, excellent for spare parts.. **$2.95**

TUNING UNITS (TU-18 3000-4500 Kc; TU-25 3500-5250 Kc). Brand New in Original Carton..... **$6.95**
Metal Case to Hold Above Tuning Units..... **$1.00**

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..... **$139.50**
MODULATED TYPE **$169.50**
MODULATED TYPE with AC Power Supply **189.50**
These Frequency Meters are factory treated, checked for frequency alignment and GUARANTEED.

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20 LBS. of ASSORTED RADIO PARTS
A terrific buy at only **$1.99**

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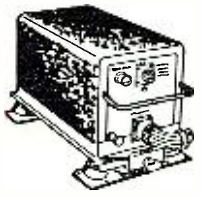


R-47/ARN-5 Glide-Path Receiver

R-47 is a single-channel Glide-Path Receiver tunable from 330 to 340 mc. Excellent condition, less tubes. Operates on 24 VDC..... **$9.95**

RADIO CONTROL BOX BC-732-A

used with R-47/ARN-5 also R-57 and R-89/ARN-5..... **$1.95**

DYNAMOTORS

DA-1A—input 28 VDC @ 1.6 amps. Output 230 VDC @ 100 mills. BRAND NEW.... **$8.95**
BD-AR-93—input 28 VDC @ 3.25 amps. Output 375 VDC @ 150 mills, good used.... **$7.50**
DM-33—input 28 VDC @ 5.0 amps. Output 575 VDC @ 160 mills. BRAND NEW..... **$4.95**
DM-53—input 24 VDC @ 1.4 amps. Output 220 VDC @ 80 mills. BRAND NEW..... **$5.50**
MP-28-B—A dynamotor power supply unit, input 25 to 28 V 14.8 amps DC, output 540 V 450 MA DC. With a transmitter modulation section using 1 6N7, 1 6P6 and a pair of 807 tubes in push-pull. Also includes modulation transformer. Used for Bendix TA-12, excellent used..... **$14.50**
PE-94-C—input 28 VDC @ 13 amps. Output 13 VDC @ 3.9 amps. 150 VDC @ 10 mills. 300 VDC @ 260 mills. BRAND NEW..... **$7.50**
PE-98—input 12 VDC @ 26 amps. Output 13 VDC @ 3.9 amps. 150 VDC @ 10 mills. 300 VDC @ 260 mills, good used..... **$22.00**

TELEGRAPH KEYS

J37	$1.50
J38	1.50
J41	.98
J45	3.95

TUBES

BRAND NEW! JAN! BOXED!

1B22	.69c	114B	.29c	841	.29c
1B23	$3.75	215A	.09c	843	.17c
2B22	.49c	221A	.29c	864	.19c
2C26	.09c	316A	.29c	1626	.19c
2C26A	.09c	388A	.59c	7193	.19c
3B22	$1.19	471A	$1.19	9002	.69c
3D6	.39c	532A	$1.19	E1148	.49c
7C4	.39c	722A	.99c	RK34	.99c
12K8Y	.39c	801A	.19c	VR92	.14c
15R	.39c	826	.39c	VT127	.15c
39/44	.29c				

ELECTRIC MEGAPHONE SYSTEM

For Rural Areas, Hotels, Commercial Steamers, Ball Parks, Etc.

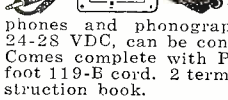
U. S. NAVY type PAE-1 Electric Megaphone equipment is designed for voice reinforcement in much the same manner as, but to a greater degree than, the familiar acoustic megaphone. Consists of Megaphone Unit (which combines a microphone and reproducer in a single assembly). Portable Amplifier which electrically amplifies the output signal of the microphone section of the megaphone and feeds this amplified signal to the reproducer section. Charging Rack for recharging the self-contained storage battery of the portable amplifier. BRAND NEW—A TREMENDOUS VALUE! DEMONSTRATION GIVEN AT EITHER OF PLATT'S STORES..... **$149.50**

T9/APQ-2 RADAR TRANSMITTER

80/115 V 400-260-26 VDC. Designed primarily for aircraft operation.

NEW! $19.95

AS-65/APQ-2 ANTENNA ASSY. FOR APQ-2. COMPLETE—BRAND NEW..... $6.95



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 AC. Comes complete with PL 55 plug and 2-foot 119-B cord. 2 terminal blocks and instruction book.

BRAND NEW.....SPECIAL! **$3.95**

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.)

LP-21-A LOOP

Used with BC-433 & R5-ARN-7 Army Compass Receivers. Excellent, used..... **$19.95**

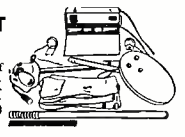
HEADSETS

HS-23 high impedance. BRAND NEW with ear pads..... $4.65
HS-33 low impedance. BRAND NEW with ear pads, cord and PL54 plug..... 5.65
CD-307A Cords, 6 ft. NEW..... $1.49
H-16/U high impedance. Includes two receiving units..... 3.95
HS-16 high impedance—used..... .98

SPECIALS-OF-THE-MONTH!

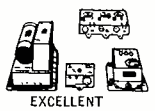
HS-33 HEADSET, used..... $1.89
JK-26 JACK..... .19
ENGLISH TYPE PL-55..... .15
FL-5 RADIO FILTER..... .99

MINE DETECTOR SET SCR-625



A portable device capable of detecting all types of metals. Hundreds of uses: Agricultural, mining, etc.
NOW ONLY..... **$79.95**

SCR-274N COMMAND and ARC-5 EQUIPMENT



RECEIVERS	USED	USED	NEW
BC-453—190 to 550 KC	$29.95		$49.95
BC-454—3 to 6 MC			24.95
BC-455—6 to 9 MC	5.95 (as is)	$13.95	19.95
1.5 to 3			34.95
TRANSMITTERS			
A-958—2.1 to 3 MC			29.95
BC-457—4 to 5.3 MC		14.95	
BC-458—5.3 to 7 MC	9.95	14.95	29.95
BC-459—7 to 9.1 MC			24.95
T-15 ARC 5—500 to 800 KC			29.95
ADDITIONAL EQUIPMENT			
BC-456 Modulator			7.29
BC-450 Control Box (3 Receiver)	1.49	1.95	
BC-451 Control Box (Transmitter)	1.29	1.79	
BC-442 Relay Unit (ANT)			5.69
Plugs: PL-147, 148, 151, 152, 153, 154, 156—EACH		1.25	
Flexible Shafting with gear to fit receivers			2.69
3 Receiver Rack	1.79	2.29	2.98
2 Transmitter Rack	1.69	2.39	3.97
Single Transmitter Rack			3.97
DM-33 Dynamotor for Command Set		2.95	3.95
Mounts for Above Racks		1.95	

Field Telephones

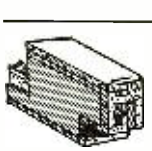
Army surplus, completely reconditioned and electrically tested, using 2 flashlight cells and a pair of interconnecting wires. GUARANTEED. New $28.95
Like new **$21.95**

SPECIAL! NOW! Fill Your Battery Only Twice a Year with Automatic Battery Filler

Made by leading Detroit Auto Mfr. Doubles battery life over ordinary care, prevents battery break-downs, fits all cars, instantly installed.
ONLY 69c COMPLETE

BEACON RECEIVER BC-1206

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 **$12.95**



SENSATIONAL SALE! ARC-5/R-28 2 MTR RCVR

$19.95

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 I.F. 16.9 Mc.
12SL7—Det. AVC Squelch, 12SL7—1st audio-squelch amplifier.
12A6—2nd audio, 12SH7—R.F. Osc.—4th Harmonic Gen.
717A—Trip. 12th Harmonic Gen. 717A—Dblr.—12th Harmonic.

PLATT ELECTRONICS CORP.
DEPT. A, 489 BROOME ST., NEW YORK 13, N. Y.
PHONES: WO 4-0827 and WO 4-0828

What's New in Radio

(*Continued from page* 104)

tor range switch actuates a mask which exposes the operating frequency dial range.

BEAM POWER AMPLIFIER

The Tube Department of *Radio Corporation of America,* Harrison, N. J. has released a new beam power amplifier of the 7-pin miniature type which has been designed primarily for use as the output amplifier of auto radio receivers operating from 12-volt storage batteries. It may also be used in the output stage of a.c. operated radio receivers.

According to the company, within its maximum ratings the 12AQ5 is the performance equivalent of the larger glass-type 12V6GT. A tentative data sheet on this tube is available from the company on request.

TUBE TESTER

Smithguild, Inc., 360 W. Eighth St., Erie, Pa. is offering a new tube tester for checking the continuity of filaments in tubes used in all types of electronic devices.

The compact unit, 4" x 6", is completely self-contained and weighs only 7 ounces. It requires no external bat-

teries or other accessory equipment. The sockets provided on the face of the unit are designed to accommodate any electronic tube now manufactured for use in household appliances.

The meter indicates whether the tube is good or defective.

"HERMETIC-OUNCERS"

The Electronic Division of *Thermador Electrical Mfg. Co.,* 2000 Camfield Rd., Los Angeles 22, California now has available a small, light, hermetically-sealed transformer, the "HO-Hermetic Ouncer."

The new transformers are $1\frac{5}{16}$" in diameter and $1\frac{3}{8}$" high. They weigh from 1 to $1\frac{3}{4}$ ounces. They feature 40 db magnetic shielding, 200 degree F operating temperature, true hermetic sealing, and schematic decals with a gray satin finished case.

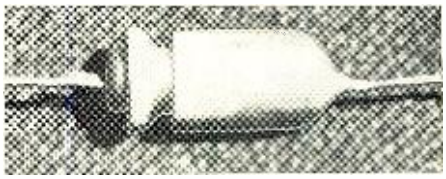
Complete information is available from the company.

TANTALUM CONDENSERS

General Electric Company's Capacitor Department, Hudson Falls, N. Y. has developed a tiny tantalum condenser which is believed to be the smallest high capacity unit ever designed for low voltage, direct current applications.

The new unit is $\frac{5}{16}$" long and $\frac{1}{8}$" in diameter and is designed to make possible further size reductions in miniaturized assemblies using transistors. It is intended as a companion to the transistor.

The condenser is available in ratings from 2 to 16 volts, 4 to .7 microfarads



respectively. It is designed to operate over a temperature range of —20 to + 50 degrees C.

CONNECTOR KIT

The *Microdot Division* of *Felts Corporation,* 1826 Fremont Ave., South Pasadena, California has introduced a new kit for micro-miniature connectors and cables. The kit is fully equipped for prototype construction with a self-assembly hand tool especially designed for make-up of typical coax assemblies using "Microdot" connectors, "Mini-noise" cable, "BNC" adapters, etc.

The kit is expected to bring economies in time and money for laboratories, research, and design engineers. The kit will enable specialists to work out several experimental coax assemblies before "designing in" and production.

Complete information is available from M. H. Lewis of the company.

FREQUENCY CONVERTER

In response to the growing demand for a convenient 400-cycle supply, *Georator Corporation* of Manassas, Va. has developed and is marketing a compact motor-generator unit to convert 60 cycles to 400 cycles.

Because of its "Nobrush" construction, the unit is said to possess long life, durability, and freedom from excessive maintenance. It is compact and has reduced heating.

Outputs of 150 volt-amperes to 25 kva single or three phase are available with motor drive for any standard frequency or voltage. Circular E 11 describes the product in detail and is available on request.

"SPEED-CHASSIS"

Specific Products, 5864 Hollywood Boulevard, Hollywood 28, Cal. is in production on a new "Speed-Chassis" which provides a flexible breadboard assembly with interchangeable socket arrangement.

A novel feature of this chassis is that it can be mounted on a relay rack. A sturdy shield can is available to permit the breadboard assemblies to be made permanent.

A copy of Bulletin #853, listing all

Send for Your **FREE** Copy of the NEW 1954 MIDWEST TELEVISION and RADIO Catalog

MIDWEST *Presents*

For 1954 a Completely NEW LINE of 21" and 27" TELEVISION

CONSOLES
TABLE MODELS
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COMPLETE CHASSIS
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LOW FACTORY PRICES

YOUR CHOICE OF EITHER 12 CHANNEL VHF or All-Channel VHF-UHF Models

Buy your Television or Radio Direct from the Midwest Factory . . . on 30 DAYS TRIAL . . . Easy Terms . . . and at LOW FACTORY PRICES. For 34 years Midwest, the world's largest and oldest exclusive Factory-To-You radio and television manufacturer, has served hundreds of thousands of satisfied customers all over the world.

EASY TERMS
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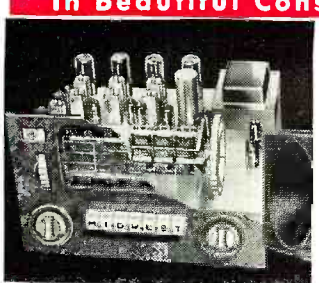
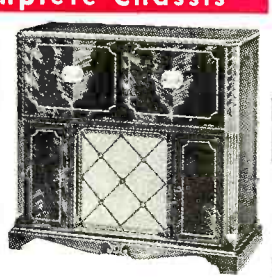
All models available in your choice of mahogany, walnut finish or blond limed oak.

Also—Powerful New 1954 World-Ranging
MIDWEST Series 16 RADIOS
In Beautiful Consoles and Complete Chassis



Once again Midwest offers its famous series 16 five band AM-FM radio chassis and the magnificent new Symphony Grand Radio-Phonograph with 3-Speed Automatic Intermix Record Player. Also, a complete line of clock radios, table radios, and portables.



MIDWEST RADIO & TELEVISION CORP.
DEPT. D-37, 909 BROADWAY, CINCINNATI 2, OHIO

WRITE IN NAME AND ADDRESS (PLEASE PRINT) ON COUPON OR 2c POSTCARD

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Dept. D-37, 909 BROADWAY · CINCINNATI 2, OHIO

Please send me your new FREE 1954 Catalog.

NAME _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

of the features of the product, is available from the company on request.

PIN STRAIGHTENERS

A new tool, a twin pin straightener, has been developed by *CBS-Hytron* of Danvers, Mass., for radio and television service dealers as well as electronic technicians and engineers.

The new tool is compact, handy,

light, and roll-proof. It will straighten the pins of both 7- and 9-pin miniature tubes. The individual 7 and 9 pin straighteners are still available for bench mounting, etc.

CHECKING DEVICE

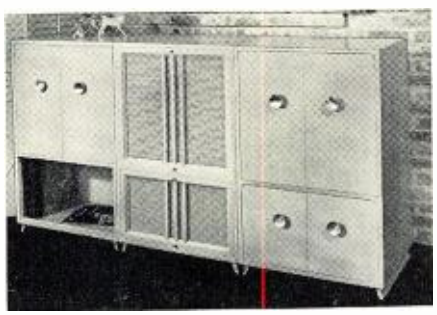
A new low-cost device to be used as a substitute for an expensive v.t.v.m. in checking frequency responses of high-fidelity music systems has been announced by *The Dubbings Company* of 41-10 45th Street, Long Island City, N. Y.

Utilizing the principle that the loudspeaker is driven by electric current that is measurable in volts, this device, called the D-500 test level indicator, consists of three low-current, low-voltage bulbs so calibrated as to light up at 3 db intervals when fastened across the loudspeaker leads of a sound system or the output terminals of an amplifier. When used with any frequency test record, the D-500 will indicate whether a phonograph or record-playing system is reproducing the sound spectrum properly.

CABINET LINE

The Angle Genesee Corporation, 107 Norris Drive, Rochester, N. Y. is in production on a wide variety of cabinet housings for high-fidelity music systems.

Among the items now being offered



is a line of co-related equipment consoles available in a wide choice of arrangements to house any combination of equipment. As the audiophile adds to his sound systems, cabinet arrangements may be changed by simply replacing panels.

These consoles come in mahogany and blonde finishes in traditional and modern styling. Write the company for full information on its complete line.

"STYLUS-DISK"

Audak Company, 500 Fifth Ave., New York 36, N. Y. has developed a "Stylus-Disk" made of specially compounded, soft material which makes the home checking of any jewel point easy and simple.

To check the stylus, an ingenious method has been devised. Grooves are recorded eccentrically introducing considerable thrust, first on one and then on the other side of the stylus during each revolution of the disc. Thus any worn or defective stylus will scrape the delicate surface of the grooves, leaving a positive, visible indication.

The new disc is currently available at stores handling hi-fi gear.

AUDIO COMPENSATOR

The McIntosh Laboratory, Binghamton, New York is now offering an accurate and easily-operated professional audio compensator, the C-108.

The unit is supplied with an instruction booklet showing curves and settings recommended by each recording company. Separate bass and treble compensation adjustments can be seen at a glance on the simple diagrams.

The C-108 is equipped with an aural compensator and rumble filter. Its

flexibility permits the listener to enjoy high-fidelity records from any manufacturer without changes in basic playback equipment.

PERMOFLUX SPEAKERS

Permoflux Corporation, 4900 W. Grand Ave., Chicago 39, Illinois is now offering its new line of "Super Royal" speakers for use in quality audio systems.

The "Super" series features a newly-designed magnet structure, utilizing a heavy Alnico 5-ring magnet and Armco iron; a newly designed voice coil for extended high-frequency response and added power handling capacity; a slotted, treated cone for low resonance and good low-frequency response: and a metal diaphragm at the cone apex for better dispersion of highs.

Included in the line are the "Super Royal 12," the "Super Royal 15," and the "Super Royal 8." The 12" speaker has a frequency response of 35 to 14,000 cps; the 15" unit covers 30 to 11,000 cps while the 8" speaker has a frequency response from 45 to 14,000 cps. —30—

REG. $117.50 SUPREME TUBE TESTER—V.O.M. ON SALE AT McGEE FOR $64.95

WITH ROLL CHART — 7 INCH METER — BUILT IN BATTERY TESTER

Supreme Model 616 tube tester and battery tester. This is the same instrument as the model 600 except it has no volt-ohm and milliamp scale. However, it's a top quality tube tester, with illuminated roll chart and a complete dry battery tester. Made to sell for $87.45 dealers' net. Our price of $49.95 is good only as long as the limited supply lasts. Shipping weight 24 lbs. Sale price, **$49.95**

MODEL 616
REG. $87.45

$49.95

SUPREME MODEL 600 $64.95

Supreme Model 600 tube tester, dry battery tester, volt ohm meter. All in one gray metal portable carrying case, 16"x12"x7¾". Large 7" meter, easy to read. Calibrated good-bad scale for tube testing with easy to read volt-ohm and milliamp scale. Most people can operate this meter without glasses, the printing is so large, as you would expect with a 7" meter. Illuminated roll chart. Push button tube checker operation. Easy to learn how to operate. Battery tester will check all dry batteries under proper load. Has 5 resistance ranges from .1 to 20 megohms. 6 AC-DC volt ranges from 0 to 2500 volts. 6 milliamp ranges from 1 to 1000 and 0 to 10 amps. This meter had a regular net price of $117.50. Our special purchase makes this $64.95 price possible. Think of it, the battery and VOM part is worth one-half our sale price. Stock No. 600 Supreme tube-set tester on sale for only **$64.95** at McGee. Only a limited supply is available. Shipping weight 24 lbs.

SUPREME MODEL 600

INDIVIDUALLY CARTONED ELECTRONIC RADIO & TV TUBES

McGee offers you a wide selection of good quality TV and Radio tube types. Individually cartoned. Our private brand. These are not set mfg's. culls, but a carefully inspected private line of tubes with a full 6 months' guarantee. Types listed are in stock in good quantity at this time. Thousands sold. Order 50 tubes and take 10% off the listed prices.

OZ4	$0.59	6BA7	.69	6T8	.79	12K8GT	.59
1A7GT	.59	6BC5	.59	6U8	.79	12Q7GT	.59
1B3GT	.79	6BD6	.49	6V6GT	.59	12SF5GT	.69
1H5GT	.59	6BF5	.59	6W4GT	.59	12SJ7M	.59
1L4	.59	6BF6	.59	6X4	.39	12SJ7GT	.59
1R5	.59	6BG6G	1.29	6X5GT	.49	12SN7GT	.69
1S5	.59	6BH6	.59	7A7	.69	12SL7GT	.79
1T4	.59	6BJ6	.59	7B6	.69	19BG6G	1.79
1U4	.59	6BK7	.99	7H7	.79	25BQ6GT	.99
1U5	.59	6BQ6GT	.99	7Y4	.69	25L6GT	.59
3Q4	.59	6C4	.39	12AL5	.59	32L7GT	.79
3Q5GT	.69	6CB6	.59	12A8GT	.69	35B5	.59
354	.59	6CD6G	1.49	12AT6	.49	35C5	.59
3V4	.59	6H6GT	.59	12AT7	.69	35W4	.39
5U4G	.49	6K7GT	.59	12AU6	.59	35L6GT	.59
6AB4	.69	6L6G	1.09	12AU7	.69	43	.79
6AK5	.89	6S4	.59	12AV6	.59	47	.89
6AL5	.49	6SA7GT	.59	12AV7	.89	50B5	.59
6AQ5	.49	6SH7GT	.59	12AX4GT	.59	50C5	.59
6AT6	.49	6SF5GT	.59	12AX7	.69	50L6GT	.59
6AU6	.49	6SK7GT	.39	12BA6	.59	70L7GT	.99
6AV6	.49	6SL7GT	.69	12BE6	.59	117Z3	.39
6AX4GT	.69	6SN7GT	.69	12BD6	.59		
6BA6	.49	6SU7GT	.69	12BF6	.79		

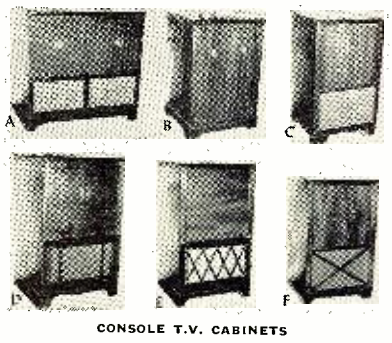
25-WATT MOBILE AMPLIFIER $99.95

WITH 25 WATT TRUMPET $127.95

25 watt, mobile amplifier for 6 volt and 110 volt operation complete with 3 speed turntable and pickup for playing all 3 speeds and all 3 size records. Less than 5% distortion. Inputs for 2 microphones and phonograph. Has separate volume controls for each mike and phono, tone control, off-on switch and standby switch. Includes tubes: 6SJ7, 6SC7, 6J5, 2-6L6G and 2-6X5GT rectifiers. Frequency response from 40 to 15,000 cps. Output impedances 2, 2.7, 4, 8, 16, 250 and 500 ohms. Size, 13" x 14½" x 9" high. Two-tone gray hammerloid finish. Model MG-25M, 6-110 volt amplifier. Sale price $99.95.

Model MG-25M, 6-110 volt amplifier, complete with 1-25 watt trumpet and driver as pictured. Sale price only $127.95.

Model MG-25M, 6-110 volt amplifier complete with 2-25 watt trumpet and driver combinations and Astatic JT-30 crystal mike and desk stand. Complete system. Stock No. MG-25MS. Sale price, $165.90.



CONSOLE T.V. CABINETS

TERRIFIC SALE TELEVISION CONSOLE CABINETS

(A) Radio-T.V. Cab. $39.95

Stock No. AH-170 mahogany console radio-television cabinet, with double doors. 34" high, 35" wide and 21¾" deep. The compartment behind the right hand door is 17" wide, 16¾" high and 19" deep. Suitable for most 17" TV chassis. Left hand compartment is 14¾" wide, 16¾" high and 19" deep, for radio chassis or could be adapted to various other uses. Both compartments have blank panels. Baffle is cut for an 8" speaker but is large enough to hold a 10". This attractive cabinet cost the TV manufacturer more than our price. Shipping weight 95 lbs. Stock No. AH-170, Sale price, **$39.95.**

(B) 17" FULL DOOR MAHOGANY T.V. CABINET **$34.95**
Stock No. AH-430 mahogany television cabinet with full doors. 36" high, 24" wide and 21¾" deep. Furnished with blank panel. Chassis area 22" wide, 17¾" high and 18¾" deep. Will hold 17" sets easily. Might hold a 20" set, but be sure to check your measurements. Speaker baffles cut for 10" speaker, but will hold a 12" speaker. This fine cabinet will look nice in any home. Offered at way less than it cost the famous TV manufacturer. Shipping weight 80 lbs. Stock No. AH-430, Sale price, **$34.95.**

(C) 17" ¾ DOOR MAHOGANY T.V. CABINET **$29.95**
Stock No. AH-85 mahogany console television cabinet suitable for most 17" chassis. 35¾" high, 20¾" wide and 20" deep. Has blank panel. TV chassis area 20¼" wide, 17" high and 17" deep. Speaker baffle cut for an 8" speaker but there is room for a 10 or 12" speaker. This is a very attractive, well proportioned TV cabinet. Put your old 10" or 12" set in this and be up to date. On sale at less than cost of manufacturer. Shipping weight 65 lbs. Stock No. AH-85, Special sale price, **$29.95.**

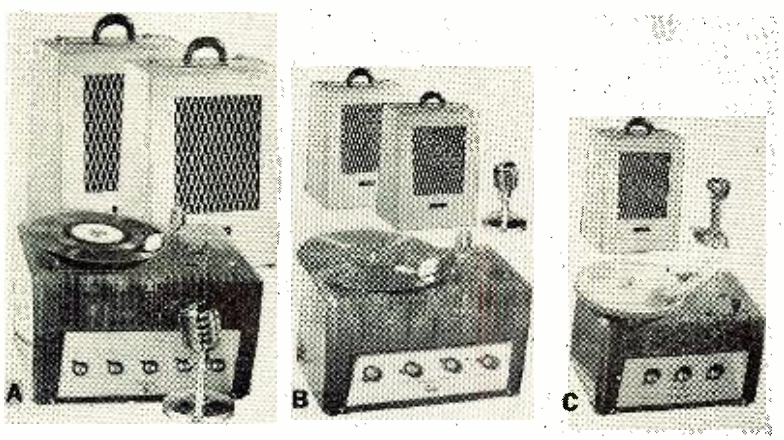
(D) 21" ¾ DOOR MAHOGANY T.V. CABINET **$39.95**
Stock No. AH-56 mahogany television cabinet with doors. 41" high, 25" wide and 21" deep. Has blank panel. Will hold 17", 20" or 21" TV chassis. However, be sure to watch your measurements so that you have room enough for whatever you intend putting in the cabinet. Chassis area is 20¾" wide, 19¾" high and 18¼" front to back. Plenty room for speaker up to 12" diameter. Shipping weight 86 lbs. Stock No. AH-56, Sale price only **$39.95.**

(E) 21" OPEN FRONT MAHOGANY T.V. CABINET **$29.95**
Stock No. AH-46 mahogany television cabinet. 41" high, 23½" wide and 20½" deep. Has blank panel. Chassis area 20¾" wide, 21" high and 19½" deep. Will hold 17", 20" or 21" TV chassis. Speaker up to 12" diameter. A terrific cabinet value. Only a limited quantity are available. Shipping weight 70 lbs. Stock No. AH-46, Sale price **$29.95.**

(F) 17" "OUR LEADER" MAHOGANY T.V. CABINET **$19.95**
Stock No. AH-26 mahogany television cabinet with a blank panel. 35" high, 20⅝" wide and 20" deep. TV chassis area is 17¼" high, 20" wide and 18¾" deep. Will hold most 17" sets. Speaker baffle is cut for a 12" speaker. Buy this cabinet at the very low price of **$19.95.** Only few to sell. Shipping weight 57 lbs. Stock No. AH-26. Sale price, **$19.95.**

Buy a conversion kit with any of the above cabinets and save **$3.00.** You may take **$3.00** off the cabinet price when ordered with one of the picture tube, safety mask, flyback and yoke conversion kits listed on the opposite page.

AMERICA'S FINEST 28 WATT—50 WATT AND 10 WATT P.A. VALUES



A B C

$69.95 BUYS A 28 WATT $150.00 LIST VALUE PORTABLE P.A. SYSTEM

(Illustration B)

3-SPEED PHONO TOP—TWO 12-INCH SPEAKERS 7-TUBES PUSH PULL 6L6'S HEAVY LEATHERETTE COVERED PLYWOOD PORTABLE CASES CRYSTAL MIKE $8.95 EXTRA

STOCK No. AP-28X. Portable 28 watt public address system. You get a 7-Tube heavy duty push-pull 6L6 amplifier with inputs for 2 mikes either crystal or dynamic with separate mixing volume controls. One phono input. Fully variable tone control high fidelity, wide range frequency response. The heavy duty output transformer has taps for 4, 8, 16, 125, 250 and 500 ohm speaker connections. Two heavy duty 12 inch alnico V P.M. speakers, each with 25 feet of speaker cable. Each speaker is mounted in separate carrying cases. Each case has a snap on back and is large enough to give good speaker baffling. Each case is 21 x 16 x 13 inches. One is used to carry the amplifier. A 3-speed phono motor and pick-up is mounted in the top of the amplifier to play 33⅓, 45 and 78 RPM records.

This portable PA system will put out 20 watts all day long and 28 to 30 watts peak audio. McGee offers you this $150.00 list portable PA system at a terrific saving.

STOCK No. AP-28X complete portable PA system with 3-speed phono and speakers as pictured (less mike) ship. wt. 71 lbs. **$69.95.**

Electro Voice model 910 $28.50 list crystal mike with 20 feet of cable and desk stand **$8.95** extra.

Floor type mike stand instead of desk stand **$4.95** extra.

50-WATT PORTABLE P.A. ON SALE $99.95 3-SPEED PHONO TOP—TWO 12" SPEAKERS

(Illustration A)

10-tube portable 50-watt public address system. 4—6L6G (push-pull parallel) output tubes. Inputs for 2 microphones, either crystal or dynamic, with separate mixing volume controls. Twin bass and treble tone controls. High fidelity wide range output transformer with taps at 4, 8, 16, 125, 250 and 500 ohms. Complete with 2 super heavy duty 12" PM speakers and 25 ft. cables mounted in separate leatherette-covered carrying cases. 21"x21"x13". The amplifier fits in one of the cases for carrying. This amplifier will put out 40 watts all day long and 50 to 60 watts peak with ease. 3-speed turntable and pickup arm to play all records 33⅓, 45 and 78 RPM is mounted in the top of the amplifier. Stock No. AP-60X, 50 watt portable P.A. system similar to the 28-watt model pictured above, less microphone. Sale price, **$99.95.** Shipping weight, 100 lbs. Shipped via Express or Truck only.

Regular $45.00 list Electro-Voice 610 dynamic microphone with 20 ft. cable and desk stand, **$11.95** extra. For floor stand instead of desk stand, add **$4.95.**

10-WATT PORTABLE P.A. ON SALE $42.95 3-SPEED PHONO TOP—10" ALNICO PM SPEAKER

(Illustration C)

5-tube portable 10-watt (14-watt peak) public address system. (Push-pull 7C5) U. L. approved amplifier with wide range response. Inputs for microphone and phono, with separate mixing type volume controls. Tone control. 10" Alnico V PM speaker is housed in a leatherette case 21"x16"x13" which holds the amplifier for carrying. 3-speed turntable and pickup arm to play all records 33⅓, 45 and 78 RPM is mounted in the top of the amplifier. List value, $90.00. Stock No. AP-10X, 10-watt portable P.A. system has only one case and one 10" speaker, less microphone. Sale price, **$42.95.** Shipping weight 41 lbs. Shipped via Express or Truck only.

Crystal microphone with non-removable desk stand, **$3.95** extra when ordered with the AP-10X portable P.A. system.

BIGGEST STOCK OF STANDARD COIL T.V. TUNERS IN THE NATION AT LOW PRICES

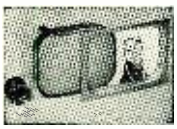
STANDARD COIL SUPER CASCODE TUNER $19.95

The TV-2000 series of the Standard Coil Cascode tuner offers a new development of this famous TV front end assembly which affords a 2 to 1 improvement in gain and a 35% to 50% reduction of noise over the earlier pentode tuner. Other advances include: easy conversion to UHF reception by a simple interchange of channel inductors; increased sensitivity for fringe area reception; elimination of booster use and a high profit item for the serviceman as a replacement unit sale. We offer brand new factory cartoned TV-2000 series Standard Coil Cascode TV tuners complete with tubes 6BQ7 or 6BK7 and 6J6. These tuners are available with shaft lengths of 4⅝", 5⅛" and 6¼". Specify shaft length desired when ordering. TV-2000 Standard Coil cascode tuner (21 mc). Sale price. **$19.95.**

TV-3000 Standard Coil Cascode tuner with 41 mc video I.F. and 4⅛" shaft. Complete with tubes 6BQ7 and 6J6. Same as tuner described above, except it has 41 mc video I.F. instead of 21 mc. Brand new factory cartoned TV-3000 Cascode tuner. Sale Price. **$19.95.**

SC-948. Standard Coil TV-1000 series Pentode TV tuner with 2⅞" length shaft. Complete with tubes 6AG5 or 6BC5 and 6J6. Brand new factory cartoned. Stock No. SC-948. Sale price, **$13.95** each or two for **$27.00.**

All of the above tuners are furnished with diagrams for quick installation. Longer shafts may be readily cut to the desired length. Matching knobs for channel selector and fine tuning, fits any of the above. Stock No. SCK-2. pair **59c.** Set of volume and contrast knobs to match. Stock No. VCK-2. pair **59c.**



14-Inch Conversion Kit With 1 Year Guarantee Tube $22.95

14-inch conversion kit: You get a 14-inch black face, 1 year warrantee Rauland, Syl. RCA or G.E. 14" picture tube (as available), a 70° deflection yoke with matching 14,000 volt G.E. flyback and a 14" plexiglas gold trim safety mask, plus conversion instructions. Stock No. 14-RSG. Sale price, only **$22.95** complete.

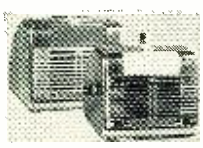
17-INCH CONVERSION KIT $25.95

17-inch conversion kit with a 17BP4A, 17" rectangular blackface electro-magnetic focus picture tube with 6 months' guarantee, plus a matched 70° cosine yoke, a G.E. built 14,000 volt flyback and a 17" rectangular gold trimmed plexiglas mask and safety shield. Suggested diagram furnished. Shipping weight, 30 lbs. via Express or Truck only. Stock No. 17-4XL, 17" conversion kit. Sale price, **$25.95.** Kit Price with GE or Raytheon 1 year guarantee picture tube, **$5.00** extra.

20-Inch Conversion Kit $29.95

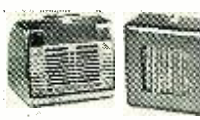
Our 20" conversion kit includes a 6-month guaranteed 20HP4, 20" rectangular blackface picture tube, plus a 14,000 volt G.E. built high voltage flyback transformer, plus a matched 70° cosine yoke, plus a 20" rectangular gold trimmed plexiglas mask and suggested diagram. The picture tube is the latest electro-static focus type that requires no focus coil. Shipped via express or truck only. Ship. weight, 40 lbs. Stock No. 20-TP, net price. **$29.95.** Price with Raytheon or GE 1 year guarantee picture tube. **$10.00** extra.

3 STATION INTERCOM MASTER $16.95
SUB STATION $3.95



3-station intercom master housed in chrome plated metal cabinet 7½"x6"x5" sloping front. Full 3-tube amplifier for 110 volt AC-DC operation. Press-to-talk switch is on top of the cabinet and volume control with off-on switch and station selector switch are on either side. May be used with from one to 3 sub-stations. (See matching cabinet chrome plated sub-station No. PM-A3.) Master is quiet at all times except when press-to-talk switch is pressed at the master or call-back switch is pressed at the sub. Uses 3-wire intercom cable. 3-station intercom master MPM-A3, shipping weight 10 lbs. Sale price. **$16.95** each, sub-stations extra. 3-wire plastic intercom cable, 100 ft. for **$1.95**, 500 ft. for **$8.95.**

500 INTERCOM SUB-STATIONS TO SELL AT $3.95 EACH



Chrome plated, with call back switch for a 3-wire intercom master. Size 7½"x6"x5" sloping front. 5" Alnico V PM spkr. Intercom dealers buy at less than present production costs. Limited quantity. Stock No. PM-A5, ship. weight 8 lbs. Sale price. **$3.95** each or 3 for **$10.00.** Special 3-wire plastic intercom cable. 100 ft. **$1.95**, 500 ft. for **$8.95.** Brown leatherette covered intercom sub-station with call back switch for use with 3-wire intercom masters. 5" square and 2½" deep. Has new plastic grill cloth. Alnico V PM speaker. A true McGee value. Stock No. NE-5, ship. weight. 1½ lbs. Sale price **$3.95** each or 3 for **$10.00.** 3-wire plastic intercom cable. 100 ft. for **$1.95**, 500 ft. for **$8.95.**

STANDARD COIL

T.V. BOOSTER CLEARANCE SALE
Your Choice $8.95
Two for $17.00

SUPER SONIC

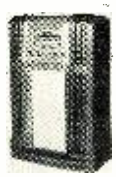
Read the article on pages 52 and 53 of the December 1952 "Radio & TV News." You will see how a booster like the McMurdo Silver Super Sonic was used for fringe area TV reception. We can't guarantee this unusual reception, but we will guarantee this booster to be a sensational value. Continuously variable inductance type tuner from channel 2 including the FM band through channel 13. Self-powered for 110 volts AC operation. Incorporates a 6J6 tube. Input for 300 ohm TV line and 300 ohm output to TV set. Single knob tuning. Attractive plastic case. McMurdo Silver Super-Sonic TV-FM booster. Stock No. GB-6B, shipping weight 5 lbs. Sale price, **$8.95** each or two for **$17.00.**

Brand new B-51 Standard Coil 12 channel VHF TV booster. Utilizes printed high frequency circuits for improved performance. Continuous one knob tuning and channel selector, off-on switch, 6AK5 tube. Modern dark brown plastic cabinet 8 x 4¼ x 4½". For 110 volt 60 cycle AC operation. Special sale price, **$8.95** each or 2 for **$17.00.**

3-TUBE SARKES-TARZIAN T.V. TUNER $9.95

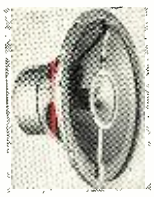
This popular Sarkes-Tarzian Type 3 tuner is widely used. 13 channel rotary type switch with individually tuned coils. Price is complete with diagram and three tubes: 6C4 osc., 6BH6 R.F. and 6AG5 mixer. Regular factory cost is twice our price. Each tuner is wired ready to hook up to a video and sound IF strip. May be used with either inter-carrier or separate sound IF circuits. Has built-on convertor coil, built in fine frequency control. Sarkes-Tarzian TV tuner, with 3 tubes. Net price, **$9.95** each. Shaft length. 2⅞".

SPECIAL BARGAIN SALE BUY
8 TUBE—2 BAND
WALNUT CONSOLE RADIO
PUSH-PULL OUTPUT—3 GANG TUNING
RECEIVES BROADCAST & SHORT WAVE
SALE PRICE $42.95



Beautiful, 8 tube walnut finished console 2 band radio with 3 gang tuning condenser and push-pull output tubes. Receives broadcast 550 to 1600 KC and short-wave 6 to 18 MC. Heavy duty concert tone 8" Jensen PM speaker has exceptionally fine quality. Has illuminated slide rule dial and loop antenna built in cabinet. Tubes are 14A7, 14Q7, 14R7, 12SL7, 2-50L6 and 2-35Y4 rectifiers. Walnut cabinet 37" high, and 24" wide has inlaid sections and fine quality furniture finish. Brand new in factory cartons. Model C-81-B, 8-tube walnut console radio. Shipping weight. 40 lbs. Special sale price only **$42.95.** Shipped via express or freight only. For 110 volt operation.

FOR YOUR CUSTOM HOME MUSIC SYSTEM
McGEE'S $62.50 LIST 15" COAXIAL SPEAKER, $23.95



New 1954 Model—21 Oz. Alnico V Magnet—5" Tweeter

This is the finest 15" coaxial PM speaker value that we have ever offered. Latest production of a famous manufacturer of fine speakers. The 15" speaker has a 21⅛ oz. Alnico V magnet; equal to 68 oz. of the Alnico 3 type magnet. The cone is free floating, of one piece construction. Will reproduce low frequencies down to 20 cps. The 5" tweeter is coaxially suspended and has a ridged cone to reproduce only the high frequencies. It will respond up to 17,500 cps. The high-pass filter is concealed under the pot cover, leaving only two wires to connect both the tweeter and woofer to any 8 ohm output transformer of a radio, or high fidelity music lover's amplifier. Stock No. P-15CS, shipping weight 13 lbs. Net price **$23.95.**

12" JENSEN PM, $15.95

Another McGee Scoop! Jensen Concert 12", 14½ oz. Alnico V magnet PM speaker. 8 ohm voice coil. Will take 25 watt audio. You save dollars on this speaker. Just 100 to sell. Shipping weight 8 lbs. Stock No. P-12P. Sale price **$15.95**; 2 for **$30.00.**

12" COAXIAL SPEAKER, $12.95

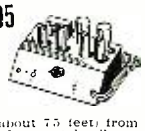
McGee offers the new 1954 model 12" coaxial PM speaker. Quality you would put in your finest sets if you were a manufacturer, 12" woofer has 6.8 oz. Alnico V magnet. Tweeter is coaxially suspended and has a metal diffuser. High pass filter is under the pot cover. Only two wires to connect to your radio or audio amplifier. 8 ohm with 18 watt peak and 10 watt average. Shipping weight 8 lbs. Response from 30 to 17,500 cps. Stock No. CU-14Y. Sale price **$12.95** each: 2 for **$25.00.**

COMPLETE RADIO, TELEVISION AND AMPLIFIER KITS AT McGEE

3-WAY PORTABLE KIT $15.95

New 1954 Model 3-way personal portable radio kit. Operates on 110 Volts AC-DC or 67½ B plus 1½ volt self-contained batteries. Leatherette covered case size, 5¼"x5¾"x8". Receives broadcast 550 to 1650 KC. A conventional 2-gang superhet circuit with 456 KC iron core IF's. Incorporates the new super gain stick loop antenna. All plated chassis. Lab. approved circuit—matched parts. Price includes all parts, tubes, diagram. Alnico V PM speaker. A factory quality kit. Stock No. PN-4T, shipping weight 7 lbs. The complete kit. Less batteries **$15.95.** 67½V. B, **$1.59**; 1½V. A. **39c** extra.

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 1000 to 1500 kc. Inputs for crystal mike or crystal phono pickup. Fader control fades from mike to record. Ideal for a home P.A. system, ham 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 ½" thick. Specify hidden mike when ordering. Stock No. T-001. Net. **$3.95** extra.

8-Tube Hi-Fi Amplifier Kit $29.95

A complete kit, including tubes; 3-7E5, 2-12AX7, 2-triode plus rectifier diagram and photos. Inputs for radio tuner and any kind of phono pickup (crystal or G.E. variable reluctance) and either crystal or dynamic mike. Output matches 8 ohm voice coil. Twin electronic bass and treble tone controls with range selector switch for either juke box quality with heavy bass response or brilliant symphonic range. Response 18 to 20,000 cps. 8 tube all triode amplifier kit, complete with tubes. Shipping weight 25 lbs. Model 7X5. Net **$29.95.**

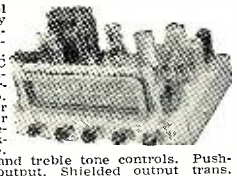
Write for Your Copy of

McGEE'S GIANT 1954 CATALOGUE

Bargains Like These on Every Page

Everything for the Television and Radio Service Man. Up-to-date U.H.F. Television Material. High Fidelity Equipment.

RADIO AMP. KIT $29.95



1954 Model high fidelity broadcast radio and amplifier kit. Straight AC 3-gang condenser superhet with loop. Inputs for crystal or variable reluctance pickup and mike. Twin bass and treble tone controls. Push-pull 6V6 output. Shielded output trans. for any high quality 12 or 15" speaker. All parts furnished including punched chassis 12 x 9 x 7". full 150 ma. power trans., tubes and diagram. Tubes: 6AK5, 6BE6, 6AU6, 6AT6, 12AX7, 6SL7, 2-6V6 and 5Y3. Stock No. BKR-99. Ship. wt. 20 lbs. Sale price, **$29.95.**

17, 20" T.V. Kit $59.95 Less Tubes

A complete kit of parts to build an AC transformer operated television chassis for use with a 16", 17" or 20" rectangular picture tube. The 12 channel Sarkes-Tarzian tuner is ready wired, as is the 4 tube video IF strip. Circuit is of the conventional design. Do not buy this unless you understand Television. It is difficult to wire. We furnish schematic. Kit model WH-20. Ship. wt. 40 lbs. less all tubes. Net **$59.95.** Cascode tuner $10.00 extra! 12" speaker $2.95 extra.

Kit of 19 tubes. less picture tube **$10.95.** 17" 17BP4A. **$17.95.** 20HP4. **$25.00**

6-TUBE 2-BAND KIT $14.95

Popular with schools and colleges for training. 6 tube AC-DC, 2 band radio kit with plastic cabinet. Receives broadcast and 6 to 18 mc shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12SK7, 12K8, 12SK7, 12SQ7, 50L6 and 35Z5, diagram and instructions. Factory quality. Cabinet size 13"x6¾"x6¾". Shipping weight 12 lbs. Model ME6-2. Net **$14.95.**

5-TUBE AC-DC KIT $12.95

Model RS-5. A 5 tube AC-DC straight broadcast kit, housed in the same cabinet as ME6-2 above. Complete with tubes. Shipping weight 10 lbs.. Net **$12.95.**

AC POWERED BROADCAST TUNER KIT $14.95

A self-powered, 3-gang superhet tuner kit with R.F. stage. This complete kit is furnished with a diagram, photos and tubes. 6BA6 R.F., 6BE6 oscillator R.F.. 6BA6 I.F. detector. 6AL5 diode. AVC. plus rectifier. Connect to any audio amplifier. Ideal for use with our S-2020 or 7x5 amplifier kits. Chassis size. 9½x4x1½" high. Shipping weight. 7 lbs. Broadcast tuner kit Model BT-38X. Net price. **$14.95.**

McGEE RADIO COMPANY Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Partial Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER 1422 GRAND AVE., KANSAS CITY, MISSOURI

BEAUTIFUL WALNUT COMBO' CABINET FOR HOME MUSIC SYSTEM—$89.95

MADE FOR A $1000.00 CAPEHART

BEAUTIFUL WALNUT

$89.95

Beautiful, finest quality walnut combination radio-phono cabinet. 42" high, 42" wide and 22" deep. Made for Capehart's finest combination, selling for $900 and up. Cabinet cost manufacturer over $200.00. Has highly polished matched walnut panels. Made of ¾" material. Top 1⅛" solid stock. This cabinet weighs approximately 175 lbs. The changer radio and speaker grill all have hinged doors. Radio compartment on right hand side is 14" high and 11½" wide. Made to mount chassis vertically. Changer compartment is 14" high by 26½" wide. Large enough to hold any record changer or recorder mechanism. Front 10" of top over the changer compartment is hinged to fold back for easy access to the changer. Both radio and changer compartments come with uncut blank panels. Speaker baffle is cut for a 12" speaker and the speaker compartment is completely enclosed. Shipping weight, 275 lbs. Stock No. K-275W Capehart combination. Net price, **$89.95**. Walnut.

G.I. 3-SPEED CHANGER WITH G.E. $22.95

VARIABLE RELUCTANCE TURN-ABOUT CARTRIDGE

Another tremendous McGee Scoop! Brand new General Instrument 3-speed automatic record changers. Complete with RPX-050 G.E. variable reluctance cartridge with turn-about stylus. Plays all 3 speeds automatically: 7", 10" or 12" records. Has reject button. Repeats last record. Base size, 12" x 12⅞". Shipping weight 14 lbs. Stock No. 700-GE. Scoop price. **$22.95.**

GI 3-speed changer same as above, but with Webster flip-over twin needle cartridge. Stock No. GI-700 Sale price, **$21.95** each.

WEBSTER CHICAGO MODEL 114 SALE PRICE $29.95

Model 114, 3 speed Webster-Chicago automatic record changer. All brand new in original factory carton. Automatically plays all 3 speed and all 3 size records. Has new Shure 2 needle flip-over crystal cartridge with muted styli, to assure the correct needle for the record to be played. Has 3 speed selector lever with neutral position, so that drive wheels will not become flattened, causing distortion. Base size, 13½" x 12". Shipping weight 12 lbs. Sale price, **$29.95** each.

HALLICRAFTERS S-78
11-TUBE FM-AM CHASSIS

ONLY **$89.50** LESS SPEAKER

WITH 12" COAXIAL SPEAKER **$99.50**

★ PUSH-PULL WIDE RANGE AUDIO

Hallicrafters S-78. 11-tube AM-FM radio receiver chassis, with push-pull 6K6 high fidelity audio system. A new model chassis for custom installation. Full range tone control, with bass boost. Input for automatic record changer. Output transformer has 3.2 ohm and 500 ohm connections. Chassis size, 12¾" x 10" x 7¾" high. Knobs and escutcheon plate are furnished. Receives standard broadcast and FM, 88 to 108 mc. Shipping weight, 25 lbs. Model S-78, priced less speaker at **$89.50** net.

S-78, 11-tube AM-FM chassis with our 12" coaxial PM speaker, both for **$99.50.** S-78 with 15" coaxial PM speaker, both for **$107.95.**

If you want a record changer, see our special listing above and below.

NEW GARRARD AUTOMATIC CHANGERS—GE CARTRIDGES

Garrard RC-80 automatic record changer plays all 3 speed and all 3 sizes. Separate 45 RPM spindle. Heavy duty motor. Weighted turntable. Has two separate plug-in heads for cartridges.

RC-80 changer, less cartridge, ship. wt. 20 lbs. Net price, **$41.45.**

New Garrard RC-90 3 speed automatic record changer. The finest changer built, less cartridge. Net price, **$51.95.**

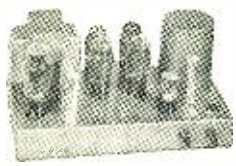
RC-80 changer complete with RPX-050 GE variable reluctance cartridge. Net price, **$47.40.**

RC-80 changer complete with RPX-052 GE "Golden Treasure" variable reluctance cartridge. Net price, **$60.95.**

RC-90 changer complete with RPX-050 GE variable reluctance cartridge. Net price, **$56.90.**

RC-90 changer complete with RPX-052 GE "Golden Treasure" variable reluctance cartridge. Net price, **$71.45.**

50-WATT BOOSTER AMPLIFIER

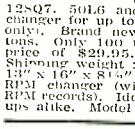


50-WATT BOOSTER AMP. $39.95

2-Mike Pre-Amp $12.95 Extra. Not a Kit, but a Manufactured Amp.

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 6 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 bass boost tone control. Size 8 x 6½ x 14½. Stock No. PA-55N. Shipping weight 26 lbs. Sale price **$39.95** ea.

2-MIKE PRE-AMP. Pre-amplifier plugs in directly to the PA-55N 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 watt Booster Amplifier. Small chassis size 5 x 3¼ x 4". Stock No. PR-2X, with tubes 7F7 and 7N7. Net price **$12.95** ea.



CROSLEY RADIO

WITH 45 RPM CHANGER $29.95

5 tube superhet radio (540 to 1600 kc Broadcast) using 12AT, 12BK7, 12BQ7, 50L6 and 35Z5 tubes). Automatic changer for up to 8 45 RPM records (6⅞" only). Brand new in original factory cartons. Only 100 to sell at the terrific low price of $29.95. Shipped Express only. Shipping weight 23 lbs. Mahogany cabinet 13" x 16" x 8¼" high. Lid covers 45 RPM changer (will not play 78 or 33⅓ RPM records). Ideal for children and grown-ups alike. Model No. 10-145M. **$29.95.**

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.

TERRIFIC FLUORESCENT FIXTURE SALE

IS YOUR SERVICE DEPT. PROPERLY LIGHTED?

SAVE 50% ON THIS 4-LIGHT FIXTURE

$12.95, TWO FOR $25.00 WITH LAMPS

TOP ILLUSTRATION—This is the finest value in a fluorescent fixture that we have ever offered. Constructed of heavy gauge metal with lustre white enamel finish. All General Electric high power factor ballasts. Furnished with General Electric 36", 30 watt white fluorescent lamps. Fixture may be mounted next to the ceiling or suspended on chains. These fixtures are beautifully constructed. Use them over your service bench, in your display room or in your office. Brand new in factory cartons properly packed for shipment. These fixtures sold for up to $30.00. We bought 6 truck loads and are passing our bargain on to you. Why pay more than this to modernize your shop. Shipping weight 26 lbs. each. Shipped via Express, Rail Freight or Truck only. Stock No. MK-430 fixture complete. Net **$12.95;** 2 for **$25.00.**

DELUXE MODEL WITH GLASS, $14.95; CEILING CANOPY, $1.95

Bottom Illustration

Deluxe Model No. MK-430X, same as No. MK-430 described above with the exception that it has translucent glass over the lamps to diffuse the light. CEILING CANOPY that is shown, **$1.95 extra.** Shipping weight 33 lbs. Net price **$14.95;** 2 for **$28.00.**

Canopy for suspending either of the above fluorescent fixtures 30" from the ceiling. For use where it isn't advisable to mount fixture flush or suspend it on chains. Canopy kit is complete with stamped metal box cover with hardware for mounting to any outlet box and 2—30" lengths of ⅜" white enameled tubing. Ship. wt. 6 lbs. Fixture canopy kit. No. I-30. **$1.95.**

3 SPEED RECORD PLAYER SALE!

PORTABLE MODEL 7843 $15.95

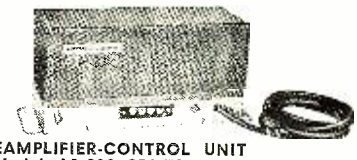
Our new 1954 model 3 speed record player, now offered at a special saving. Model 7843, 3 speed portable electric record player, with a powerful 2-tube plus rectifier and full size Alnico V PM speaker. Plays all three speeds and all three sizes. Crystal pickup has an all purpose three-speed needle. Brown reptile finish leatherette case 12½" x 10⅛" x 5¾". Shipping weight 10 lbs. Model 7843, 3-speed portable record player only **$15.95** each.

3 SPEED WALNUT CAB. PLAYER

Stock No. WC-374, 3 speed record player in walnut cabinet with hinged lid, so that records can be played with the lid closed. Plays all 3 speed and all 3 size records. **$21.95**

Powerful 3 tube amplifier with tone and volume controls. Crystal pickup has two needle flip-over cartridge. Heavy duty Alnico V magnet speaker. Shipping weight 16 lbs. Stock No. WC-374 3 speed record player. Sale price, **$21.95** each.

GENERAL ELECTRIC CUSTOM MUSIC ENSEMBLE



G-E PREAMPLIFIER-CONTROL UNIT
Model A1-200 $56.79

Combines functions of equalized preamplifier plus adjustable record compensation, program input selection, tone controls and volume control. Matching unit for the "Custom Music" amplifier. Self-powered for use with any installation. Net price, **$56.79.** Technical information sent on request.

G-E POWER AMPLIFIER
Model A1-300 $46.80

A medium power, compact amplifier designed to provide needed speaker power. Essential element in the new General Electric "Custom Music" Ensemble. Delivers high-fidelity performance at very low cost. Net price, **$46.80.** Technical information sent on request.

G-E DUAL COAXIAL SPEAKER
Model A1-400 $41.11

New approach to coaxial speaker design—high sensitivity at low cost. Exceptional balance between speakers with G-E Acoustic Balancer. Newly developed Pressure Equalizer . . . a wavefront shaping plug . . . provides smooth tweeter response. Net price. **$41.11.** Technical information sent on request.

SALE! 1954 MODEL TAPE RECORDER $74.95

New, sensational 1954 tape recorder only $74.95. Priced so that anyone can afford to own one. Small, compact size, 9" x 12" x 12". Beautiful two-tone leatherette case. Complete with microphone, 5" reel of tape and take-up reel. Will record for a full hour on a 7" reel. Fast forward and rewind. Frequency response 70 to 8500 CPS. Heavy duty speaker. 3 watt amplifier. inputs for radio-phono and mike. Tape speed 7½ IPS. Weighs only 20 lbs. For 110 volt AC operation. Stock No. 907-67, special sale price, only **$74.95.** 7" reel of plastic recording tape, **$2.49** each or 4 for **$8.79,** extra.

TELEVISION CAB. WITH DRAWER FOR CHANGER

Stock No. SE-21, mahogany combination television-phonograph cabinet. 40" high, 24" wide and 18½" deep. Has blank panel and will hold chassis for 17", 20" or 21" picture tube. Be sure to check your chassis measurements to see that it will fit. TV chassis compartment measures 19" high and 20¾" wide on the inside. Record changer compartment has pull-out drawer with space 19¾" x 13" deep. Baffle cut for 10" speaker. Shipping weight 75 lbs. Via Truck or Rail only. Stock No. SE-21, combination cabinet. Sale price, **$39.95.**

$39.95

BRUSH CRYSTAL EAR PHONE With Control

Simply clip on to the speaker voice coil of any radio or TV set or to an audio amplifier. No soldering necessary. Listen in privately to your favorite programs. The tiny Brush crystal earphone fits your ear just like a regular hearing aid ear piece. A small remote control box enables using 20 ft. from the radio or TV set. Has its own separate volume control and small matching transformer built-in to operate the crystal from any speaker voice coil. Ideal for hospitals, homes, hundreds of other uses. 10 times more comfortable to wear than conventional earphones. Stock No. BH-500 includes Brush crystal ear piece, remote control box, 20 ft. of cable and instructions. Sale price, **$5.49** complete. Brush crystal earphone with 36" cord. Stock No. BR-51, **$2.95.** (You connect it like any crystal earphone, diagram furnished.) Accessory kit includes volume control with switch plus coupling capacity and instructions, **99c** extra.

$5.49

Servicing in the Home

(*Continued from page* 49)

or car. Also, from a customer's description of the symptoms, the technician can, in many cases, determine in advance which parts he will probably need. When a component is required which is not available at hand, the technician must decide whether to take the set to the shop, or get the part and complete the work in the home. The latter might be more efficient, provided the technician checked by phone with his distributor to make sure the item is in stock and, of course, the distributor is not too distantly located.

The tube and parts caddy, shown in the right hand of the technician in Fig. 1, is ideally suited for carrying a selected stock of spare parts and is available as a promotion item from many parts manufacturers.

The objection to customer annoyances is easily overcome by the simple expedient of politely reminding the customer that the labor charge is based on time, and the more they get in the way, the higher the bill will be.

Standard equipment for home servicing should include a masonite board upon which the chassis and test equipment may be set to prevent scratching the table top; also, a drop cloth for the floor is a handy accessory. Above all, use common sense and be careful and you will avoid damage to household furnishings.

When the bill is computed, the labor charge must take into consideration the high proficiency of the technician. The charge-per-hour, in this writer's opinion, should be higher than for the "tube-pulling" type of service call where no test equipment is used. The customer should be made aware of the time and money saved in not having to transport the set to and from the shop. He has the set in his home and not in some shop for an indefinite period of time.

Service technicians doing complete outside repairs would require the same knowledge as the inside bench technician. This means that most outside service technicians of today would require additional training to enable them to do a thorough job in the home. Most of these technicians are desirous of acquiring greater skills and learning more theory. Evidence of this is seen by the attendance at the periodic lectures given by the various test equipment manufacturers and by the circulation of service publications such as this magazine. Consequently, with proper encouragement, there should be no lack of qualified technicians. The higher salaries these technicians will command will be made up by the service operator from the increased business he will obtain from a "complete service in the home" policy.

Some of the definite advantages for the service operator in home servicing are the following:

a. Time and labor are saved when the chassis is not carried on a round trip between the home and shop.

b. The risk of damage to the television chassis while transporting it is definitely avoided.

c. Customer confidence is gained when the work is performed right in his home. Many customers, mindful of some unhappy experience, insist that the work be done in the home.

d. When the service technician is called back to service a new defect, it is easier for him to prove that it is a new defect.

e. The set is worked on in its own location with its usual line voltage, outside interference, etc., instead of at the shop where conditions may be entirely different.

f. While the technician is in the home, he can test all the tubes on the tube checker, replacing those which show up as weak. Besides avoiding a call-back for a tube which, at the time of the service call gave no outward indication of trouble, extra income is obtained by the sale of replacements for weak tubes. Many customers, after having their sets repaired, inquire as to the status of the other tubes. The tube checker gives them visual proof of the need for replacing one or more. It doesn't require any salesmanship to point out to the set owner that replacing those tubes today avoids extra service charges tomorrow.

-30-

Tape Editor's Notebook

(*Continued from page* 51)

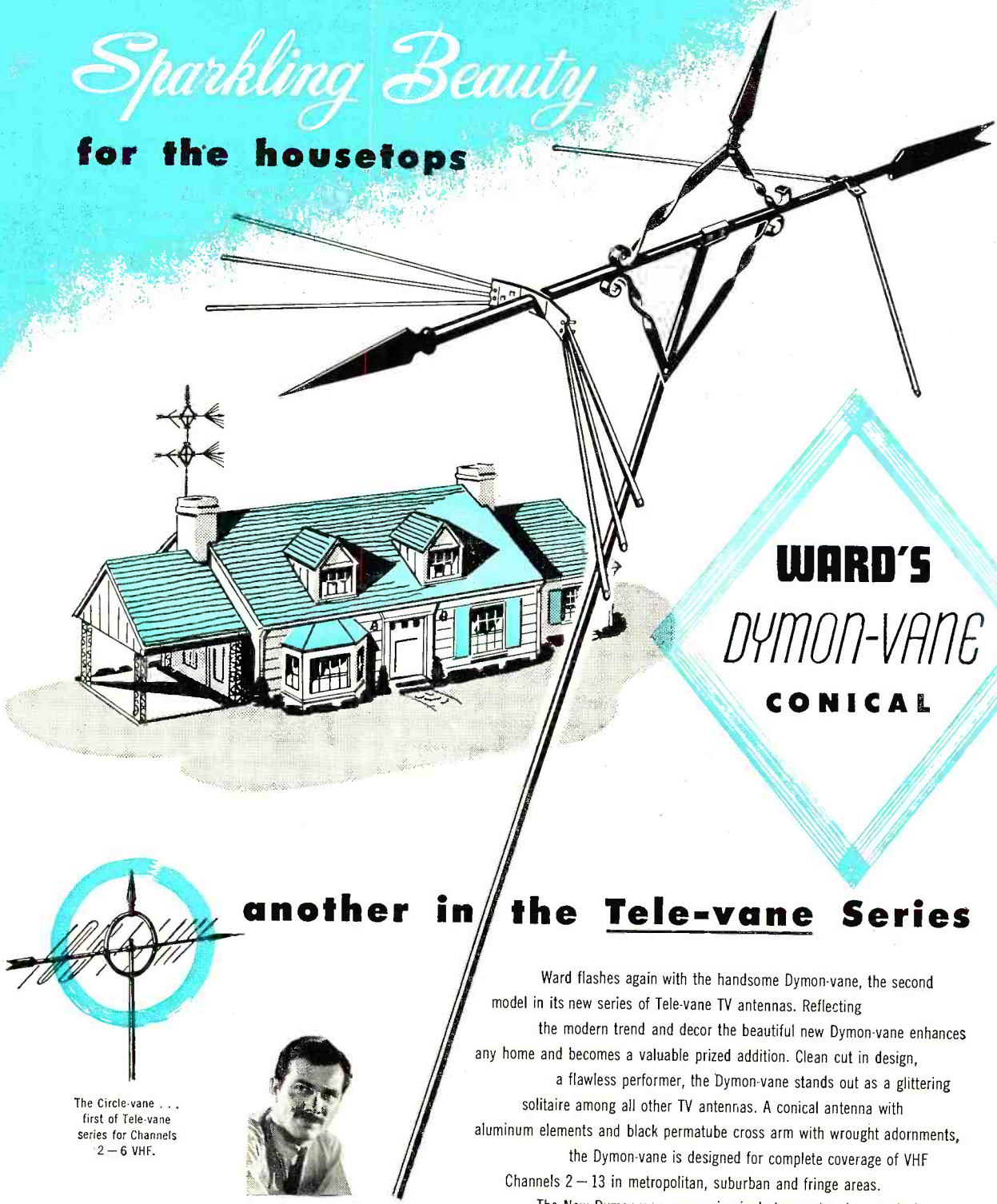
signal to start the machine holding the incoming part. Then this incoming tape or disc is backed away a few turns from the beginning of sound, and a cue mark is made with the grease pencil. With the playback head set at this cue mark, the outgoing part is played and the incoming machine is started on the musical cue. During rehearsal, faders on both machines should be open, as much trial and error is often necessary before perfect synchronism is attained. After the desired effect is reached several times in rehearsal, the operation is repeated with the recorder turned on and the incoming fader closed. Again the second machine is started on cue, the incoming fader is opened, the overlap is made and the outgoing fader is closed. This process requires patience, and occasionally some fancy acrobatics, but when handled properly it will produce the simulation of a continuous performance which can almost never be detected.

In the third part of this series we shall demonstrate how the sound of existing recordings can be improved in the transfer to tape. Dubbing from various recording media will be discussed, with the objectives of better tonal quality, reduced background noise, and the elimination of ticks, pops, and thumps.

(*To be continued*)

Sparkling Beauty

for the housetops



WARD'S DYMON-VANE CONICAL

The Circle-vane . . . first of Tele-vane series for Channels 2 — 6 VHF.

another in the Tele-vane Series

Dave Chapman, S.I.D. Famous designer of the Ward Tele-vane series of TV Antennas.

Ward flashes again with the handsome Dymon-vane, the second model in its new series of Tele-vane TV antennas. Reflecting the modern trend and decor the beautiful new Dymon-vane enhances any home and becomes a valuable prized addition. Clean cut in design, a flawless performer, the Dymon-vane stands out as a glittering solitaire among all other TV antennas. A conical antenna with aluminum elements and black permatube cross arm with wrought adornments, the Dymon-vane is designed for complete coverage of VHF Channels 2 — 13 in metropolitan, suburban and fringe areas. The New Dymon-vane comes in single bay or two bay stacked models . . . folded and pre-assembled ready for easy installation.

THE WARD PRODUCTS CORP.

DIVISION OF THE GABRIEL COMPANY

1148 Euclid Avenue, Cleveland 15, Ohio

A GABRIEL PRODUCT

In Canada: Atlas Radio Co., Ltd., Toronto, Ont.

Amateur Facsimile

(*Continued from page 48*)

100 microamperes at the last dynode was obtained by the use of about 800 volts across the nine stages of the photomultiplier. Thus, video signals on the order of 1 to 2 volts were available for application to the mixer.

As a result of the policy of using what was at hand, the power transformer in this supply is somewhat heavy for the actual requirements. The unit, a *Thordarson* T21P89, is rated at 250 ma. with a d.c. output of 450 volts d.c. in normal full-wave power supply service. The current requirements of the photomultiplier system are quite small and any transformer that will give 800 volts, as connected in Fig. 9, will do.

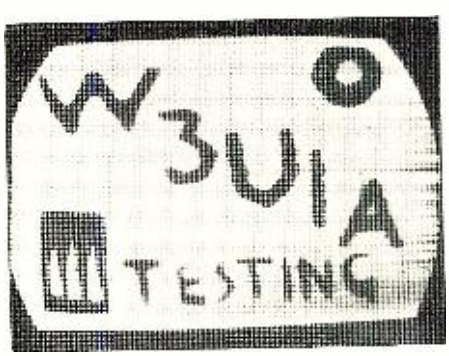
The sync, mixer, and r.f. unit, shown diagrammatically in Fig. 8 contained a 30-second time-base generator built around a 6AK5 tube but almost any pentode would have been satisfactory. The anode of the tube was connected directly to one of the *Y* plates of the oscilloscope, and the grid circuit of the tube had a 2-pole, 3-position switch incorporated in it. The purpose of this switch was to initiate the time base during normal operation and also to provide the maximum and minimum plate voltages in setting up the vertical shift circuits on the flying-spot scanner.

The line sync-pulse generator consisted simply of a 15-cps multivibrator built around a 6J6 tube and synchronized to the line frequency. The waveform developed at one of its plates was differentiated and fed *via* a diode to the oscilloscope and the mixer unit. The mixer unit consisted of a resistance network arrangement as shown, the output being fed directly to the suppressor of a 6AS6 tube used as an oscillator. This tube was chosen as a low-power oscillator because its suppressor grid characteristic afforded good d.c. modulation of the radio frequency output.

Receiver

A war-surplus receiver type BC-AR-229 was used at the receiving station and its video output was fed *via* a one-stage amplifier directly from the

Fig. 10. A sample picture from the simple facsimile system. With gamma correction and a better optical system resolution equal to television should be obtainable.



Again proving tube-design leadership...

40% OF 1952's NEW RECEIVING TUBES WERE G-E DEVELOPMENTS...TWICE ANY OTHER MAKE

FOURTEEN out of thirty-five registered *new* receiving-tube designs —40%—were G-E, in the last calendar year, 1952. As still further proof of leadership... new G-E types numbered more than twice those of any other manufacturer!

Outstanding research and development by General Electric have given to the TV-radio industry its newest, most advanced tubes. You can be sure, when servicing latest-model receivers, that G-E tubes are available for every need—that G-E leadership in tube development brings you the finest obtainable product. Every working day, you will receive extra dividends in superior performance and reliability.

You can expect more new and improved tubes from General Electric in the months ahead—types that will make your work easier and cut callbacks. Keep in touch with your G-E tube distributor for forthcoming new-tube announcements, each with a profit message for you! *Tube Dept., General Electric Co., Schnectady 5, N.Y.*

SHOWN BELOW: a few of the many new G-E tubes that are making money for service dealers.

You can put your confidence in—

GENERAL ELECTRIC

161-1A8

detector of the receiver to the *Z* axis input of the *Du Mont* oscilloscope, type 304H, as shown in Fig. 7. The oscilloscope was synchronized by means of the output of the sync-pulse discriminator, and the *Y* plates were d.c. connected to the output of a 30-second time-base generator as shown in Fig. 5. For convenience a *"Polaroid Land"* camera was used for recording the received pictures although a larger picture could be obtained using ordinary roll film in a conventional camera with a portrait lens attachment.

A box camera may be used by providing a light-tight box to support the camera a foot or so away from the scope face, and installing a portrait lens attachment to reduce the focal length of the camera lens.

To initiate operation, switch S_1 of Figs. 7 and 8 are thrown from position 2 to position 3 simultaneously. For on-the-air tests, the start signal could be transmitted orally by the microphone, or by a tone signal to actuate a frequency-sensitive relay.

Results

A typical example of the recorded pictures is shown in Fig. 10. Black-and-white copy gave the best reproduction because no gamma correction has been incorporated into the system. With gamma correction and a better optical system for use with the flying-spot scanner, pictures should be produced with the resolution of television pictures.

However, the simple and economical system described in this article should be capable of stimulating an interest in facsimile transmission in the ranks of radio amateurs, and it is hoped that this article may be instrumental in opening up a new field of amateur activity. —30—

DAMAGED 6V6 IN RAYTHEON 16AX23 TV SETS

By GEORGE ANGLADO

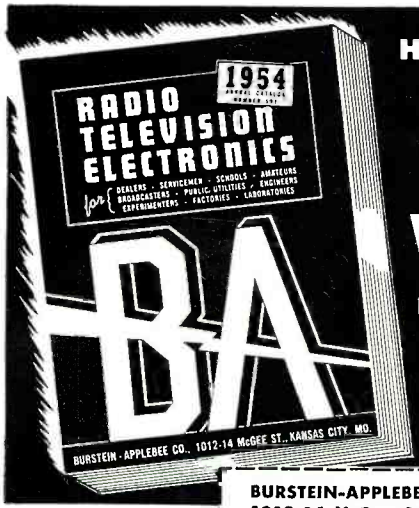
MORE than one of these sets have come into the shop with a blown-out fuse and damaged 6V6 tube. We couldn't understand how a tube could be damaged by a simple fuse blowout. However, upon examination of the schematic, it was found that the fuse was connected in the plate supply line of the 6V6 tube. When the fuse blows, the plate supply is cut off, but the screen has 240 volts applied to it which results in a damaged tube.

Future trouble was eliminated by disconnecting the red lead of the vertical output transformer from "B+" and connecting it to pin 5 of the power jumper socket. —30—

PRODUCTION HIGH

AUGUST production of both radio and TV sets was at the highest level for that month since 1950, according to figures released by the RETMA.

603,760 TV receivers and 991,637 radios were produced during August as against 397,769 video sets and 607,402 radios for the same period last year. TV total for the first eight months is 4,754,285 units. —30—



HERE ARE JUST A FEW OF THE

BIG VALUES

IN THE 156 PAGE 1954 B-A CATALOG

WRITE US, IF YOU HAVE NOT RECEIVED IT

FREE

1954 B-A CATALOG

BURSTEIN-APPLEBEE CO.
1012-14 McGee St., Kansas City 6, Mo.

☐ Send Free B-A Catalog No. 541
☐ My order attached for items in this ad.

$..... enclosed.

Name.....

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ALL ALUMINUM PORTABLE FOLD-AWAY TABLES

2 SIZES

LIST PRICE $21.95

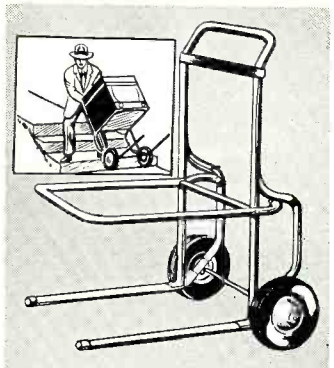
$15.95 24"x60"

Powerfully constructed of aluminum top and tubular aluminum legs. Full table height. New patented Saf-T-Lock Hinge.
Versatile, go-anywhere, all-purpose tables for 1001 uses. "Just it" for the Radio or TV Serviceman to provide work table at service jobs in the home, for anyone for on the spot table needs. anywhere. Fine for workshop, in home for cards and serving, for picnics, in business for displays, counter, even as an attractive desk. Sturdy—supports up to 1000 lbs.
Tables fold or unfold easily, quickly—easy to carry as luggage, have leather handle, take little room in car, store on edge when not in use.

No. 40A183. Size 24"x60" open, closed 24"x30". Shpg. wt. 21 lbs. List Price $21.95. **NET EACH**..... **$15.95**

No. 40A184. Size 30"x72" open, closed 30"x36". Shpg. wt. 27 lbs. List Price $29.95. **NET EACH**..... **$20.55**

TV TRUCK

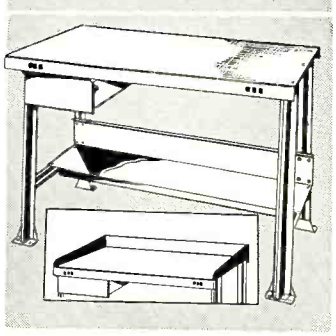


Makes Home Demonstration, Delivery and Pick-Up for Service of TV Sets a 1-Man Job.

Equipped with special stair climbing feature for safe movement on steps; engineered to handle largest or smallest set—console or table; reduces set and cabinet damage from handling; lightweight, compact; equipped with 8-in. semi-pneumatic ball bearing wheels. Folding tray supports table set 16" above floor . . . folds back for consoles. Supplied with strap that fastens securely around set in moving. Constructed of tubular steel, grey finish. Shipped K.D. in flat carton 20"x 39½"x4¾". Shpg. wt. 25 lbs.

No. 40A205.
NET EACH..... **$23.95**

SHOPMASTER WORK BENCH



Sturdy all steel (16 gauge) construction. 48" long x 24" wide working surface of ½" masonite on steel top. Stands 32¼" high and has bottom shelf for tools and equipment. Smooth sliding 12" wide, 18" deep, 5" high drawer handy for small tools. Has provision for padlock. Steel form channel legs provide extra strength. Supports vises, drill presses, jig saws, grinders, etc., with ease. 6 built-in receptacles ready for wiring to electrical power. Grey finish. Rear and side risers optional. Shipped K.D. wt. 80 lbs.

No. 6A94. Net Each ... **$24.75**

Rear and Side Risers. 6A95. Wt. 6 lbs. **Net Each** **$4.50**

COMPLETE AM-FM HI-FI RADIO CHASSIS

NATIONALLY-KNOWN MAKE

REGULAR $138.50 NET VALUE

FOR ONLY **$99.50**

DeLuxe Tuner Chassis and Amplifier power supply in separate units with 20 Tubes including tuning eye and rectifiers assures maximum efficiency of each unit and provides more latitude in installations.

The Tuner, an AM-FM Superhet Features: Built-in Pre-amp for use of GE or other Variable Reluctance Cartridges, as well as Crystal type, 6-gang Tuning Condenser, AVC, Separate Full Range Bass and Treble Controls, Fly Wheel Tuning Drive, Tuning Eye.

Separate Tuned RF stages are employed on both the AM and FM bands to provide extreme sensitivity and minimize spurious responses. The FM circuit also includes two stages of high gain IF amplification and a ratio detector circuit of advanced design—all stabilized against drift.

Tunes AM: 535 to 1720 KC—FM: 88 to 108 MC. Sturdily built with pleasing panel, indirectly illuminated "Slide" Rule Dial. Controls at front include 3-position selector switch for Phono, AM, FM radio. AC phono outlet in rear. Supplied with AM loop antenna and FM flexible dipole with provision for external antennas.

Tube complement: 2-6BA6, 2-6BE6, 6C4, 6SG7, 6SH7, 6J5, 6SQ7, 6AL5 and 6U5. Supplied complete with tubes, antennas and hardware.

The Power Supply and Audio Amplifier, designed specifically for above, features Parallel Push-Pull Beam Power Output . . . 18 watts undistorted, 25 watts max. power. Extended Range Hi-Fi Response, Inverse Feedback, Output Impedance 4, 8, 15, 250 or 500 ohms. Tube Complement: 2-6J5, 4-6V6, 2-5Y3. Supplied complete with tubes and connecting cable.

Dimensions—Tuner: 13½" W. x 8½" H. x 9" D. Wt. 10 lbs. Amplifier: 13½" W. x 7½" H. x 7" D. Wt. 18 lbs. Operate from 105-125 volts AC; 50/60 cycles. Shpg. wt. of both 31 lbs.

No. 31B217-2. Tuner and Amplifier
Complete Ready to Operate. Both for Only..... **$99.50**

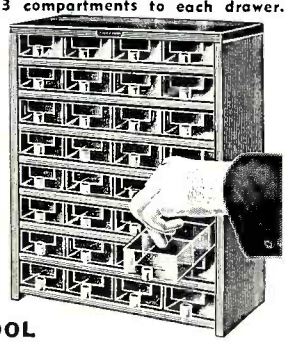
COMBINATION DEAL—Above Tuner and Amplifier with Garrard Changer and GE Variable Reluctance Turnabout Cartridge.
Deal No. 31A282. Shpg. wt. 53 lbs. **Special**..... **$139.50**

HANDY METAL STORAGE CABINETS

WITH CLEAR PLASTIC DRAWERS

Provides an easy-to-find arrangement for small items in store, office, shop, home . . . anywhere.

The ideal storage cabinet for stocking and storing of hardware, small parts, tools, etc. Made of sturdy steel, handsomely finished in baked grey enamel. Can be stacked side by side, back-to-back or one on top of the other. Heavy molded plastic drawer features a name plate holder, safety catch to prevent accidental spillage. Size of drawers 5¾x2¾x1¼", each provided with two removable plastic dividers making possible **3 compartments to each drawer.** Overall depth all size cabinets 6".



12 Drawer, 6" H. x 12½" W. **$5.83**
No. 36B85. Wt. 6 lbs. **Net Each**...

16 Drawer, 8" H. x 12½" W. **$6.81**
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20 Drawer, 10⅛" H. x 12½" W. **$7.79**
No. 36A147. Wt. 9 lbs. **Net Each**...

32 Drawer, 15¼" H. x 12½" W. **$12.69**
36A118. Wt. 10½ lbs. **Net Each** ...

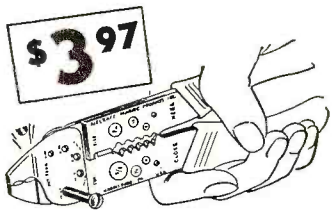
64 Drawer, 15¼" H. x 25" W. **$24.45**
40A154. Wt. 25 lbs. **Net Each**.....

128 Drawer, 30½" H. x 25⅛" W. **$54.83**
No. 45W12. Wt. 50 lbs. **Net Each**

AMP HAND TOOL

CRIMPS SOLDERLESS TERMINALS TO WIRE . . . SHEARS BOLTS . . . CUTS, STRIPS AND GAUGES WIRE

Never before a single tool with so many uses. Crimps solderless terminals (see page 81) to wire ends; Shears bolts sizes 10-24, 10-32, 8-32, 6-32, and 4-40 to desired length without damaging threads; Strips, Cuts, and measures wire, sizes 22 to 10.



$3.97

No. 15B268. Each..... **$3.97**

Asst. of 100. Solderless terminals, most popular sizes.
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RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

THE managing director of the Television Technicians Lecture Bureau recently made an announcement of a new program that is of special significance to every man who operates a full-time service business, whether it is a one-man shop or a fifty-man organization.

This announcement stated that the Bureau was commencing a service business registration program for the purpose of compiling and publishing a National Electronic Service Directory. The major purpose of this program is to establish the identity of businesses engaged in the servicing of radio, television, sound, and electronic products and to pave the way for direct contacts by manufacturers with competent service companies as new types of electronic devices are developed. Also, there are strong indications that closed-circuit television will go through a period of rapid growth during the next few years. Manufacturers of closed-circuit TV systems will need to locate qualified independent servicing companies in all sections of the country as the applications for these systems expand.

The National Electronics Service Directory will be presented alphabetically by states, with cities and towns listed alphabetically under each state. The listings of the individual service businesses will also be made in alphabetical order with each listed service business coded to identify its size and facilities.

No charges will be made for a conventional style of listing. The only requirement is that the business must be an established service business requiring the entire time and attention of at least one man. Service businesses listed will include all types of companies that handle the installation and servicing of electronic products. The business can be either an exclusive servicing company or it may be a full-fledged department of a retail establishment.

It is felt that the publication of the National Electronics Service Directory will bring six distinct advantages to the independent servicing industry:

1. It will establish the fact beyond question of a doubt that radio, television, sound, and electronics servicing is handled by an established independent industry and not by a shifting mass of nameless and faceless electronic mechanics.

2. It will put the fact on record that the bulk of the service business is being handled by legitimate service businesses ranging in size from one-man shops to organizations employing ten or more technicians.

3. It will show that competent independent service facilities and personnel are available in all sections of the country—businesses fully capable of handling any type of radio, television, sound, or electronic installation and maintenance if the right kinds of information are made available to them.

4. It will provide the reasons why set manufacturers need not set up their own national or distributor-operated service organizations to handle the installation and servicing of color television receivers.

5. It will help manufacturers of closed-circuit TV systems and of electronic control devices to directly contact competent service companies in all sections of the country where their products may be sold.

6. It will help to channel more industry money into public relations and other programs that are of distinct value to established service businesses.

All listings in the National Electronic Service Directory will be coded to show organizational information and the categories of service each business is currently handling.

It is the Bureau's plan to make copies of this directory available to the more than four thousand manufacturers that are now engaged in producing a wide variety of radio vacuum-tube devices, many of which are for limited applications. It will make it possible for such manufacturers to contact competent service operators in any city or section where their devices are sold.

Color TV Service

Some service authorities feel that many set manufacturers will arrange to provide either direct factory service or distributor service to buyers

of color television receivers. They feel that annual service contracts will be widely used again to insure prompt and efficient service on color sets. Service sold on an annual contract basis enables the service company to maintain a stable, year-round staff of competent technicians and cushions the drop in service income during the normally four bad mid-year months.

It is felt that the information on service businesses that will be provided in the National Electronics Service Directory will convince most set manufacturers that color TV installation and maintenance can be capably handled by the independent service businesses now in operation.

An official form has been prepared for service directory registrations. No listing will be made except those submitted on the official TTLB form. These forms are available without charge from most electronic parts distributors. Copies may also be obtained by sending a stamped and addressed envelope to TTLB Directory Department, P. O. Box 1321, Indianapolis 6, Indiana.

Cost of Doing Business

Even the smallest service operators are taking a sharp look at their costs of doing business. With living and operating costs at a high level, a man cannot stay in business very long unless he is able to make a living for himself and pay for all of his costs of operation.

Further, set owners are gradually getting wise to the sharp boys who advertise low service charges and then stick their customers for tubes and parts—many of which they don't put in. Now and then we get reports of set owners who have allowed the "price" operator to fix their sets, got an itemized bill for the tubes and parts and then refused to pay for the service because they were charged for parts that were not used. There isn't a thing the sharpie can do except take his loss of time and those parts he did not put in. The law is on the customer's side.

More and more district attorneys are leaning toward the opinion expressed by Tarrant County's District Attorney, Howard M. Fender, in the talk he made at the Texas Electronic Association's convention in Ft. Worth, Texas:

"I hate a cheater worse than almost anything else in the world . . . a man who will take advantage of the ignorance of his customers in order to perpetrate a fraud upon them is less than nothing in my sight. and I have no use for him. I am personally willing to bend whatever energies are present in my office to prosecute a person of that type."

Russ Hansen, of *Motorola, Incorporated,* has developed some very interesting tables on the cost of operating a TV service business. Mr. Hansen has pointed out consistently in his talks on service business management that the ratio of payrolls to service

income should not exceed 40% if the business is to pay its owner a reasonable income and a small return on his investment.

As an example of the accuracy of these tables, a company that pays its field service technicians $80.00 per week for a five day, eight hour-per-day week, must get five dollars per call if its technicians average 8 calls per day. This checks against actual operating costs that have been furnished to the Bureau by a number of service executives whose records are regularly checked by accountants. Most companies have difficulty maintaining this average of 8 calls-per-man-per-day.

In a one-man TV service operation it is difficult for the operator to average over four calls per day. On an average of 4 calls per day and working a five day week it would be necessary for the technician to get ten dollars per call in order to earn for himself an $80.00 per week take home pay. Of course, most men who operate independently do not observe an eight-hour per day, five days a week schedule. Where they charge $2.50 per call they must complete 80 service jobs per week to make $80.00 per week "take home" pay for themselves. Those who charge $3.50 per call have to handle 65 service jobs per week to earn the eighty dollars a week for themselves.

Standard TV Labor Charges

The standard TV labor charges that have been made available to readers of this department have helped hundreds of small service business operators to up-grade their charges for services to a more realistic level. Obviously, very few service businesses can afford to hire cost accountants to help them figure their costs of operation. In a small shop, where one man must spread his attention over many things, it is often difficult to stay with one major service job until it is completed. More often than not, sets pulled to the shop for service are checked and repaired on a piecemeal basis. The standard TV labor charges charts provide a yardstick to measure what the charges for any type of service job should be when handled by an efficient service business.

The newer chart makes it easier to figure estimates. It also provides flat rate schedules for circuit checking with very nominal charges for the actual time it takes to remove and replace components. The new chart is called form TVL#2. The original chart is known as form TVL#1. Both of these charts are available printed on bristol board 11 x 14, suitable for use under glass or as wall charts. Both charts may be obtained by mailing $1.00 to TTLB, P. O. Box 1321, Indianapolis 6, Indiana, and asking for wall charts TVL#1 and TVL#2.

Color TV Progress

Most everyone in the industry expects the FCC to approve the standards for compatible color television recommended by the NTSC (National Television System Committee) before the end of this year.

Recently the NTSC delivered technical documents weighing fifty-two pounds and two ounces, to the Federal Communications Commission in support of its request for adoption of its proposed standards for a compatible color television system. FCC approval will probably usher in a mad race among manufacturers to produce all of the equipment that will be required for the completion of color TV sets. However, industry leaders have predicted that only a small percentage of television set production will be in color receivers next year. Production is not expected to exceed one per-cent of the total set production in 1954 at prices considerably higher than comparable black and white sets. Some estimates have ranged from $800 to $1000 for a color set with a 14-inch picture tube.

The sixty-four dollar question among manufacturers, set distributors, and dealers is whether the public will "sit it out" with their old sets waiting to buy color sets when they are available at nominal prices. Even those dealers who are most optimistic about the continuing market for monochrome sets despite the imminence of color realize they have a tough selling job ahead of them that will get even tougher as larger segments of the set owning public get to see color receivers in operation. Many dealers are jittery about the sale of monochrome sets taking a sharp nosedive right after the holidays and staying there until growing production of color receivers breaks the buying drouth.

We're in a Buyers' Market

For the first time in many years manufacturers of tubes and components find themselves deep in a buyers' market. The long-time boom that absorbed manufactured items almost faster than they could be produced dulled the selling effectiveness of many organizations. Now they are all faced with the necessity of sharpening up their sales and sales promotional programs in trying to retain their places in a market where they are trying to shove more products than it normally could absorb.

The economic situation now shaping up in the industry will give the independent service industry its greatest opportunity during the next two years to establish service as a stable, respected, and profitable segment of the electronics industry.

If set owners generally "sit tight" with their present TV sets waiting for color receivers at a price they can afford, the demands for service will increase. More and more sets that go into their fourth and fifth years of operation will increase the volume of major service jobs required. All indications are toward a growing volume of service that will permit established businesses to entrench their operations

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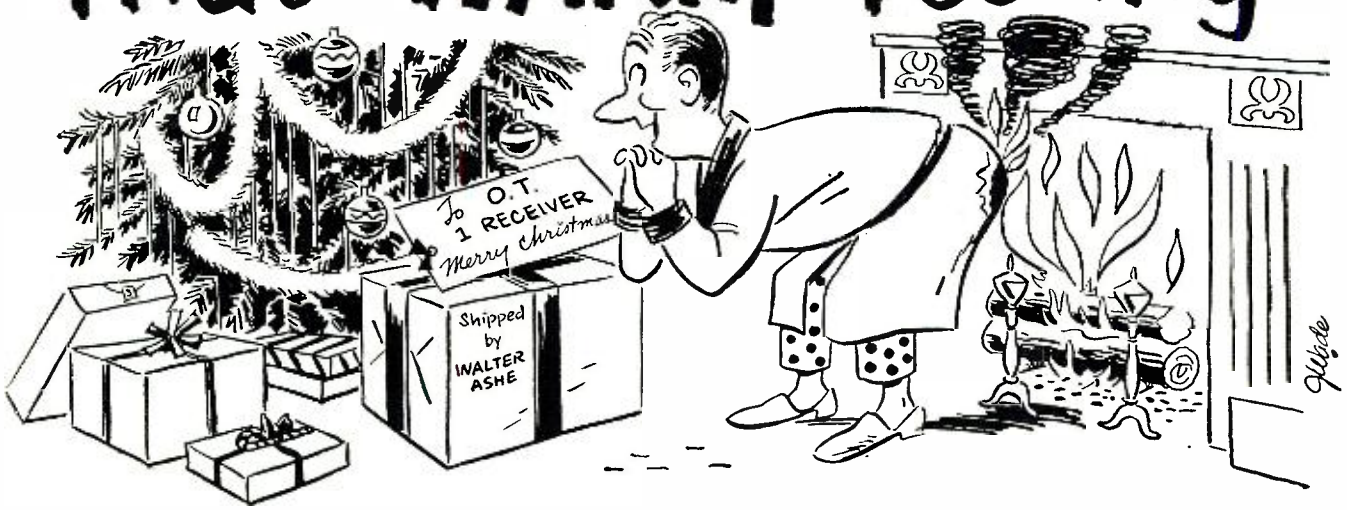

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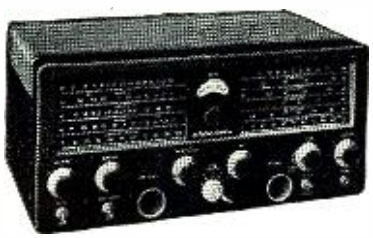

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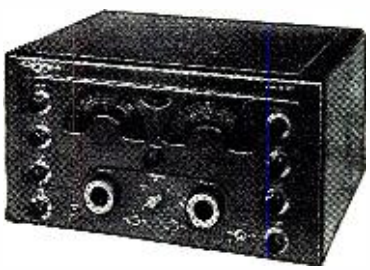

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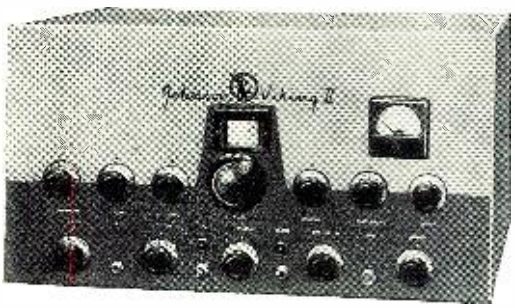

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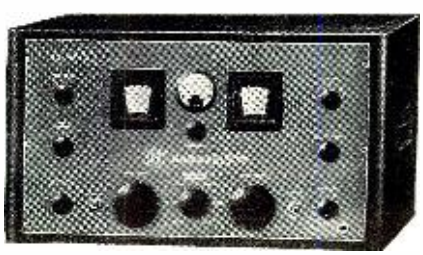

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and prepare for the real boom that will occur when color receivers become available in volume.

The bottleneck in the large scale production of color sets will be picture tubes. However, the electronic manufacturing industry has pulled production rabbits out of a hat time after time since TV was first launched commercially in 1946 and they will work this problem out too.

But the greatest boom the industry has yet experienced is expected to develop when color receivers become available at a price the average consumer can afford to pay. There is no question that every one of the present twenty-four million owners of monochrome sets will want to own a color TV receiver as soon as they see one in operation.

The big question is, of course—to what extent will the independent service industry share in the color TV boom? The answer to that rests largely in the hands of the people who are now operating successful service businesses. If they continue to work along as rugged individualists, take no interest in cooperating with their fellow service businessmen in programs for their common good, or fail to cooperate in programs designed to bring industry recognition of the importance of service as a vital factor of the electronics business—then the opportunities of the next year will be lost and the color TV boom will find independent service shoved back again to an insignificant position in the industry's spectrum. —30—

Certified Record Revue

(*Continued from page 70*)

thoven 5th symphony records you're likely to hear for a long time. None of the previous versions can hold a candle to these discs, but between the *Mercury* and the *Victor*, there is also a difference. For sheer sound, the Dorati version wins the potted palm. The Toscanini disc is a good clean recording, but suffers from a dry, nonresonant type of acoustical environment. Dynamic and frequency range is somewhat restricted. The *Mercury* disc has its familiar big hall liveness, incisive strings, and bright brass. It also has what has long been missing from all recordings of Beethoven's 5th: great dynamic range and superb transient response. The orchestration of this symphony demands that these two conditions exist. This is the first time I have heard the Beethoven 5th with the score completely articulate and cleanly delineated. Musically, we have the formidable Toscanini to deal with. No doubt about it. The Maestro knows his Beethoven. His reading is tremendously powerful, hugely conceived. He drives his orchestra at a furious pace, becomes almost frenetic. In fact this pace has made Toscanini the target of much criticism. Dorati has a much more leisurely conception of the score, and while he may not have lived with the 5th symphony as long as the Maestro, he knows his way around the complexities and the pitfalls and his reading leaves little to quibble about. Both recordings have nice quiet surfaces, and follow their prescribed equalization, with the *Victor* disc requiring a slight boost in bass and treble.

VERDI
OTELLO
NBC Symphony Orchestra conducted by Arturo Toscanini with soloists, and chorus. Victor LM 6107 (three 12" LP) Orthophonic curve. Price $17.16.

I don't know how many of my readers like opera, but as a musically literate group there's bound to be enough of you to warrant an occasional foray into this field. In this recording of "Otello," there is enough sound and fury and good musical drama to break down even the most hidebound opera-hater. This is really one of the outstanding opera recordings in many a year. From the very opening bars, the music hits you with tremendous impact, and as the violent drama unfolds, you sit enthralled by the consummate artistry of Toscanini. For this recording is the quintessence of Toscanini. His is the driving, almost elemental force that makes this performance a monument to his conducting. I have never been one of that group of sycophants to whom Toscanini is almost god-like. I admire and respect the old man, but I am not so blinded by his virtues that I can't see his faults. There have been many times when one of his performances has been called great, but which in less emotional analysis was merely competent. Not so here. This *is* great, as shown by his subtlety of phrasing, his sure deft handling of large tonal masses, the iron control he exercises over all the forces at his command. The orchestra and the chorus are at their best here, with great precision being coupled with sumptuousness of tone. The two faults in an otherwise wonderful recording are the somewhat inadequate soloists, and the sound itself. This disc was made from air checks of the famous broadcast in 1947 and is about what you would expect from that period. Not at all wide range, or distortion-free, but nevertheless acceptable by reason of the great music. I had to search around a bit for a proper curve to reproduce this satisfactorily. An 800-cycle bass turnover with a 6 db roll-off in the high end seemed best suited. Surfaces were moderately quiet.

COPLAND
THIRD SYMPHONY
Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury "Olympian Series" MG 50018. AES curve. Price $5.95.

This will probably go down in history as one of the finest lease-breakers ever devised! I have seen a great many extravagant claims by manufacturers of discs lately, in which they tout one of their recordings as "the

highest fidelity ever made, etc." You know, after a while this sort of thing gets to be a little ridiculous. What are they trying to prove? Anybody who wants to can stick a mike right down inside every instrument and come up with some pretty fantastic sounds. The only trouble is, it isn't music. *Mercury* makes no claims about this disc being the most ultra-stuff, or super-something. They don't have to. If you play this disc as per *Mercury's* suggestion, at full room volume, it will advertise itself in no uncertain terms. This is just about the most fantastically accurate representation of the original musical performance I have ever heard from a phonograph record. Strong words? You bet! When you hear the section in the last movement known as the "Fanfare," I'm sure you'll agree. Absolutely tremendous bass drum and tympani, the bright blare of massed trumpets, huge cymbal and gong crashes! With a big speaker system those bass drum blasts hit you like a low blow to the stomach. *And yet,* there is *no loss of proper musical balance or perspective.* That is the crux of the matter. This isn't phony sound for trick effects. When you listen to the recording as a whole and pay attention to the dynamics involved, you realize those huge sounds are properly represented. And mind you, this is still done via the single- *Telefunken* and *Miller* cutter routine. I stress this because so many outfits are trying to pull rabbits out of the hat with trick sounds designed to bowl you over. This is a very unhealthy trend, as unhealthy as these set manufacturers calling everything they make, "high fidelity." I think I stated in my very first column, that we should not forget, in our quest for "perfect sound," that we are still dealing with music and must, perforce, stay within the bounds of good taste. I certainly have no objection to exciting sounds as long as musical values are preserved. Musically, Copland's Third Symphony can probably be gauged his most important work. Many parts of the writing remind you of his "Appalachian Spring" and "Billy the Kid." A work of great contrasts, it can be alternately soft, almost pastoral in nature and swiftly change to dance rhythms with more than a hint of jazz figurings, and then to the thundering perorations of the "Fanfare" and the finale. It goes without saying that this disc will be used for hi-fi demonstration purposes. The happy thing about this fact is that this is wonderful, brilliant and interesting music. We won't have to endure some dreadful cacophony just for the sake of some "super-sound." I understand Dorati's performance has the blessing of the composer himself, in this first recording of the work. I've never heard a "live" performance of this work, but Dorati certainly seems to be authoritatively at home with the complex score, and the playing he elicits from the Minneapolis is magnificent. In fact, with this recording,

and other recent efforts, the Minneapolis Symphony must be reckoned with as one of the most potent top rank orchestras in the country. The AES curve reproduced the record without recourse to touch up on bass or treble. Surfaces were quiet. Everything considered, one of the top releases of the post-war era.

BERLIOZ
ROMEO AND JULIET
Boston Symphony Orchestra conducted by Charles Munch with chorus and soloists. Victor LM-6011 (two 12" LP) Orthophonic curve. Price $11.44.

The advent of a complete version of this work is likely to cause some consternation among those who invested in the excerpted LP recently issued by *Columbia*. Well, that is LP for you! It's either feast or famine. This latest recording is one of *Victor's* best efforts with their new Orthophonic recording. A fine orchestral balance is matched by good acoustic treatment. The surprisingly good choral work is clean and articulate. Soloists are in proper perspective to the greater tonal masses. *Victor* advertises this disc as, "For Hi-Fi fans," on a little sticker applied to the front of the album. This *is* a good recording and I certainly recommend it to those interested in this work. But I don't think it need be called "Hi-Fi." The dynamic and frequency response still fall a little short of the efforts put forth by several other companies. Charles Munch, certainly one of the most controversial conductors of the Boston Symphony, is at his best here. Throughout the recording, the score bears witness to his painstaking efforts, in this highly polished performance. The orchestra is rich and sonorous and sympathetic to every demand made of it by the conductor. The recording followed the Orthophonic curve with a couple of db boost in the bass end adding an extra fillip. Quiet surfaces and the inclusion of a libretto complete the bonus picture.

HANSON
SYMPHONY #4
HARRIS
SYMPHONY #3
Eastman-Rochester Symphony Orchestra conducted by Howard Hanson. Mercury "Golden Lyre Series" MG 40004, AES curve. Price $5.95.

This is the second recording of the Hanson 4th and a most welcome one. The previous effort by American Recording Society was but a miserable shadow of the stature of this work. One of the most lyrical of modern symphonies, Hanson wrote the work as sort of a Requiem Mass for his Father. Though an intensely personal and dramatic work, it is completely fascinating in its complex orchestration and never for a moment does it become maudlin. The sound is magnificent. Take a listen to the Dies Irae, which is actually the scherzo. Against the background of the main orchestration, mostly heavy brass and strings, listen to the infinitude of detail that you can hear. This is a test

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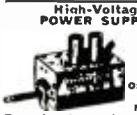

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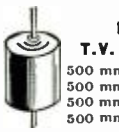

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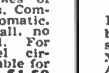


50 - 1½ and ½ watt, 25 - 1 Watt, 25 - 2 Watt. All new, all clean. Good value $2.65
List price—$15.00

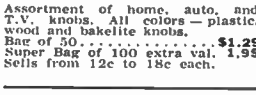
Hi-Voltage T.V. CONDENSERS

500 mmfd 10KV. $ .39 ea.
500 mmfd 15KV. .49 ea.
500 mmfd 20KV. .49 ea.
500 mmfd 30KV. 1.59 ea.

5" Utah AUTO SPEAKER
3-4 Ohm V.C.—4 Ohm Field

Exceptional price for a standard well-known speaker. Designed for auto radio use. **79c**
List price—$5.05

KNOB KIT (Choice Groups!)



Assortment of home, auto, and T.V. knobs. All colors — plastic, wood and bakelite knobs.
Bag of 50 . . . . . $1.29
Super Bag of 100 extra val. 1.9$
Sells from 12c to 18c each.

..OLD FASHIONED SAVINGS!

Cathode Ray TUBE REJUVENATOR

Fits all makes of picture tubes. Completely automatic. Easy to install, no tools needed. For A.C. parallel circuits. (Avaiable for all sets.) $1.59
YOUR OLD PICTURE TUBES ARE STILL USEFUL
List price—$5.95
Everyone is a potential user—10 for $14.90

Army - Navy HEADSETS

Individually boxed. Very sensitive. Meets both Army and Navy specifications.
Ea. per set. $2.95
List price—$16.00

4x6 Inch Quam P.M. Speaker

Alnico 5 Field. Lowest price oval speaker ever offered. Can be used in almost every table model television set. Exceptional value and high quality. $1.95
List price—$4.75

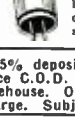
12" Magnavox P.M. Speaker

Heavy Magnet. Delivers high volume and clear tone. Ideal for radio and P.A. use, and replacement of small speakers—for better tone. $5.95
List price—$11.50

Volume Control Kit

Kit of 10 includes 3 wire-wound, 2 dual post, 5 carbon
The price of one (1) for the quantity of ten (10). Short and long shaft.
PER KIT $1.79

AUTO VIBRATORS
(Kit of 5)



Sync. and non-sync. Mfd. by Oak Mfg., Electronic, others. Four (4) and seven (7) prong. $1.95

Kit of BATTERY PLUGS

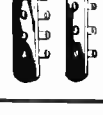
Polarized, 3, 4, 5, etc.
50 for **$1.69**

TERMS: A 25% deposit must accompany all orders—balance C.O.D. All shipments F.O.B. Irvington warehouse. Orders under $10—$1.00 Handling Charge. Subject to prior sale.

SOLDER LUG STRIPS

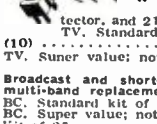
Kit of 48—very usable assortment of solder lug terminal strips. Brand new. Unusually fine value!
Comp. Kit of 48 . . . **89c**
List price $4.00

TERMINAL STRIPS



Assortment of 50 terminal strips (screw type). Kit contains wide selection to meet every design.
Kit of 50 . . . . . **89c**
2, 3, 4 and 5 screw strips.

T.V., RADIO, and F.M. COIL KITS



Kit for television servicemen and experimenter consisting of width coil, peaking coil, 4.5 m.c. ratio detector, and 21.9 m.c. IF coil. TV. Standard kit of ten (10) 99c
TV. Suner value; not duplicated. 25—$1.85
Broadcast and short-wave, midget to multi-band replacement coils.
BC. Standard kit of ten (10) 99c
BC. Super value; not duplicated.
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BC kits include RF, Osc., IF, and detector coils.

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0A2	.74	6BJ6	.43	12BD6	.45
0B2	.81	6BQ6GT	.79	12BE6	.39
0C3	.72	6BQ7A	.90	12BF6	.39
0D3	.70	6BZ7	.90	12BH7	.63
0Z4	.55	6C4	.37	12BY7	.65
1A5GT	.30	6C5GT	.39	12BZ7	.65
1A7GT	.47	6C6	.58	12C8	.34
1AX2	.62	6CB6	.44	12J5GT	.42
1B3	.68	6CD6G	1.11	12J7GT	.59
1B7GT	.30	6D6	.45	12K7	.59
1C5GT	.43	6E5	.48	1258	.62
1E7	.29	6F5GT	.39	125A7GT	.65
1G6	.24	6F6	.59	125F5	.50
1H4G	.30	6G6G	.52	125G7GT	.52
1H5GT	.40	6H6GT	.41	125J7	.67
1L4	.46	6J5GT	.43	125K7GT	.63
1LN5	.89	6J6	.52	125L7GT	.47
1N5	.67	6J7G	.43	125N7GT	.52
1P5	.57	6K5	.47	125Q7	.56
1Q5	.58	6K6GT	.37	125R7	.49
1R5	.49	6K7G	.44	12V6GT	.46
1S4	.79	6L6	.64	14A7	.44
1S5	.43	6Q7G	.45	14H7	.44
1T4	.49	6S4	.38	14J7	.30
1T5	.53	6S8	.53	14W7	.30
1U4	.49	6SA7GT	.43	19B6G	.95
1U5	.43	6SD7GT	.41	19C8	.70
1V	.53	6SF5GT	.46	19T8	.69
1X2A	.63	6SG7GT	.41	19V8	.79
2A3	.30	6SH7	.49	24A	.53
2A4G	.24	6SJ7GT	.41	25AV5	.83
2W3	.38	6SK7GT	.41	25BQ6GT	.79
2X2	.59	6SL7GT	.48	25L6GT	.39
3A4	.45	6SN7GT	.52	25Z5	.66
3E5	.46	6SQ7GT	.37	26	.45
3Q4	.48	6SR7GT	.45	27	.39
3Q5GT	.49	6SS7	.42	35	.58
3S4	.49	6T4	.99	35B5	.40
3V4	.51	6T8	.56	35C5	.39
5U4G	.50	6U4	.60	35L6GT	.41
5W4	.50	6U5	.44	35W4	.37
5Y3GT	.37	6U6	.59	35Z4	.39
5Y4G	.35	6U8	.61	35Z5GT	.47
5Z3	.46	6V6GT	.39	36	.39
6A8	.62	6W4GT	.44	41	.42
6AB4	.44	6W6GT	.44	42	.42
6AF4	.90	6X4	.37	43	.55
6AG5	.48	6X5GT	.37	45	.55
6AG7	.99	6X8	.75	45Z3	.44
6AH4	.57	7A4	.47	45Z5	.49
6AJ5	.65	7A6	.69	50A5	.79
6AK5	.55	7A7	.69	50B5	.43
6AL5	.38	7AF7	.53	50C5	.39
6AQ5	.39	7B4	.44	50L6GT	.61
6AQ6	.37	7B6	.69	50Y7	.50
6AR5	.37	7C5	.69	53	.24
6AS5	.50	7C6	.40	56	.24
6AT6	.37	7E6	.30	57	.58
6AU4	.68	7N7	.46	58	.60
6AU6	.38	7X7	.70	70L7GT	1.09
6AV5	.83	7Y4	.69	71A	.60
6AV6	.37	12A8	.61	76	.44
6AX4	.53	12AL5	.37	77	.57
6B4G	.64	12AT6	.37	78	.47
6BA6	.39	12AT7	.66	80	.35
6BA7	.57	12AU6	.38	83V	.68
6BC5	.49	12AU7	.54	85	.59
6BD5GT	.59	12AV6	.39	117L7	1.09
6BD6	.45	12AV7	.63	117Z3	.37
6BE6	.39	12AX4	.56	807	1.19
6BF5	.41	12AX7	.56	1274	.30
6BF6	.37	12AY7	.99	2050	.89
6BG6G	1.25	12BA6	.38	1000FM	.59
6BH6	.46	12BA7	.60		

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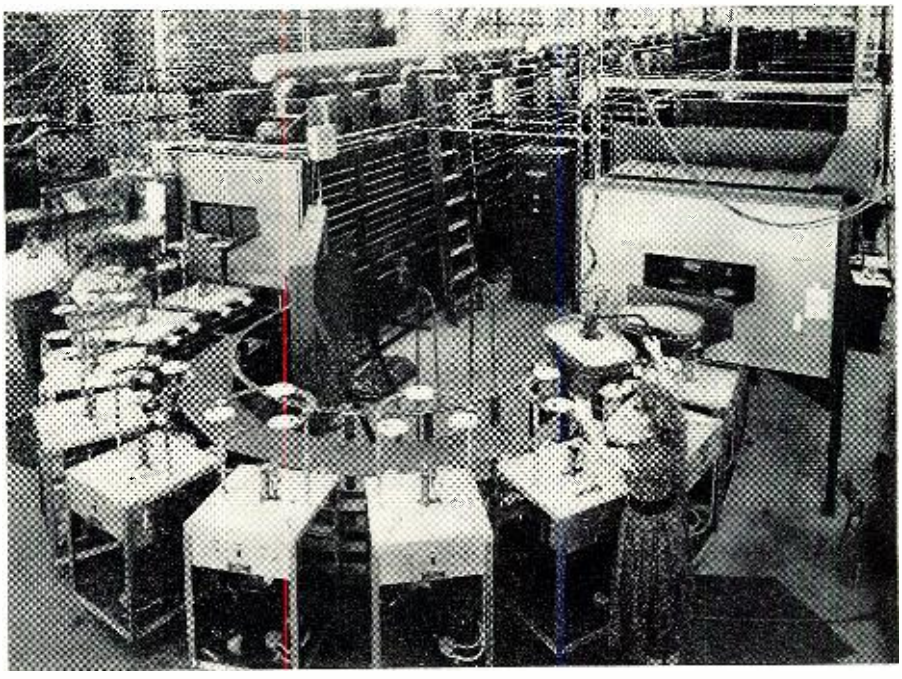
of true balance in a recording and this one has it to spare. A very live recording, bright and clean in every section of the orchestra. Dr. Hanson leads an extremely good orchestra in a completely satisfying and authoritative performance of his work. Using the AES curve, no touch-up on bass or treble was required. Surfaces were even more quiet than usual. The Harris 3rd is an extremely interesting work and again falls into the category of a "modern" which makes for easy listening. Starting sonorously in the celli, the work expands on rather broad and expressive lines, with strings predominant. About half way through this one-movement symphony, the strings take up a dance-like figure and a fascinating fugal development takes place. First the trombones and trumpets state the theme, followed by horns and trumpets. After further development a quiet pastoral-like interlude has its brief moments and a restatement of the opening theme occurs, and the symphony ends with heavy percussion in the bass drum, tympani, and cymbals. This one is a "sleeper." With the wonderful sound throughout all these sections, this could become one of the favorite demonstration records, even though the music will be unfamiliar to most. Dr. Hanson and the Eastman-Rochester Symphony with their brilliant performance of this work and previous efforts, must be considered as among the finest interpreters of "modern composition" since the Koussevitsky-Boston Symphony era. The AES curve was adequate again and surfaces were quiet. (Thank goodness I've noticed a growing trend among the recording companies to follow their published curves more than has been usual.)

BEETHOVEN
SYMPHONY #6
NBC Symphony Orchestra conducted by Arturo Toscanini. Victor LM 1757, Orthophonic curve. Price $5.72.

Still another warhorse from *Victor,* but as in the case of the Beethoven 5th, equally welcome. This is the thirteenth version on LP and by all odds the best. This work has always been one of Toscanini's particular dishes of tea and his performance here is superb. I find it superior even to his older version with the BBC orchestra, and that was a darned good one. In a score that demands subtlety and restraint be coupled with ultra-careful attention to tempo, Toscanini has met the challenge most successfully. His reading is a marvel of balance and integration. While the sound is not as opulent as the *Westminster, Capitol,* or *London* versions of this symphony, it is nonetheless highly acceptable. Strings and woodwinds are clean and good acoustic balance is maintained throughout. A deficiency in the bass end, responds to 4 db of boost. No, not sensational sound, but good enough that with the excellence of interpretation, it is the preferred recording. Typical quiet *Victor* surfaces. —30—

Loading and unloading tubes at the end of the exhaust machine through which the tubes travel nearly 300 feet at the Raytheon plant. These tubes automatically receive the processing required during various parts of the exhaust cycle. One feature of this exhaust machine is that glass strains and bulb breakage are minimized since the long length of the machine allows ample temperature control and permits the tubes to emerge at a temperature only slightly above that of the room. This operation takes place at Raytheon's new 105,000 square foot picture tube plant which is now producing 21, 24, and 27 inch picture tubes. The plant contains the largest available bake-out oven as well as the largest screen settling and exhaust machines in the world.



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0Z4	2A7	6AK5 .89	6BJ6	6K6GT .59	6SQ7GT	7C6	12AV6 .59	12SQ7	27	58 .79	
0Z4G 59c	2B3 .89	6AK6 1.08	6BK7 1.19	6K7GT .69	6SR7GT 59c	7C7 79c	12AV7 .89	12SQ7GT 69c	35A5 .99	70L7 1.49	
1A5GT .79	2B7 .89	6AL5	6BL7 .79	6K8GT 1.19	6SS7 .99	7E5	12AW6 1.19	12SR7GT	35B5	70L7GT	
1A7 .69	2C34 .60	6AQ5 69c	6BN6 1.19	6L5G .95	6T7G 1.15	7E6 79c	12AX4 .69	12Z3 .95	35C5 69c	71A .87	
1A7GT .79	2E5 .89	6AQ6 .81	6BQ6G 1.19	6L6G 95c	6T8 .89	7E7	12AX7 .69	14A7 1.05	35L6	75 .79	
1B3GT .95	2X2/879 .74	6AQ7 1.19	6BQ6GT 1.19	6L6GA	6U5	7F7 .89	12AY7 1.95	14AF7 .93	35W4 .59	77 .69	
1B5 .29	3LF4 1.25	6AR5 .79	6BQ7 1.29	6L7 1.19	6U6GT 69c	7F8 1.47	12BA6 .59	14B6 89c	35Y4	78/6D6 1.10	
1H5GT .59	3Q4 .69	6AT6 .59	6BZ7	6N6G 1.40	6U7G	7G7 1.19	12BA7 1.19	14B8	35Z3 99c	80 .69	
1J6GT 69c	3Q5GT .89	6AS5 .90	6C4 .59	6N7GT 1.19	6U8 .89	7H7 1.05	12BE6 69c	14C5 1.25	35Z4 .75	83 1.45	
1L4 .69	3S4 .69	6AU5GT 1.29	6C5GT	6P5GT .69	6V3 1.29	7I7 1.19	12BF6	14C7 1.12	35Z5 .55	84/6Z4 .72	
1L6 1.29	3V4 .95	6AU6 .59	6C6 69c	6Q7GT .59	6V6GT .69	7K7	12BH7 .89	14F7 1.05	35/51 .79	85 .79	
1LA4 1.19	5T4 1.40	6AV5GT .89	6C8	6R7GT .69	6W4GT .59	7L7 .79	12BY7 .89	14F8 1.45	36 1.06	VR90	
1LA6 1.19	5U4G .59	6AV6 .59	6CD6 2.49	6S4 .59	6W6 .69	7N7 .69	12BZ7 1.19	14H7 1.12	37 .93	VR105 $1.19	
1LC5 .69	5V4G .87	6AX4 .69	6CD6GA 1.69	6S7GT 1.15	6X4	7Q7 .79	12F5GT .65	14Q7 1.05	38	VR150	
1LC6 1.19	5W4	6AX5 .79	6CF6	6S8GT 1.25	6X5GT 59c	7R7 1.19	12H6 .89	14W7 1.19	39/44 88c	VT51 29c	
1LD5	5W4GT 59c	6AX6 .69	6D6/78 1.19	6SA7GT 69c	6X8 1.29	7S7 1.19	12J5GT .75	14X7 1.19	41 .72	VT52	
1LE3 1.19	5Y3GT .45	6AY5GT .89	6D8G 1.15	6SC7	6Y6G .69	7V7 .79	12K7GT .69	19AG6 1.89	42 .69	117L7 1.40	
1LH4 1.19	5Y4G .54	6B4G 1.44	6E5 .69	6SD7GT .99	6Z4/84 .72	7W7 1.19	12K8 .89	19BG6G	43 72c	117N7 1.95	
1LN5 1.19	5X4G	6B8GT 1.15	6F5GT	6SF5 .59	7A4 .95	7X6 1.05	12Q7GT .89	19T8 .89	45	117P7 1.95	
1N5GT	5Z3	6BA6 .59	6F6GT 59c	6SF5GT .59	7A5 1.19	7X7	12S8 .89	20 1.40	45Z5 .69	117Z3 .59	
1P5GT	6A3 1.68	6BA7 .89	6F8G 1.59	6SG7	7A6 .89	7Y4 79c	12SA7GT .69	24A .69	46	117Z6 1.19	
1Q5GT 79c	6A7 .89c	6BC5 .69	6F7 1.59	6SH7 69c	7A7	7Z4 .89	12SC7 1.05	25AC5GT 1.04	47 89c	715B 7.75	
1R5	6A8GT	6BC7 1.05	6F8G 1.59	6SH7GT .69	7A8 79c	12A6 .69	12SF5GT .69	25BQ6	50A5 1.05	807 1.55	
1S4 .99	6AB4 69c	6BD5GT .89	6G6G .95	6SJ7 .79	7B4 .89	12AH7 1.38	12SF7 .99	25BQ6GT 1.19	50B5	866A 1.49	
1S5	6AB7 1.15	6BE6 .59	6H6GT .89	6SJ7GT 59c	7B5 .89	12AL5 .54	12SG7 .89	25L6GT .59	50C5 69c	1299	
1T4 69c	6AC5GT .89	6BF5 .59	6J5GT .59	6SK7GT	7B6 .89	12AT6 .59	12SH7GT	25W4GT .69	50C6G 1.39	1619 49c	
1U4	6AF4 1.19	6BF6 69c	6J6 .79	6SL7GT .69	7B7	12AT7 .89	12SJ7GT	25Z5 .69	50L6 .69	2051 1.15	
1U5 .59	6AG5 1.05	6BG6	6J7G .69	6SN7GT .69	7B8 89c	12AU6 .69	12SK7GT 69	25Z6GT .69	50X6 .69		
1V 89c	6AG7 1.49	6BG6G 1.89	6J8G 1.15		7C4 1.30		12SL7GT 1.15	32L7GT	50Y6 .99		

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3.) Jumbo 300 ohm tubular transmission line.
4.) Sealer cap for UHF transmission line.
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11.) Illustrated instructions for quick, easy assembly.

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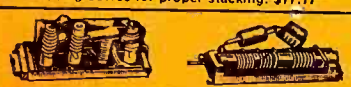

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pedance *vs* frequency curve of a popular 15" speaker, selling in the $100 price bracket, when mounted in a totally enclosed box (infinite baffle) of the same cubic content as "The Purist." Fig. 6 is the impedance curve of the same speaker when mounted in "The Purist". The speaker used for these tests had a free-cone resonance of 47 cycles and a cone mass of 85 grams. Note the reduction in the speaker resonant frequency to 34 cycles when mounted in "The Purist".

The resonant frequency of the speaker can only be reduced by: (1) Increasing the compliance of the speaker cone suspension; (2) Adding mass to the cone of the speaker in the form of cone material; and (3) Adding mass to the cone in the form of increased air loading.

Since no material is added to the cone nor the compliance of the speaker affected in any way except a stiffening due to coupling chamber capacitance, the reduction in resonance can only result from an increase in the air loading on the speaker cone. The amount of this increase can be calculated as follows:

$$M_c = F_{rm}^2 \times M_a / (F_r^2 - F_{rm}^2)$$

where:

F_{rm}=effective resonance of the cone with mass added (cps)

M_c=mass of cone (grams)

M_a=mass added (grams)

F_r=free cone resonance of speaker (cps)

The air loading of a 15" speaker when mounted in an infinite baffle is approximately 22 grams. By the above relation, it is calculated that "The Purist" increases the air loading by 94 grams. This amounts to more than quadrupling the air load on the speaker in the 35 cps region. At higher frequencies the increase in air loading is even greater. This increased air loading reduces the motion of the speaker by a factor of 4 for the same amount of radiated acoustic power, thus reducing non-linear distortion. The impedance curves show how the peak of the curve due to the bass resonance of the speaker is lowered and broadened when the speaker is mounted in "The Purist." This amounts to lowering the "*Q*" of the tuned circuit and illustrates how the increased air loading increases the acoustic damping on the speaker cone. Transient response is preserved by the lack of any tuning devices and by the increased acoustic damping.

Fig. 5 gives the dimensions for "The Purist" for 12" and 15" speakers. Production models of this enclosure are made from ¾" plywood and all joints are screwed and glued. It is strongly recommended that home constructors follow the same procedure to prevent rattles, vibrating panels, or loose baffles that might mar the transient

response of the enclosure. Access to the speaker chamber may be obtained by making the top slide towards the back of the enclosure in a tongue-and-groove arrangement. It is important that the top make an airtight seal. Home constructors are especially cautioned to make the speaker cavity air tight. Failure to do so results in poor coupling between the speaker and the throat of the horn which gives a porting effect on the coupling chamber. A port of this type gives rise to a peak in the response curve and mars the transient response of the enclosure.

Since speakers vary in their cone mass, compliance, and resonant frequency, padding of the speaker cavity is usually necessary to give optimum results with any given speaker. The amount of padding necessary must be determined by a listening test with the individual speaker. A general rule of thumb is that lightweight coned speakers need more padding than the heavier coned types. Some padding is necessary on the inside surfaces of the side panels to avoid standing waves.

The ultimate test of any musical instrument or reproducer is the listening test as it is here that many theoretically ideal designs fail to live up to their expectations. During A-B test comparisons with vented enclosures may appear to have more bass than "The Purist". A few moments of careful attention, however, reveal the "Johnny One Note" characteristic of the vented enclosure in contrast to the true bass response of "The Purist."

(*Note*: This article covers material on which the authors have patents pending and on which it is the authors' intention to file for basic patents. Publication of this material does not give or imply any right or license under patents pending or to be filed.

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Olsen, H. F.: "Cabinets for High-Quality Direct Radiator Loudspeakers," RADIO & TELEVISION NEWS, May 1951. —30—

FISHING BY SONAR

A NEW approach to foolproof commercial fishing was introduced recently by the *Minneapolis Honeywell* marine equipment division. Using a transceiver working in the ultrasonic sound wave range, a transducer, and a radar-type indicator, this system, when installed in a commercial fishing vessel, allows fishermen to detect schools of fish.

Sonar, as used by the Navy, can detect the presence of mines, submarines, and similar objects. The "Sea Scanar," as the new development is called, working in a different frequency range, however, is so sensitive that it can detect fish.

In operation, the transducer, which is located in a soundome projecting a few inches below the hull of the vessel, sends out a narrow beam of sound waves. If the waves strike an object, an echo returns, is picked up by the transducer, fed to the transceiver, and then to the indicator. The screen of the indicator is normally dark and shows up objects as light pips. —30—

TV Low-Voltage Supplies

(*Continued from page* 60)

other one, tied to the —135 volt supply point, is used to supply those stages whose cathodes are operated at from —50 to —150 volts. The heater circuits are otherwise straightforward, with inductor-condenser decoupling networks for the heaters of the tuner and input i.f. stages.

Servicing Power Supplies

There is no question that the power supply must be operating properly if the other stages are to do likewise. As an example, consider the fact that the impedance of the power supply is an important factor involved in the proper operation of critical stages, such as the video detector and video amplifiers. An aging electrolytic in the power supply has reduced capacitance and thus increases the impedance of the supply. As a direct result of these stages working into an improper load, video smears and poor definition are likely to result. This is one example of a trouble that does not look as though it were caused by a defective component in the power supply—but was.

Many of the bypass condensers in the receiver are part of the multiple section electrolytics that are physically located in the vicinity of the power supply. Don't overlook the possibility that excessive heating of these condensers may introduce troubles into the circuits to which they are connected.

In one case, a number of symptoms indicated that the "B+" voltage was too low. Upon checking d.c. output voltage of the filter this was confirmed. The voltage dividers, rectifiers, filter condensers, and the choke were checked—all were good. The line voltage was checked and found to be normal. Then, the secondary a.c. voltages were measured and found to be too low. Therefore, the transformer was checked, but it was good. Even a bridge measurement was made to determine if any turns were shorted—all to no avail. The actual trouble proved to be a defect in the vertical output stage that caused the 6K6 beam-power tube to draw excessive current, and thus cause the transformer to saturate. In this saturated state the power transformer secondary had low inductance and, therefore, the induced secondary voltage was much too low. All power stages, such as the audio, vertical, and horizontal output circuits, are frequent sources of trouble because their tubes draw close to half of the total d.c. current drain, and they are often worked very hard.

In certain types of tuners, many instances were found where there was no high-channel reception. The low channels were fine. Naturally, it was assumed that tuner trouble existed. However, the tubes checked out all right on a tester, and new tubes from stock were tried out to make sure. The trouble proved to be in the power sup-

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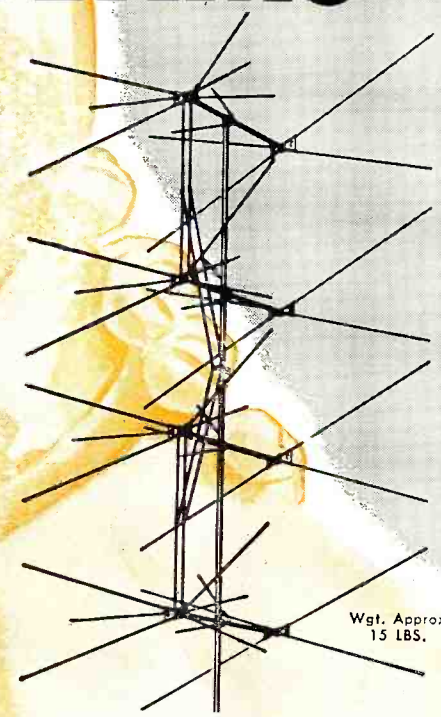

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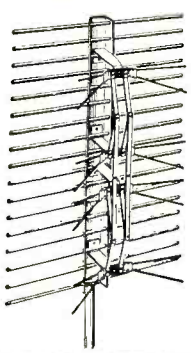

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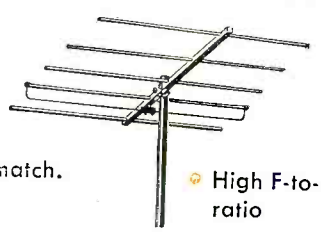

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ply. The "B+" voltage was too low and this prevented the oscillator from "taking off" on the high side.

Those chassis which use an electromagnetic speaker present a unique servicing problem. This is due to the fact that when the chassis is pulled for bench testing, the speaker (with field coil) is usually left attached in the cabinet. If the correct speaker or its direct replacement is not used during servicing, it is possible that the "B+" voltage will be incorrect, or nonexistent.

Many receivers have the focus coil interlocked through the power supply in such a manner that if the power is applied while the focus coil is disconnected, the supply is likely to be damaged unless it is fused. Irregular connections like these give rise to ten rules for troubleshooting power supplies. These are:

1. Determine the type of supply being used.
2. Consider any peculiarities (including voltage distribution) of the particular model.
3. Think about the symptoms, before picking up a soldering iron.
4. Decide which things could not cause the symptoms obtained, and don't hunt through these circuits until all else fails.
5. Make all measurements accurately and decide if the reading obtained is well within the tolerance for the point being measured (*e.g.*, a 9 volt reading instead of 12 volts is a lot more indicative of trouble than a 225 volt reading instead of a 250 volt one).
6. Don't replace a defective component until you have removed the cause of the defect.
7. Observe the necessary safety precautions while working with the power on. The "B+" supply is, in many cases, more lethal than a 15 to 20 kv. flyback supply.
8. Don't redesign the circuit to clear the trouble.
9. Replace parts carefully so as not to introduce new troubles by sloppy workmanship.
10. Use quality parts to prevent component failures that require costly callbacks. —30—

The "Compleat" Fidelity

(*Continued from page 52*)

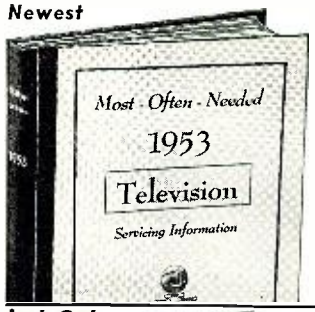
"The Compleat Fidelity" system a very simple addition to the circuit will eliminate these lines. Three condensers and two resistors do the trick, as shown in Fig. 2.

Mount the additional parts on a tie point, just in front of T_3, the transformer associated with the 6BL7 vertical output stage. No changes in the original wiring were found to be necessary.

Next month the author will give details on a simple equalizer circuit which may be added to the *Craftsmen* RC-10 FM-AM tuner incorporated in the system.

(*To be continued*)

Newest



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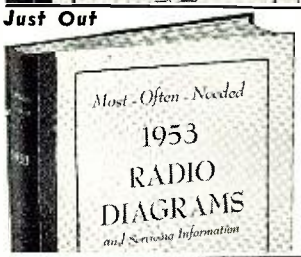

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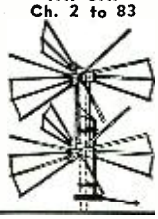

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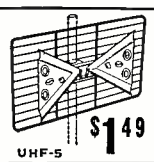

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Has tube compliment of 6J6 osc. and conv. and a 6BQ7 or 6BZ7 RF amp. Designed for inter-carrier circuit and also adaptable for split sound IF circuits such as the "630" and similar types, by use part #XM-752 trap assembly. (Available separately.) IF is adj. 19 to 26 mc. Adaptable to UHF. Shaft length 4¼" overall.
XM-752 TRAP ASSEMBLY **$1.14**
UHF STRIPS. Available for Standard Coil tuners. Specify channel no. and series designated by letter such as F, G, Q, etc. stamped on each strip of your present tuner. Set (osc. & ant)..... **$7.50**

TV TUNER FOR OLDER SETS

Series TV-200. Standard coil's original type tuner. Has sound trap which can be eliminated for use in intercarrier circuits. Sound IF of 21.25 mc. Shaft length 5" overall. Pre-aligned. Complete with tubes..... **$16.95**

FREE! WRITE FOR NEW VALUE PACKED FYI BULLETIN NO. 125

WESTINGHOUSE GAMMA COUNTER TUBES

Was $50. Alpha, Beta and Gamma Counter Tubes. Self-quenching. #5979/BS-1 ..... **$8.95**

Was $35. Gamma Counter Tubes. Self-quenching. #5980/BS-2 ..... **$4.95**

WHOLESALE RADIO PARTS CO., Inc.

311 W. BALTIMORE ST., BALTIMORE 1, MD.

Sangamo Molded Plastic 600V. Tubular Cond.

.0005	.10	.02	.12
.001	.10	.025	.12
.002	.10	.03	.15
.0022	.10	.035	.15
.003	.10	.04	.15
.0033	.10	.047	.15
.004	.10	.05	.15
.0047	.10	.06	.18
.005	.10	.068	.18
.006	.10	.1	.18
.01	.12	.25	.25
		.5	.32

D.C. Amplifier

(*Continued from page 83*)

pedance scale shifting to the right by a factor of ten for approximately a doubling of current. The power curve is not the product of the voltage gain and current gain curves because the signal voltages and currents were computed from E_g/R_g while the power input was computed from $E_g^2/4R_g$. All points were for constant output power at full-scale meter deflection: 20 microamperes, 1850 ohms, 37 millivolts, 0.74 microwatt. This treatment may appear rather unorthodox but is more indicative of circuit performance in the face of a basic concept of good instrumentation (which postulates that the power expended in the measuring system must be small compared to the total power in the circuit being measured) than other presentations that could be used.

The parenthetical remark indicates more clearly why the circuit fails (in a usage sense) at maximum power gain because at this point the impedances are matched and the two powers are equal.

In the early months of transistor history, much was made of the fact that here, for the first time, was a device that could be regarded as a current amplifier. In the intervening years, however, very little has appeared in the form of practical devices making use of this important and interesting property. This being so, it may be permissible to emphasize the current-amplifying properties of the present device and gloss over its rather mediocre performance as a voltage amplifier.

From a source impedance, then, on the order of 50,000 ohms or more (depending upon the operating point chosen) the current gain of the circuit is approximately the grounded-emitter current amplification of the transistor multiplied by the shunting effect of the load resistors across the meter: $CG=[\alpha/(1-\alpha)]\ [R_L/(R_L+R_m)]$ approx. where:

CG = the current gain (expressed as a factor)

R_L = collector-to-collector load

R_m = meter resistance.

The foregoing neglects the further shunting effect of the collector resistance because this will be at least several hundred-thousand ohms.

Interesting and informative comparisons may be made between the d.c. transistor amplifier and its vacuum tube counterpart. In a d.c. vacuum-tube voltmeter of the balanced cathode-follower variety, the "bottom" tube usually functions mainly as a balancing tube, to stabilize zero in the face of changes in contact potential and emission with changes in cathode temperature. While the balancing transistor is even more necessary in the transistor amplifier (although for a different reason) the second transistor is active dynamically and does

not "shunt down" circuit sensitivity as is often the case with balanced tube circuits. Also, it is usually the practice to ground the lower grid of the tube circuit because of troublesome ground capacitances and currents while the transistor circuit, being a relatively low impedance circuit containing very little in addition to the meter movement, need not be grounded and can therefore be operated at a considerable impedance to ground. The "bottom" transistor, then, is at the bottom only on paper and actually there is no necessity to designate "high" or "low" terminals at the input nor to provide a polarity-reversing switch (except as a convenience) at the indicating meter.

Certain types of laboratory and service instruments would appear to be logical candidates for improvement, through transistorization, in one or more of the following particulars: Instrument size and weight; number of components; manufacturing costs; performance; etc. For example, the volt-ohm-milliammeter class of instrument (as exemplified by the *Simpson* Model 260 and the *Triplett* Model 630-A), which at present uses a 50 microampere movement can offer 200,000 ohms-per-volt and 1.5 to 5 megohms at center-scale in the same instrument size at slightly higher cost. For this purpose, the CK722, with a current gain of 10 or 12 should be adequate. Or, conversely, the performance of the d.c. vacuum-tube instrument (of the balanced cathode-follower type referred to before) can be approximately equalled in a smaller instrument of the same or possibly lower cost.

While much of the foregoing also applies, of course, to a.c. amplifiers and instruments, it will be understood that the present discussion is confined to d.c. This is partly because there is such a glaringly obvious discrepancy between the power supply requirements of d.c. instruments (particularly battery-operated instruments) and what may and should be possible with transistors. In this class of instrument with its plethora of batteries, including separate "A" batteries, "B" battery, coupling batteries and bucking battery, it is not unusual for the weight and bulk of the power supply to exceed 75% of the total. Further, if the designer attempts to reduce this percentage substantially, the usual result, on meters used only intermittently, is a considerable loss of time in servicing operations. To this may be added the difficulty of maintaining fresh stocks of several types of batteries in the usual situation where most of the available instruments require different battery types.

Among the d.c. instruments which are often battery operated may be mentioned: photometers, densitometers, pH meters, spectrophotometers, infrared amplifiers, strain gauge amplifiers, mass spectrograph leak detectors, etc. While most of these require the sort of input impedance which can only be realized from electrom-

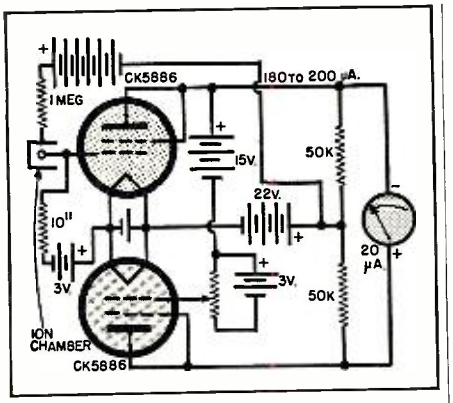
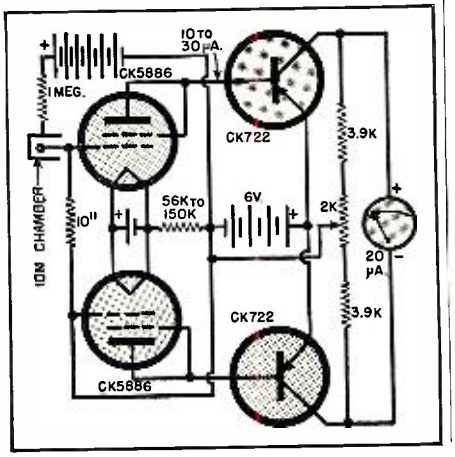


Fig. 8. Simplified schematic of the "Zeus" type radiation meter which has a full-scale sensitivity of 25 milliroentgens per hour.

eter tubes, there appears to be no reason why the remaining stages cannot be taken over by transistors. In fact, in the type of circuit using a large negative feedback, it is possible that the transistor stages can be operated single-ended because the temperature drift of the first transistor, *i.e.*, the second stage, will be reduced in proportion to the gain of the electrometer input stage. In this type of hybrid (tube and transistor) operation, coupling batteries, where required, and the meter stage battery will be single cells, one of which is already present in the form of the electrometer tube filament battery.

A fair example of a simple conversion to a combination circuit may be seen in Figs. 8 and 9. The former is a simplified schematic of the familiar *"Zeus"* type of radiation meter with a full-scale sensitivity of 25 milliroentgens per hour and using five batteries (not counting the ion chamber battery which is not part of the amplifier proper). The addition of two transistors not only reduces the number of batteries to two but also increases over-all sensitivity at lower plate current to the electrometer tubes. The temperature characteristics of the transistors are not particularly important in this application since there is an electrical zero adjustment and instruments of this type are frequently checked for this setting.

Fig. 9. Circuit simplified by using transistors which helps eliminate three batteries while increasing instrument sensitivity.



Such d.c. amplifiers working from low impedance thermal and mechanical transducers and not requiring the electrometer input stage will undoubtedly pose rather severe problems in relation to temperature drift at the input transistors—the severity of the problem varying according to the over-all gain required and the maximum drift that can be tolerated. In applications where these requirements are particularly stringent. the most careful attention to the complete thermal circuit associated with the input stage will be necessary. In those extreme cases where temperature control appears to be unavoidable, the separate transistor amplifier associated with such a control would be a relatively simple and straightforward affair since, as already remarked, a transistor amplifier intended to amplify a temperature signal is much easier to design, circuit wise, and construct than one which must produce nearly zero output for the same kind of signal.

The long-term stability of the temperature characteristics of junction transistors has yet to be determined. However, to judge by our present knowledge of this subject, it appears likely that the "zero adjust" control commonly found in d.c. amplifiers need have no greater (and quite possibly less) range in a transistor amplifier than in the vacuum-tube instrument it replaces.

To those who have not yet touched transistors, the meter amplifier described earlier in this article may be recommended as a relatively painless introduction; while the design engineer, steeped in the lore of his own particular specialty—whether it be microwaves, radar, pulse modulation, or computers—should not have too much difficulty in mastering the intricacies of the circuit illustrated in the diagram of Fig. 3. —30—

RADIO SERVICE HINTS

By JACK DARR

A FADA 659 table model radio set came into the shop with an intermittent; when the humidity went up, the oscillator went out. After checking all the common causes of this trouble, a leakage was discovered in the insulator of the oscillator section of the tuning condenser. It was removed, baked out, and checked. The leakage disappeared, and the insulator was given a coat of "Q" dope and baked again.

Many 1953 *Buick* autos use a top-mounted antenna for the radio. If the radio in this auto suffers from an intermittent loss of volume, check the antenna lead-in for shorts. The lead-in cable on this car runs in the trim strip that holds the windshield, and is held in place by small metal clips. If the clips are not properly installed, one of the mounting screws can penetrate the cable, causing a short.

By taking out the trim mounting screws you may spot the cable through one of the holes. Remove the trim, patch the cable, and set the clip properly. —30—

MANUFACTURERS' LITERATURE

The various listings presented in this section are for your convenience. The bulletins, unless otherwise indicated, are available to all our readers. For prompt attention write directly to the manufacturer for this literature.

PISTON-TYPE TRIMMERS

Engineers, purchasing agents, and electronic parts jobbers are invited to write in for the new four-page brochure on piston-type variable trimmers just released by *JFD Manufacturing Company, Inc.* of 6101 16th Ave., Brooklyn 4, N.Y.

Known as form No. 220, the new publication lists units for industrial, military, experimental, and radio trade requirements.

Also available from the company is a one-page flyer detailing the company's new miniature u.h.f. piston type, the "Mighty Midget" model VC3-G. This publication, form No. 226, is obtainable from the same source.

TV ACCESSORIES

United Technical Laboratories, Morristown; N.J. has issued a new bulletin which describes eight new television accessory products.

Items described include a new TV interference filter, u.h.f.-v.h.f. crossover network, two-receiver TV coupler, a calibrated variable inductance kit, and new "Klipzons" for panel mounting. Also included are alligator clip adapters and banana plug adapters.

Copies of this new bulletin are available from the company, its regional sales representatives, or its distributors.

EM FOCUS COILS

Two new electromagnetic focus coils are illustrated and described in the new catalogue page currently available from *Syntronic Instruments, Inc.* of 100 Industrial Road, Addison, Illinois.

The Type F10, for 1½" neck diameters, is for laboratory, military, and special-purpose applications. The type F30, for 2⅛" neck diameters, is for projection, laboratory, and special-purpose applications. Complete technical information includes dimensional drawings and electrical and mechanical data.

RADIO SHACK CATALOGUE

Radio Shack Corporation, 167 Washington Street, Boston 8, Mass. has just published its new 1954 electronic parts mail-order catalogue.

The 224-page edition is the largest the company has published in its 31-year history and includes a 32-page roto section covering high-fidelity custom music systems, Also included are extensive listings of transistors and germanium diodes, antennas, converters and test equipment for u.h.f., printed circuit components, and radiation detection apparatus.

Over 30,000 items are listed and illustrated in this new catalogue which is available from the company on request.

SUPREME INDEX

Supreme Publications, 3727 West 13th Street, Chicago 23, Illinois is offering a copy of its "Master Index" to readers of this magazine who send in four cents postage and mention this publication.

The newly-published index covers the material in all of the company's thirteen radio manuals, all of the seven TV volumes, and the u.h.f. book. With the aid of this index, needed material can be quickly and easily located in the company's service manuals.

STANCOR DATA SHEET

The *Standard Division* of *Chicago Standard Transformer Corporation,* Addison and Elston Streets, Chicago 18, Illinois has issued a new catalogue sheet, Bulletin 467, which describes six transfomers recently added to the *Stancor* line of stock components.

Complete electrical and physical specifications are given for three power transformers, P-6348, PC8422, PM8422; two audio output transformers, A-3337 and A-3839; and a heavy-duty plate transformer P-8044 for ham use.

Copies of this new bulletin are available without charge from the company.

1954 HEATHKITS

Heath Company, Benton Harbor, Michigan has just released a new catalogue which lists, pictures, and describes its new 1954 *Heathkit* line.

Among the new items are a service scope, a laboratory generator, a new 20,000-ohm-per-volt multimeter, a record player kit, an a.c.-powered impedance bridge, a TV alignment generator, and a wattmeter which measures audio output level.

In addition, the catalogue lists other popular items in the company's extensive line of audio, radio, and test equipment.

A copy of the new catalogue is now available for the asking.

TV REPLACEMENT TRANSFORMERS

The *Standard Division* of *Chicago Standard Transformer Corporation,* Addison and Elston Avenues, Chicago 18, Ill. has released a new *Stancor* bulletin, No. 469, entitled "TV Re-

placement Transformers Popularity Tables".

The publication, based on the company's new TV replacement guide, lists the number of TV models that use each *Stancor* replacement transformer. There are separate tables for each of the 55 major set manufacturers.

The bulletin is a valuable inventory aid for both the TV technician and the parts distributor. The user can plan a replacement transformer stock based on the most popular sets in his area.

ANTENNA BOOKLET

A 30-page illustrated booklet describing the entire "Vee-D-X" line of u.h.f. and v.h.f. antennas and accessories is currently available from *La-Pointe Electronics Inc.,* Rockville, Conn.

Some thirty-six different products, including the company's antenna rotator, are pictured and described in this handy, wallet-sized guide.

NEWARK CATALOGUE

Newark Electric Company, 223 W. Madison St., Chicago 6, Ill. is now offering copies of its comprehensive parts catalogue, No. 56.

This 196-page book contains thousands of listings covering items for industry, laboratories, high-fidelity fans, and radio and television technicians. Whole sections are devoted to test equipment, industrial equipment and supplies, high-fidelity systems and components, TV chassis, accessories and antennas, etc.

Copies of the new catalogue are available upon request to the company direct.

"TV ANTENNA FOLIO"

American Phenolic Corporation, 1830 South 54th Avenue, Chicago 50, Illinois now has available copies of its new "TV Antenna Folio" which graphically illustrates the importance of the antenna and its installation in obtaining a good TV picture.

With each copy of the "Folio" are enclosed the new *Amphenol* antenna and accessory catalogue sheets which contain complete gain charts and radiation patterns for the antennas pictured and discussed.

The company will supply a copy of this colorful and complete "Folio" on request.

"PERPETUAL" CATALOGUE

United Catalog Publishers, Inc., 110 Lafayette St., New York 13, N.Y. has introduced its new "File-O-Matic" to the trade.

This new perpetual counter catalogue service, now being introduced to distributors, includes all products made by radio, television, and electronic parts and equipment manufacturers. Periodic replacement sheets on new and discontinued items will be issued to insure that this loose-leaf system is kept up-to-date.

Manufacturers' products are broken down into separate and distinct sec-

tions with all similar products being grouped together in one section, thus eliminating excessive and unnecessary time searching for products information.

Additional information on the "File-O-Matic" is available on request.

DAVIS BULLETIN

Davis Electronics, Box 1247, Burbank, California has issued a four-page, two-color catalogue and technical data folder giving complete information on the company's "Super-Vision" television antenna.

The publication provides technical data of interest to TV dealers and the technicians who make the installations. The essentials of a 61-page laboratory report on the antenna, as supplied by *Microwave Engineering Co.,* have also been presented in condensed form.

A copy of this No. SV-7 catalogue-data sheet is obtainable from the company, its jobbers, or jobber salesmen.

CONVERTER DISPLAY

Blonder-Tongue Laboratories, Inc. of 526-536 North Ave., Westfield, N.J. is now offering a point-of-sale display easel which will accommodate one of the company's "Ultraverter" u.h.f converters.

The new display is supplied free of charge to dealers and distributors on request, and, in addition, is included in each master carton of twelve units. It is only one item in the company's comprehensive sales promotion program.

TRANSISTOR MANUAL

CBS-Hytron of Danvers, Mass., has recently issued a down-to-earth, comprehensive, 8-page transistor manual which is currently available without charge from the company's distributors or the company itself.

Profusely illustrated, the new manual is divided into three parts covering theory, data, and application. Included are nine different basic transistor applications. Both point-contact and junction transistor operations are explained by vacuum-tube analogy. Conduction by "holes" and the "p-n-p" and "n-p-n" types is explained in detail.

CONSUMER BOOKLET

Jensen Industries, Inc., 329 S. Wood St., Chicago, Ill. has issued a two-color, pocket-sized booklet on the care of records, needles, pickups, and cartridges.

This booklet, designed as a consumer publication available for dealer distribution, illustrates needle wear comparison, information on caring for the phonograph, as well as providing a comprehensive chart showing how to determine exact needle replacement for specific record players.

ELECTRICAL FITTINGS

Buchanan Electrical Products Corporation, Hillside, New Jersey has recently issued its Catalogue 53, 16 pages describing the company's complete line of solderless wire connectors and specialized electrical fittings.

Complete specifications, dimensional data, application information, and ordering instructions are included in this publication which is available on request.

TEST EQUIPMENT

Radio City Products Company, Inc., 152 W. 25th St., New York 1, N. Y. has issued a four-page illustrated catalogue covering its line of test and measuring equipment.

Complete specifications and data are included on the entire test line with particular emphasis given to the company's recently introduced instruments—Model 750 *"Do-All"* pattern, marker, and signal generator for u.h.f. and v.h.f. and the Model 324 tube and battery tester.

ENVELOPE STUFFER

Snyder Mfg. Co. of Philadelphia, Pa. is now offering a new envelope stuffer for mailing to the TV trade.

The three-color publication describes the company's two-set TV coupler, the Model AC-800. As illustrated, the coupler permits two receivers to be operated from a single antenna.

The stuffer also illustrates a colorful printed sales package. —30—

Howard W. Sams & Co., Inc., Indianapolis publisher of electronics service and technical data, has announced plans for a 38,000 square foot concrete and steel building to be erected on a six-acre tract of land at 33rd and Sutherland Ave., in Indianapolis. The building, which will cost an estimated $200,000, will house printing, warehousing, and shipping operations of the firm. These operations, now being carried on at five different locations throughout the city, will be consolidated in the new building. The administration, sales, engineering, and analytical work will continue to be located at the company's main plant at 2201 E. 46th Street.

Recording System

(*Continued from page 55*)

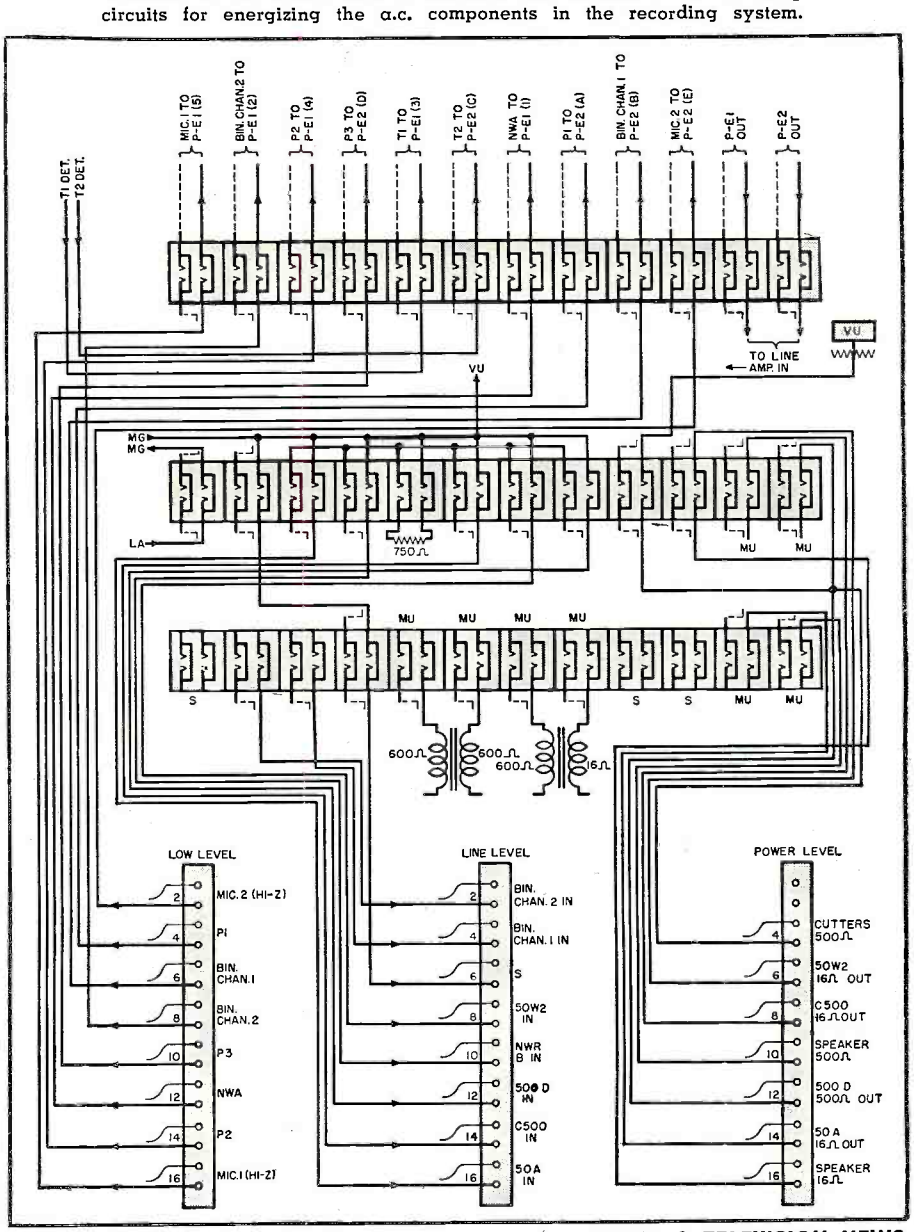
The *Fisher* 50-C and *Craftsmen* (experimental model C-300) preamp-equalizers are designed in similar fashion and both are provided with a master gain control in addition to full facilities for circuit selection, equalization, and bass and treble control. Normally the gain controls on the two preamps are pre-set for equal outputs to the line amplifier and it is seldom necessary to alter the gain at the preamps except for mixing purposes. Further compensation is provided at the input to the line amplifier and the voltage gain is usually pre-set for smoothest response of the amplifier without overloading.

Separate pre-set gain controls are provided for the individual inputs to both of the preamps. These controls are also pre-set depending upon the voltage available from the pickups, detector circuits, microphones, and from the tape machines. This technique of using pre-set audio levels at various points in the system makes it possible to interchange components, should breakdown occur, without upsetting the line level of the system.

The power or monitoring amplifiers are likewise provided with an input gain control. These, too, are pre-set when setting up the installation and their settings depend upon over-all gain of the respective amplifiers.

The output of each power amplifier is normalled to a fixed load. In the case of PA_1 and PA_3 the termination is to a 16 ohm, 10 watt resistor while amplifier PA_2 connects to a 16 ohm speaker system. This is the primary playback circuit. Amplifier PA_4 is normalled to the selector switch at the turntable console and feeds either of the two magnetic cutters. A vu meter with calibrated attenuator is connected permanently at the cutters to

Fig. 10. Simplified wiring diagram of the signal circuits for components contained in the control rack. In addition, and not shown, are the relay circuits for energizing the a.c. components in the recording system.



indicate the proper recording levels.

Note that miscellaneous components connect at the jack field so that they may be patched into suitable circuits for recording, for impedance matching, or for substituting other speakers or systems such as the *Stephens* 500-ohm voice coil system.

Any of the power amplifiers may be used independently or in multiple to provide complete facilities for one, two, or more channel use. In practice all of the amplifiers are turned on, providing spares in case of failures during recording. Likewise a choice of amplifiers is provided for monitoring purposes.

In this particular system there was no need to provide duplicate (simultaneous recording) of discs. However, for a recording studio the cutters would be connected in multiple so that a "safety" disc would be cut simultaneously with the master. Suitable changes, of course, would be made in matching the cutters at the output of the recording amplifier.

The 500-ohm speaker system may be patched directly to the output of PA_1 or may be used in conjunction with the matching transformer L for connecting to either of the other power amplifiers.

Reference to Fig. 7 shows three barrier terminal strips. The one to the left is for the low level circuits, the one in the center for the line level circuits, while the power level circuits terminate in the strip on the right. Part 3 of this series will show the relay circuits and the interconnecting of the three racks which comprise the remainder of the system.

(To be continued)

HUM IN A.C.-D.C. SETS

BY GEORGE ANGLADO

MOST present-day a.c.-d.c. receivers have the common "B—" lead connected to the chassis through an isolating condenser. Leakage between the dial-light socket and chassis in many cases will feed power-line hum into the grid circuits of the tubes.

Hum of this type is hard to isolate, and will lead one to believe that a filter condenser is at fault. In our case, we found this type of hum to be due to faulty insulation of the dial-light socket. Another case is dust and dirt on the socket providing a leakage path to the chassis. —30—

A SUBSTITUTE V.T.V.M.

BY GEORGE ANGLADO

HERE is a neat trick that I use on my Eico 20,000 ohms-per-volt voltmeter for emergency measurements on r.f. carrying circuits with negligible detuning.

An r.f. choke with low-distributed capacity is hooked to the end of the probe that is to be connected to the r.f. circuit. Very little detuning will be noticed if the proper inductance is chosen for the frequency in use. This is an excellent way to check a.v.c. voltages at the grids of r.f. tubes in receiver circuits.

This system will not work on the a.c. range of the tester, but can be used for measuring d.c. voltages present in r.f. circuits. —30—

Applause Meter

(*Continued from page 67*)

so that an applause microphone may be placed in an advantageous position to pick up sounds from the audience. The indicating instrument is the popular "one-ma." movement. A 0-100 scale might have been preferable, although the important point is to keep it simple, since it must be easily read and interpreted, in most cases, by non-technical judges.

A schematic diagram of the meter is shown in Fig. 2. V_1 and V_2 are 6AU6 and 6AQ6 tubes, respectively, in a 2-stage audio amplifier, whose function is to amplify the microphone output to a suitable level for the subsequent operations. Neither cathode resistor is bypassed, since the resulting degeneration assists in keeping gain more nearly constant as the tubes age. Adequate gain is obtained without bypassing. The output of the second stage is rectified to negative d.c. by V_3, a 6AL5 connected as a shunt rectifier with both sections in parallel. The diodes of the 6AQ6 could have been used for this purpose had its cathode been grounded. The time constant of R_8 and C_5, about 1 millisecond, is such that the output of the rectifier approximates the envelope of the applause. R_9, R_{10}, and C_6 form a long time constant (30 seconds) integrating network, so that the voltage at the grid of V_4, a 6C4, is approximately proportional to the integral of the energy in the handclaps over the interval of time during which the normally-closed push-button S_1 is held open. V_4 and M_1, with their associated components, form essentially a v.t.v.m. to indicate the grid voltage of V_4 without discharging C_6. V_5, the 6X5GT rectifier tube, supplies plate power for all stages, filtered by C_8-C_7, R_{15}, R_{16}, and V_6, a 0D3. The 0D3 also helps in holding the plate supply voltage constant in the face of fluctuating line voltage, thus keeping more nearly constant the gain of the amplifier and the balance of the v.t.v.m. bridge circuit. The balancing potentiometer R_{13} is adjusted initially to bring the meter to zero, and requires no further adjustment except to compensate for aging of the 6C4 tube.

Operation of the instrument is quite simple. After a minute or two warm-up, the needle will settle down on zero. The microphone is suspended over the audience if possible, or at least placed so as to pick up sounds from various parts of the audience as impartially as possible. During the preliminary acts, the gain control, R_6, is adjusted so that with the push-button depressed throughout each round of applause, the meter reading never exceeds full-scale. This adjustment is necessary for each program to compensate for differences in acoustics, size of audience, and mike placement. Once a satisfactory gain adjustment has been made, the control should not

be touched again on a given occasion, except as noted as follows. At the conclusion of each act to be judged, the button is held down as long as the applause continues, *i. e.,* as long as the meter reading continues to increase, the final meter reading is noted, and the button is released, resetting the meter for the next act. If two or more acts receive the same applause, or if unexpected audience enthusiasm drives the meter off-scale making a reading impossible, the two or more acts receiving the most applause may be singled out for a final judgment with reduced gain on the meter.

In making measurements of applause, it is necessary that the audience restrict their expressions of enthusiasm to handclapping, since whistles and yells, being of a more continuous nature than handclaps, will cause disproportionate readings.

The net price of the parts used in this instrument amounts to $33.93. However, most of the parts may be found in the average junk-box. The 2 μfd. condenser, C_6, should have extremely low leakage. Even a new unit should be of good quality, and should be tested to insure that its leakage resistance is at least 200 megohms, preferably higher. Otherwise, as applause dwindles at the end of a round, the meter reading will be seen to decrease slightly instead of merely increasing more slowly, as it should.

Organizations sponsoring "talent shows" are always glad to give credit for the loan of the applause meter, so that for a relatively small investment much good-will and effective, but inoffensive, advertising results. —30—

PICTURE OVERLOAD REDUCTION

By MILTON A. KENNEDY, JR.

RECENTLY we were asked to service an RCA KCS-82 chassis with the complaint that when the outside antenna was connected to the set, the picture became overly white and the blacks became blacker, leaving hardly any fine detail. When the set was connected to a built-in antenna it worked fairly normally. Someone had previously looked at the set and had disconnected one side of the lead-in, but the customer wasn't happy with this at all.

After removing the set to the shop, we discovered that none of the service-data publishers had issued information on this set since it was a new model, and the local RCA people didn't have the data either. That night I happened to be reading my July issue of RADIO & TELEVISION NEWS, and there was a complete schematic of that particular set.

We used this schematic the next day, but the a.g.c. seemed to be working according to the data, the plate and screen voltages were normal, and we couldn't find any defective resistors or condensers. We then decided that a little more cathode bias in the video amplifier stage would reduce the overload in this stage. Consequently, we replaced the 33-ohm cathode resistor of the 6CL6 video amplifier tube with a 100-ohm unit. This added the required cathode bias, and the set has been working well ever since. —30—

Jam-Jar Rectifier

(*Continued from page 61*)

the electrodes, it is possible nowdays to use an aluminum-tubing cathode. The cathode then doubles as the container, reducing size and helping to dissipate heat.

The number of cells is determined by the voltage and by the circuit. Fig. 1 shows possible connections. The half-wave connection (Fig. 1A) is not very useful—the output is rough and the regulation bad. Fig. 1B is the full-wave circuit using a center-tapped transformer. Fig. 1C is the bridge connection used for the supply described herein. In all cases, the cells will stand a back e.m.f. of about 80 volts, and the current which can be drawn depends upon anode area. The dimensions given permit a 50-ma. drain.

For construction, one-inch aluminum tubing is the main ingredient. As shown in the illustration, it is cut into 5″ lengths with a tubing cutter. Four 5″ pieces are also cut from a coat hanger, and the paint sanded off. Clean the iron and the aluminum in strong hot detergent, then rinse.

A cork is driven into one end of each tube. A #33 hole is drilled ¼″ from the other end, and tapped for a 6-32 terminal screw.

A 6″ length of "2 x 4" lumber makes a good holder. One-inch holes are bored in the wood, 1″ deep, and the tubes slipped into place.

The iron electrodes, with plastic spacers attached, are put in the cells; and the bridge wired according to Fig. 1C. A 4-terminal strip is used for external connections.

The solution is made by stirring household borax into one-half pint of hot water until no more dissolves. When the mixture cools, each cell should be filled to within one-quarter inch of the top.

The oxide coating is formed by connecting the rectifier to 117 volts a.c., with a 100-watt lamp in series to limit the current. Almost immediately, a slight d.c. voltage should appear at the output terminals. "Gassing" is normal, but if the cells boil, turn off the input for a few minutes.

At first, the lamp will burn brightly, but as the cathodes form it will dim, and finally almost go out. Forming should take less than half an hour.

If it is desired to use the 4-cell bank for continuous duty from line voltage, the lamp can be left in the circuit, to hold input to about 80 volts.

To make rectifiers suitable for higher voltage, add cells in multiples of four as shown in Fig. 1D, until they stay cool with no load. Don't be afraid to sock on the voltage! A 48-cell bank is good for about 1000 volts. Just add water to make up for evaporation, and don't drop things into the cells.

When forming a large bank, it is best to break it into groups of 4 cells, forming them on 117 volts before making the final bridge connection, in

order not to overload the power transformer.

You will find that the "slop rectifier" has a unique quality that has helped many a ham. Once in awhile a wire *will* get in the wrong place, and the modern high-efficiency "a.c. straighteners" take the road "west" with more scat than a Hollywood Hotrod. But with a rack full of purring "slop" cells, all that happens when you drop the screwdriver across the "B-plus" is a buzz and a few bubbles.

You can't hurt this old-timer! –30–

CALIBRATION CIRCUIT

By WILBUR J. HANTZ

IF YOU ever have a need for some source of accurate small d.c. voltages for calibrating purposes, this circuit should fill the bill. It was originally designed for a Brush BL-360 strain gauge amplifier as a source of d.c. voltages for calibrating the d.c. amplifier. (The Brush Development Company apparently overlooked this neeessity when the d.c. amplifier is used independently of the a.c. bridge amplifier.)

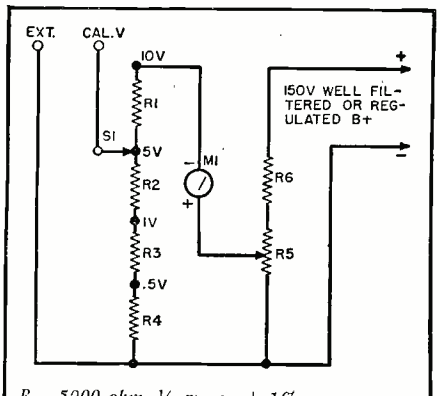
The meter range multipliers R_1, R_2, R_3, and R_4, are also used as a voltage divider to provide 10 volts, 5 volts, 1 volt and .5 volt external calibration voltages selected by the range switch. The Triplett model 227 meter has an internal resistance of 33 ohms and this value is small enough to be disregarded. With the resistance values shown, and using a 150-volt supply, R_5 is adjusted for full-scale meter reading, or 1 ma. through the voltage divider string. This provides 10 volts across the divider.

To avoid faulty adjustment of R_5, the meter calibration pot, this control should preferably be of the short-shaft screwdriver slot type and with a locknut if possible.

Do not load the external calibrating voltage output with anything less than 500,000 ohms or the unit will be in error. This circuit should come in handy as a calibrating source for v.t.v.m.'s or oscilloscopes. Other than a 150-volt supply can be used but then R_5 and R_6 would have to be changed accordingly. Due to the very small current drain of the unit, any external instrument can supply it.

–30–

Circuit for providing small d.c. voltages.



R_1—5000 ohm, ½ w. res. ± 1%
R_2—4000 ohm, ½ w. res. ± 1%
R_3, R_4—500 ohm, ½ w. res. ± 1%
R_5—25,000 ohm linear wirewound, 4 w. pot.
R_6—75,000 ohm, 1 w. res. ± 1%
S_1—S.p. 4-pos. selector switch
M_1—0-1 ma. d.c. meter (Triplett Model 227-T)

NEW TV PRODUCTS on the Market

"ROTAXIAL" CABLES

U.S. Wire and Cable Corp., Progress & Monroe Streets, Union, N. J. has developed a new cable which has been designed especially for community television systems.

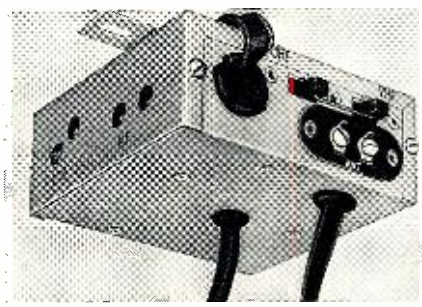
The "Rotaxial" cables are constructed to provide low radiation losses and consistent peak performance over the entire v.h.f. range. The cables are available with either double braid and single jacket or double braid and double jackets.

For engineering advice and application data write the company direct.

MULTI-CHANNEL CONVERTER

Crest Laboratories, Rockaway Beach, New York has introduced a multi-channel converter which has been especially designed for single channel use. Easily tunable to receive any channel, within a 20 channel range, without instruments, the new unit features silver-plated, high *"Q"* tuned circuits to provide high gain and sensitivity.

A fundamental oscillator provides good oscillator stability and reduces susceptibility to interference. The converter is designed to be used with a 300-ohm u.h.f. antenna.



SCREEN TISSUES

Carhoff Company, 11706 Kinsman Road, Cleveland, Ohio has developed a "giant-size" cleaning tissue which is especially effective for cleaning television screens or masks whether glass or plastic.

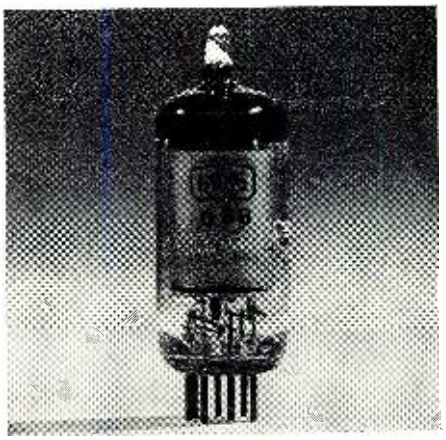
The tissues, chemically treated, are strong, soft, and durable. Each tissue can be used several times. They will clean grease and grime from glass as well as prevent fogging.

NEW TV TUBE

Sylvania Electric Products Inc. has announced the development of a new tube, the Type 6CS6, designed for combined sync separator and noise suppressor use.

The new tube is designed to be used in circuits that accomplish sync separation by feeding the video signal extending in a positive direction to grid three where the negative grid leak bias development automatically adjusts the clipping level.

Noise suppression is obtained in the 6CS6 by applying a video signal extending in a negative direction to grid



one. Strong noise impulses will cause tube cut-off momentarily and thus reduce the harmful effects of noise on picture tube sweep circuits.

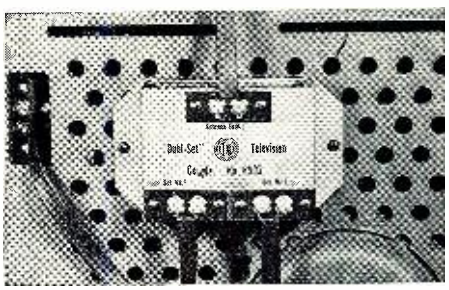
The 6CS6 grid number three has a sharp cut-off characteristic to facilitate the clipping action which removes picture information from the sync pulses. The tube is in the T-5½ bulb style and has a 6.3 volt heater.

ANTENNA COUPLERS

Insuline Corporation of America, 3602 35th Avenue, Long Island City 1, N. Y. has added two new antenna couplers to its line.

Designed to permit the use of more than one television receiver from a single antenna, the new couplers are the No. 6093 "Dubl-Set" and the No. 6094 "Multi-Set." The first allows two receivers to be operated from an antenna while the latter will permit as many as four sets to function simultaneously.

There is no interaction between receivers and no loss in signal strength when the couplers are employed, according to the company.



REPLACEMENT PARTS

The Tube Department of *Radio Corporation of America*, Harrison, N. J.

has announced the availability of two new electronic deflecting components which have been engineered for use with 90 degree, 27" television picture tubes.

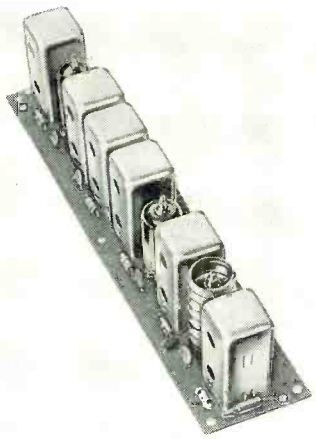
Now available for replacement applications are a magnetic deflection yoke (*RCA*-219D1) and a horizontal-output and high-voltage transformer (*RCA*-235T1). Although the yoke and transformer can be employed as independent units, they are designed for complementary operation. When used together, a proper impedance match is effected between the horizontal winding of the yoke and the horizontal output tube insuring ample deflection, good sweep linearity, and good voltage regulation.

These replacement parts are currently available at the company's regular distributors.

I.F. AMPLIFIER

The Tube Department of *Radio Corporation of America,* Harrison, N. J. has announced the availability of a new, assembled, and aligned i.f. amplifier, the *RCA*-208E1.

Complete with tubes and designed for use in TV receivers utilizing intercarrier sound systems having picture i.f. and sound i.f. carriers of 45.75 mc. and 41.25 mc. respectively, the new unit features high gain, full 4 mc. bandpass response, and excellent skirt selectivity. It provides an over-all



sensitivity of approximately 40 microvolts at 44 mc. and accurate control of the response-curve shape.

When used in conjunction with a cascode-type tuner, a voltage of only 6.5 microvolts (midband) is required at the input of the tuner to provide a d.c. voltage increase of 1 volt at the output of the amplifier.

A technical bulletin covering the *RCA*-208E1 is available on request.

LEAD-IN WEATHERHEAD

Javex, P.O. Box 646, Redlands, California has announced the availability of a new television lead-in weatherhead which has been tradenamed "Tenna-Shingle."

Molded of acrylic resin, the new unit fits under shingles on a roof or under the siding and covers the small hole required for the lead-in. The unit is transparent and takes on the color

of the surface to which it is attached.

The "Tenna-Shingle" will accommodate a standard 300-ohm line, is easy to install, and is electrically correct for this application.

NEW ANTENNAS

All Channel Antenna Corp., 70-07 Queens Blvd., Woodside 77, N. Y. has announced the availability of a redesigned, all-direction, all-channel v.h.f.-u.h.f. motorless antenna, the "Super 60." Details on this new antenna are available from the company in the form of a four-page brochure.

Channel Master Corp., Ellenville, N. Y. has developed a new all-channel v.h.f. antenna which has been designated as the "Champion" Model No. 325. It features a new type of broadband dipole system called the "Tri-Pole," triple power dipole. Thus the low-band dipole provides exceptional low-band gain and also functions as three half-wave dipoles tied together, in phase, on the high band.

Falcon Electronics Company, 2003 Cedar Street, Quincy, Ill. is now marketing a new v.h.f.-u.h.f. antenna, the "Vari-Con." The element heads are coupled to a sliding sleeve on the boom, enabling the antenna to be set as easily as opening an umbrella. The sliding sleeve is moved to the calibration mark on the boom which corresponds to the channel peaking desired. An illustrated brochure is available on request.

Neal Electronic Company, Huntsville, Alabama has released a radar parabolic-type antenna, the "Paraboray," which has a high average gain across the entire TV spectrum. The antenna is lightweight but ruggedly constructed to withstand adverse weather conditions.

Radio Merchandise Sales, Inc., 2016 Bronxdale Ave., New York 62, N. Y. has modified its yagi line to include six new 10-element broadband models which have been tradenamed "Panoramic Yagis." The models cover 2-3-4, 2-3-4-5, 2-3-4-5-6, 3-4-5-6, 4-5-6, and 7 through 13. For literature on these new antennas, write the company direct.

Television Hardware Mfg. Co., 904 Taylor St., Chicago, Ill. has introduced a new factory-assembled *"Telco"* u.h.f. corner reflector antenna, the "Golden Grid." Complete information, prices, and performance data on this antenna are available from the company upon request.

Telrex, Inc. of Asbury Park, N. J. has announced a new all-aluminum duo-band "Conical-V-Beam," the Models #520, 540, and 580 for optimum reception of channels 2 to 83 with one transmission line. A data sheet on these new models is available on request.

TV CONVERTER

David Bogen Company, 29 Ninth Avenue, New York 14, N. Y. is now marketing a u.h.f. converter, the Model UCT-1.

According to the company, the noise

figure of the UCT-1 has been reduced to only 13 db, which produces an improvement in reception roughly equivalent to quadrupling the transmitter power.

The new model is easily installed by connection to the antenna input of a standard v.h.f. receiver. The unit is housed in a brown plastic cabinet which is placed on top of the set.

The company will provide full details on request.

TELE-MATIC U.H.F. BOOSTER

Tele-Matic Industries, Inc., 1 Joralemon St., Brooklyn 1, N. Y. has developed and is in production on a u.h.f. booster, the Model UH-14-83.

The new booster provides improved TV pictures in areas where reception is poor, according to the company. The

gain of the unit is 14 db which is more than enough to minimize the noise figure of the converter. The complete absence of sliding contacts eliminates tuning noise. The bandwidth of 5-12 mc. is wide enough for full reproduction of both picture and sound details, but narrow enough for the complete rejection of spurious signals.

V.H.F. COUPLER

Technical Appliance Corporation of Sherburne, N. Y. has announced the availability of a new v.h.f. antenna coupling device which permits good impedance matching and maximum signal transfer.

The *Taco* No. 1425 v.h.f. "Magi-Mix" is enclosed in a plastic housing with straps attached for quick positive mounting. Newly developed electronic circuitry comprises standard electronic components to insure efficiency. The unit is not adversely affected by moisture or the elements.

The unit is designed to be used with broadband yagis. It may be employed in any combination of high- and low-band antennas to feed a single transmission line to the receiver, thus eliminating separate transmission lines and switching devices.

U.H.F. BOOSTER

Industrial Television, Inc., 369 Lexington Ave., Clifton, N. J. is now marketing its 133 u.h.f. "Autobooster" which covers the entire u.h.f. band.

Utilizing the newly-developed 6AJ4 low-noise u.h.f. triode, the new booster is, in reality, a continuously tunable amplifier.

Further details on this new product are available from the company's distributors or the company direct. —30—

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (TITLE 39, UNITED STATES CODE, SECTION 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF Radio & Television News, published monthly at Chicago, Illinois, for October 1, 1953.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Ziff-Davis Publishing Company, 64 East Lake St., Chicago 1, Ill.; Editor, Oliver Read, 366 Madison Ave., New York 17, N. Y.; Managing editor, Wm. A Stocklin, 366 Madison Ave., New York 17, N. Y.; Business manager, G. E. Carney, 366 Madison Ave., New York 17, N. Y.

2. The owner is: Ziff-Davis Publishing Company, 64 East Lake St., Chicago 1, Ill.; William B. Ziff, 64 East Lake St., Chicago 1, Ill.; B. G. Davis, 64 East Lake St., Chicago 1, Ill.; A. Ziff, 64 East Lake St., Chicago 1, Ill.; S. Davis, 64 East Lake St., Chicago 1, Ill.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities are: Modern Woodmen of America, Rock Island, Illinois.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only.)

G. E. CARNEY, Business Manager.

Sworn to and subscribed before me this 24th day of September, 1953.
[SEAL]

Helen Bullock, Notary Public.

(My commission expires March 30, 1955.)

Spot Radio News

(*Continued from page 18*)

The studios of WIP served as the meeting place, with Benedict Gimbel, Jr., as host. In welcoming the broadcasters, he said that sincere interest in this form of telecasting was more than evident by the attendance of so many broadcasters.

An optimistic note to the station owners, who are seeking financial aid through this new type of telecasting, was sounded by James M. Landis, former dean of the Harvard Law School, and special counsel for *Skiatron,* a subscription-TV service. The legal specialist emphasized that demand for better TV programs and the need for additional sources of income by many TV stations, would bring early support for pay TV. He declared that all of the advertising budgets in this country would be insufficient to support 500 stations, operating 10 hours daily.

A spokesman for RETMA noted that the association was certainly sympathetic to all new developments and if the Commission approved pay TV, manufacturers would be ready with the necessary gear.

Also on the podium was Ned Irish, prexy of Madison Square Garden. Comments by Abel Greene, Commissioner of the National Boxing Commission, were read into the record by Morris Mogelever of the New Jersey State Boxing Commission. Others at the meeting included representatives from WIFE, Dayton, O.; WACH, Newport News, Va.; WFPF-TV, Atlantic City, N. J.; WLBR-TV, Lebanon, Pa.; WTEV, New Bedford, Mass.; WNLC-TV, New London, Conn.; WOR-TV, New York City; WSTF, Stamford, Conn.; WIBG-TV, Philadelphia; WILM-TV, Wilmington, Del.; WKDN, Camden, N. J.; WEEU-TV, Reading, Pa.; WTTM-TV, Trenton, N. J.; WBES-TV, Buffalo, N. Y.; WBOC-TV, Salisbury, Md.; WELI-TV, New Haven, Conn.; and WHDN, New Brunswick, N. J.

To add more intrigue to the affair, the Commission received a sixth request for pay-see approval from WOCN, Atlantic City, N. J. Management of this station declared that it agreed with the others who filed for subscription television, noting that currently, the availability or non-availability of network affiliation often represented a . . . "life and death factor" in the station's economic ability to stay above water. They were not concerned with the method used to provide pay-see operation, their report added. Rather they were concerned with immediacy of action on the proposal. Nothing short . . . "of a national tragedy" . . . will occur, they added, if neither network tieup nor some alternative means appears for u.h.f. stations to obtain headline programming and financial support.

In the opinion of Commissioner Edward Webster, the decision to authorize subscription TV will be up to Congress; they will have to establish a policy and perhaps amend the Communications Act, which would authorize a fee service. Reviewing this rather delicate subject, the Commissioner said: "Very little vision is required to see that if subscription TV is authorized and it proves to be the most profitable method of operating a station, the best hours of every day will obviously be devoted to subscription, rather than free television. Every TV station licensee will be clamoring for subscription rights and will be pounding on the Commission's door for regulation, insuring that there will be no discrimination in the issuance of such rights or the rates charged . . . At the same time, owners of receivers will be fighting to retain free programming, or at the very least, will expect the Commission to promulgate rules which will provide the public with a choice of free programs during the best viewing hours, and which will insure the viewers of reasonable and non-discriminatory fees for the subscription programs . . . Those considerations point to common carrier rather than broadcast type regulations."

Legislation introduced during the last Congressional session by Rep. Carl Hinshaw also accented the fact that the term broadcasting would have to be redefined and subscription and theater TV would become common carrier type services.

Commissioner Webster wondered, he told those at the meeting, if subscription TV were not a method of . . ." point-to-point communications, closely analogous to the system of multiple-addressed communications or programs addressed to selected receivers." He wondered, too, he continued, if pay-see TV was a . . . "service in which only subscribers who pay a fee on a per-program basis can view the program, a broadcast service as the American public knows it, or is it a common carrier service for hire?" . . . "Is that segment of the population which either feels it cannot afford the subscription service or who does not want it, to be denied the right to view programs on publicly-owned channels, which are presently available to them on a no-charge basis?" asked the FCC member.

Truly a complex problem faces both the Commission and Congress, and Mr. and Mrs. Viewer, too. The winter of '54 may see an answer . . . and an important answer it will be!

MISREPRESENTATION AS to the effectiveness of TV antennas has again been soundly scored by the Federal Trade Commission. In a brief containing proposed trade practice rules for industry, the FTC notes that it should be an unfair trade practice to . . . "make or publish any false, misleading, or deceptive statement or representation, by way of advertisement,

label, mark, brand, or otherwise, concerning their (antennas) uniqueness, performance, ability to bring in distant transmission or utility for very-high or ultra-high reception."

Rapping misleading built-in and indoor antenna advertising, the FTC says that it should also be an unfair trade practice to make the . . . "unqualified general representation that TV sets equipped with built-in or indoor antennas will perform as satisfactorily as if they were equipped with outdoor antennas, when such is not the fact. When such representation is true only in a limited number of locations, or within a limited radius or TV transmitting stations, or only under specially favorable conditions, or under other performance limitations, it is an unfair trade practice under this rule to fail to make a clear disclosure of such limitations."

Also under consideration by the Commission are definitions for high fidelity, covering the specific characteristics that speakers, amplifiers, cartridges and enclosures should possess to insure truly wide-range reproduction.

INTERNATIONAL TV RELAYS, dismissed by many as moon talk, have found a serious audience in Europe. A short while ago, the BBC called a conference in London to discuss continental relays and make preliminary engineering arrangements for hook-ups during Christmas and New Years, which might become permanent during '54.

The networks would include, it was said, the existing BBC 405-line net of seven stations in the British Isles, the West German 625-line link of eight stations extending from Berlin to Baden-Baden, and between these a composite network comprising the RTF 819-line stations at Paris and Lille (with an extension to Strasbourg), the Belgian 625/819-line stations at Brussels, and the Dutch 625-line stations at Lopik and Eindhoven.

Since converters will play an important role in network operation, it was decided that, for the Christmas programs, each broadcaster would be responsible for the provision and installation of a converter where the incoming signal was of a different standard; an international converting station may be employed for this purpose. Such a station would form a link between a 405-line network to the west, an 819-line network to the south, and a 625-line link to the north. Each network, it was noted, would feed signals of its own standards to the converting station and would in turn be fed according to its own standards.

The novel conference was attended by representatives from Belgium, France, Germany, the Netherlands, the BBC, and members of the European Broadcasting Union.

Everyone eagerly looks forward to the inauguration of this unique link, one of the most unusual in the history of TV . . . . . L.W.

U.H.F. Tuners

(*Continued from page 66*)

labeled "Ant," the other "Mix." The bandwidth is determined by the amount of coupling (mostly capacitive) between networks and is adjusted by the nylon screw trimmer. The 6AF4 oscillator is conventional, but note that four r.f. chokes are employed, each subject to shorting, opening, or grounding. When the oscillator in this tuner is found to be inoperative, be sure to check these chokes.

The top view of a *Mallory* converter, the Model TV-101, is shown in Fig. 1. Note that all the trimmer adjustments for tracking the r.f. network are available from the top. The oscillator trimmer condenser, also accessible from the top, is located behind the 6AF4. The 1N72 mixer crystal is mounted on spring clips, avoiding the need for soldering to the delicate crystal. The oscillator injection voltage is coupled to the mixer by means of the 0.68 $\mu\mu$fd. condenser located on top of the chassis and visible in Fig. 1.

Despite improvements in the design of the moving contact arm, the *Mallory* tuning mechanism occasionally develops contact trouble, causing intermittents to appear. Contact cleaning fluid and a good lubricating grease will cure this trouble. Another source of service calls is the difficulty in tracking the tuning mechanism over the entire band. Where only one u.h.f. station is received, this is solved by peaking up the trimmer adjustments for best response at that station. When several u.h.f. stations can be picked up, a compromise alignment must be achieved, favoring the weakest station.

Representative of the resonant transmission line type of tuning device is the *Granco* system shown in Fig. 2. Here the two r.f. networks and the oscillator tank circuit are quarter wavelength transmission lines, and the frequency is varied by means of a noncontacting plunger which effectively reduces the length of the line. Since there is no metal-to-metal contact in this tuning device, intermittents due to the tuning action are practically nonexistent. Tracking adjustments for each of the tuned lines can be made in two ways. A master trimmer condenser, accessible from the top of the chassis, tunes each of the three networks. In addition, the relative position of each plunger can be set by turning the screw which holds the plunger onto the main tuning plate. By using these two adjustments, it is possible to track the r.f. network and oscillator fairly closely, and optimum results for at least two u.h.f. stations can always be achieved. With the exception of contact trouble, the *Granco* tuner and converter is subject to any of the other defects found in u.h.f. equipment and the troubleshooting methods outlined previously apply.

The *Standard Coil* 82-channel tuner described in the September, 1953 issue of RADIO & TELEVISION NEWS is somewhat different in its susceptibility to trouble in the u.h.f. section. Being a turret tuner, troubles can be isolated by using a new set of coil strips when the defect appears only at one channel, and by removing the entire drum when the defect appears on all channels. Fig. 7 is a diagram of the u.h.f. portion of the tuner, and Fig. 3 shows a u.h.f. coil strip corresponding to the section marked "D" in Fig. 7. The contact pins on the coil strip are underneath the coils and condenser blades. The u.h.f. portion of this tuner works in decades, channels 20 to 29, 30 to 39, etc., with each of the coil plates covering one decade or ten channels. The individual channels, or digits, are selected by means of a dielectric rotor assembly which rotates inside the drum and varies the capacity of the condensers whose stator blades are seen in Fig. 3.

In the *Standard Coil* tuner contact trouble is confined to switching from channel 19 to 20, 29 to 30, etc., and this trouble can be cured in the same manner as contact trouble in the v.h.f. *Standard Coil* tuner. The use of wiping contacts is designed to cut down corrosion and decrease contact trouble.

In addition to three master trimmer condensers mounted on the u.h.f. chassis, each individual coil plate can be adjusted for optimum performance, and to correct mistracking and the resultant weak signals. This adjustment can be done by spreading or compressing coils and bending the stator blades slightly. Because the stators are embedded in the plastic coil strip, care must be taken in any adjustment to avoid breaking the strip. With the *Standard Coil* 82-channel tuner, it is possible to get maximum signal transfer on at least one channel in every decade, making the over-all tracking quite constant.

The input network consists of three condensers and two shunt coils, making up a two-section high-pass filter (see Fig. 7). This filter will prevent interference from strong v.h.f. stations and police transmitters. Other defects such as an inoperative oscillator, or a defective crystal mixer, can be located and repaired by the method outlined.

The *Kingston Products* u.h.f. tuner which is used widely in the *Regency* line of converters and tuners, differs from most of the other tuners in that only a single-tuned r.f. network is used. Furthermore, the tuned transmission line used here consists of a parallel balanced line which has a sliding, shorting spring for tuning. The appearance and tuning arrangement of this mechanism is shown in Fig. 4. In order to simplify the mechanical drive and to save space, the parallel lines are curved around the outside of the assembly. The lower half of the unit contains the oscillator tank circuit, also a balanced, parallel transmission line. Trouble-shooting this tuner is made a little difficult by the fact that the oscillator socket is not easily accessible. Checking the r.f. chokes and other parts for shorts, poor solder connections, or other defects, especially those causing intermittents, is quite involved.

Improving weak signals by better tracking can be done quite efficiently. Note that there is one oscillator tracking trimmer and two separate trimmers for the r.f. network, one affecting the entire band, the other tuning only the lower u.h.f. channels. Additional adjustment is possible by changing the position of the oscillator or r.f. sliding short on the main tuning pulley.

Contact trouble may occur; however, the shorting spring and transmission line elements are all silver-plated to reduce the need for contact cleaning and lubrication.

The *Kingston Products* tuner has only a single-tuned r.f. network with fixed coupling to a broadly-tuned antenna loop and this permits slightly more oscillator radiation than in the more sharply tuned u.h.f. tuners, especially when the tracking is not optimized. The original *Kingston* tuner also does not have a built-in high-pass filter but the *Regency* converter does contain such a filter to eliminate interference.

The basic u.h.f. portion of the *Philco* tuner is shown in Fig. 8. This tuner uses condenser tuning and employs an elaborate, well-constructed, ganged variable condenser as the heart of the tuning mechanism. The circuit diagram in Fig. 8A shows an input filter to keep out v.h.f. and i.f. interference, and a 150-ohm matching section which connects to suitable taps on the antenna coils. Note that each resonant circuit is made up of two series networks, connected in parallel. The antenna tank, for example, has series networks, L_1, one half of C_4, and C_{3A}, connected in parallel with L_2, C_{3B}, and the second half of C_4. The result of this arrangement is to make the coils and condensers physically practical and also to permit balanced operation. An idea of the appearance of these networks can be obtained from Fig. 8B. The coils are flat strips of brass, bent into horseshoe shape, and mounted directly on the stator blades of the variable condenser. Using a balanced circuit permits grounding the rotor shaft and this allows a simple mechanical assembly. The electrical performance of this system can be compared to that of other continuous tuners having a double-tuned r.f. network, except that because capacity tuning is used, the bandwidth of the r.f. section will vary somewhat over the u.h.f. band.

An inoperative tuner, especially when the oscillator is at fault, is fairly simple to repair since the oscillator tube socket and all components are accessible once the shield cover is removed. In addition, as the circuit diagram indicates, an ample number of test points is provided. To check the oscillator operation, the grid cur-

rent can be measured by using the proper test point and, similarly, the crystal mixer current can be measured without unsoldering or disturbing anything.

For tracking the oscillator two adjustments are available, the trimmer C_9, which sets the high-frequency end, and the slug tuning of coils L_{11} and L_{12}, which should be set at the low end of the u.h.f. band. Each of the r.f. networks has one tracking trimmer, and to get good tracking at several points in the band sometimes requires the bending of the rotor plates. This is not recommended except in an emergency and only when the proper alignment setup is available to check the result of this procedure.

Intermittents in the *Philco* tuner can be due to poor solder connections, and broken or defective components just like in any other tuner. Locating such defects requires removal of the shield cover and after that, mechanical inspection will generally turn up the guilty part. When an intermittent appears due to tuning, two possible trouble spots should be checked. The rotor blades may be shorted, either due to bending, or due to dust and dirt getting into the variable condenser. (The sections tuning the r.f. network are spaced much wider than the oscillator section so the latter should be the prime suspect.) The other trouble spot is at the rotor shaft grounding springs. Poor grounds at one or two spots are sometimes due to a speck of dirt which gets into the groove and lifts the spring away from its usual contact point. Cleaning the grounding springs and surrounding areas with contact cleaner will usually clear up this type of trouble.

Interference due to v.h.f. stations or i.f. signals is rarely a problem in the *Philco* tuner due to its elaborate input filter network and its fairly narrow r.f. bandpass. Similarly, oscillator radiation is at a minimum when the tuner is properly aligned.

Another widely used u.h.f. tuner which employs a variable condenser is the one produced by *General Instrument Corp.* Unlike the *Philco* unit, the *GI* tuner uses flat transmission lines which are condenser-tuned at one end. Tracking is difficult if optimum performance on several stations is desired, but as a last resort it is again possible to bend the rotor plates slightly. Intermittents due to tuning are handled as described for the *Philco* tuner. Most of the currently used models of the *GI* tuner employ an oscillator operating on a harmonic. This means that a 6J6, connected as push-pull oscillator, feeds into a "harmonic selector" network which takes the place of the oscillator tank circuit in other tuners. The drawback of using a harmonic of an oscillator is, of course, the possibility of various beats which might result in visible or audible interference.

In the main, u.h.f. tuner troubles can be narrowed down to four principal ones; 1. inoperative tuner, 2. weak signal, 3. intermittent operation, and 4. interference. Depending on the type of tuner and the number of u.h.f. and v.h.f. stations that can be received, most of these troubles can be traced to a particular section, and often even to a single suspected component. Knowing the four basic u.h.f tuner troubles and being familiar with the features of today's u.h.f. tuners, the service technician will not find it difficult to troubleshoot u.h.f. tuners or converters.

In addition to the electrical defects described in this article, experience shows that a good portion of all service calls involving u.h.f. tuners is due to purely mechanical defects involving dial lights, dial cords, knobs slipping, etc. Considering these simple mechanical repairs and the almost equally easy electrical troubleshooting, there should hardly be any occasion for the capable technician to refuse service work on u.h.f. tuners or to simply refer everything back to the manufacturer. Aside from the long waiting period which often irritates the customer, his confidence will be retained by demonstrating that even the latest u.h.f. devices present no problem to his favorite TV service technician. —30—

IMPROVED 10-METER MOBILE ANTENNA

By **Lt. Col. BYRON E. HARGROVE, W4BSO**

Recollection of an old principle and the "surprise" use of a 75-meter loading coil give new advantages on 10 meters.

IT IS common practice when operating multi-band mobile to utilize a loaded antenna for other than ten meters. This usually takes the form of either a base coil or one inserted some distance up from the base. When operating ten meters with such an antenna combination, the loading coil normally is shorted out.

The author operates 10, 20, and 75 meter mobile with a bandswitching, v.f.o. controlled transmitter of his own design and construction housed in a 6"x9"x9" cabinet located within easy reach above the clutch pedal. The antenna used is a *Master Mobile Mount* with center-loaded shielded coils for 75 and 20. Following common practice, the coil formerly was shorted out for 10 meter operation.

Because the transmitter can be shifted from one band to another with such rapidity (one knob selects the proper coil for the 50 w. final, the proper exciter stage or stages, turns the heaters on or off in the used or unused multipliers, and changes the rate of tuning of the v.f.o. so that each phone band covers the entire v.f.o. dial) a means of rapidly shifting the antenna from one band to the other was greatly desired.

One possible solution lay in the use of the longest whip allowed (determined by overhead wires, trees, viaducts, etc., and the tolerance of an already harried XYL). Since the final uses pi-coupling networks in the plate circuit, power could be fed to such an antenna at any frequency. However, the efficiency on 75 meters, low with even the best arrangement, would have been too low to be tolerated.

In the course of pursuing the problem, the writer recalled occasions where a half-wave doublet for 75 meters fed with coax was used with fair success as a 7-half-waves out-of-phase long wire on 10 meters. If it works with half-waves why not with quarter-waves?

Accordingly the 75 meter coil was inserted in the antenna, the transmitter tuned to 10 meters, and lo! and behold, the transmitter loaded and behaved normally! Next question—was the energy going anywhere or was it being dissipated within the confines of the shielded coil?

Fortunately, our curiosity was soon satisfied since ten was exhibiting one of its now-too-infrequent openings. A station was contacted in Florida and tests made comparing the performance of the loaded antenna and the straight whip with the coil shorted. In order to insure that the antenna changes and not conditions were responsible, the change was effected several times, always with a "much better" signal from the loaded antenna than with the coil shorted out.

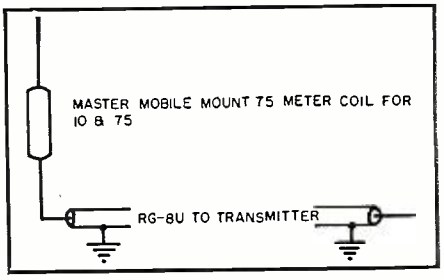
In the few openings that have occurred since making this discovery, a phenomenal percentage of contacts out of calls made has resulted. Exactly why the loaded antenna should perform so much better on 10 when using the 75 meter loading coil is not known. It is due apparently to the redistribution of current along the antenna, getting more of it up into the whip where it can be radiated.

The writer's antenna is installed on the right cowl of a 1948 *Studebaker* Land Cruiser at the height of the top of the air scoop. The RG/8-U coax lead to the transmitter is approximately four feet long. The shield is grounded at both ends. Using this combination, a change can be made from 10 to 75 meters or *vice versa* without stopping the car.

That is, you can do it without stopping *if* your transmitter controls are in easy reach, and you have marked the loading condenser settings. I suggest that you at least slow down! After all, you won't have that ten-meter QSO if you run into another car. Maybe you have gotten away with driving with a mike in your left hand, a knob in your right hand, and the steering wheel in your other hand, but such trick-riding gives amateur radio bad publicity.

Now what to do to include 20 meters? No answer yet, but we're working on it. —30—

Plainly there is "nothing to it." The mobile antenna connects in the same old way.



"MR. WIRELESS"

By **C. HOWARD BOWERS**

THIS column is dedicated to "Old Time Wireless Operators." If you were among those pioneers of 1912 or thereabouts, please write us YOUR story.

With this issue we have the story of "Mr. Wireless," himself—Commander Edwin W. Lovejoy, U.S.N.R. Comdr. Lovejoy is now identified with the Federal Communications Commission, Washington, D. C., and is a very busy man. We feel very fortunate in getting his story. The Commander, known to his friends as "Ed," practically cut his teeth on a spark-gap! His first "Ticket" was a "Certificate of Skill in Wireless Telegraphy," issued in 1911 and although "Ed" admits having been chief operator and office manager for the old United Wireless Telegraph Company at "PJ" East San Pedro, California in 1912, age 18, we have reason to believe that that was not his first professional wireless job; however that is one detail we will have to skip! Station "PJ" (later "KPJ") handled a considerable amount of ship traffic in the Los Angeles area also quite a volume of point-to-point traffic with the company's other station at Avalon, Santa Catalina Island.

In 1913 United Wireless was absorbed by the Marconi Wireless Telegraph Co. During 1914 our subject pioneer operator accepted employment with the Federal Telegraph Company (of California)—later known as the Mackay Radio and Telegraph Company. The old Federal Company was then using the Poulsen Arc System and "Ed" was one of the first operators to use an Arc Transmitter on sea-going vessels. In succession, he was assigned by Federal to their stations, KFS-San Francisco, KLS-Los Angeles, and KFZ-Inglewood, California. (Ships appealed to "Ed" only while tied to the dock!)

On April 10, 1917 "Ed" joined the Navy as Chief Electrician's Mate (Radio) and served as radioman until June 1919. And, we quote, "That ended my career as a radio operator!" From that time, he went on to serve as Radio Inspector at Baltimore, and San Francisco. He later served as Radio Engineer and Inspector for the old Federal Radio Commission and the Department of Commerce (Radio Division), predecessors of the present Federal Communications Commission. His most important post was that of Supervisor of Radio, 7th Radio District, Seattle, Washington, from 1928 to 1933. Radio Inspector Lovejoy was well qualified to check other operators as he himself held an "Extra First Grade Commercial Operator License, (Pink Ticket) which required additional technical knowledge; also a code speed of 25 wpm Morse and 30 wpm Continental.

Having retained his US Naval Reserve status and having advanced to the rank of Lieut. Commander, "Ed" was ordered to active duty in May 1941 as Electronics Officer to study radar. That was before Pearl Harbor and as World War II advanced, he also advanced to full Commander (1943) and continued as Electronics Officer at several of the country's most important Navy Yards, until 1946, when he was mustered out of service.

Commander "Ed" Lovejoy has an enviable record in the field of radio and electronics, and we are sincere in tagging him, "Mr. Wireless." —30—

Within the Industry

(*Continued from page 36*)

Jr., *Prestwood Electronics Co.*, Augusta, Ga.; Ralph E. Walker, *Walker-Jimieson, Inc.*, Chicago; Leo I. Meyerson, *World Radio Labs, Inc.*, Council Bluffs, Iowa; Elliott Wilkinson, *Wilkinson Brothers*, Dallas; Max I. Epstein, *Federated Purchaser, Inc.*, New York City; R. V. Weatherford, *R. V. Weatherford Co.*, Glendale, Calif.; H. M. Carpenter, *Thurow Distributors, Inc.*, Tampa, Fla.; and L. B. Calamaras, executive vice-president of NEDA.

* * *

ALBERT E. HYLAS has joined the engineering staff of *Industrial Television, Inc.* as chief development engineer.

Formerly associated with the research division of *Allen B. Du Mont Laboratories, Inc.*, in his new post he will be concerned with the design and development of new products for both military and commercial applications.

He brings to his new position a diversified background in electronic design which has included work on color TV receiver and studio equipment, loran, and specialized test equipment.

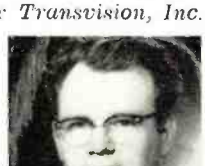
* * *

RAYMOND S. PERRY has been elected president of *Federal Telephone and Radio Company* succeeding **HENRY C. ROEMER** who has been named vice-president in charge of administration of the domestic division of the parent company, *International Telephone and Telegraph Corporation* . . . **CHARLES B. DENTON** is the new marketing manager for *Weston Electrical Instrument Corporation.* In this newly-created post, he retains direction of the advertising department but also assumes responsibility for the sale of all retail and distributor products . . . **MAJOR WILLIAM J. SCHOENBERGER,** recently released from active duty with the Air Force at the Wright Air Development Center, has joined *Insuline Corporation of America* as assistant to the firm's president . . . *General Electric Company* has made three departmental appointments in its newly-formed Commercial Equipment Department. **PAUL L. CHAMBERLAIN** has been named manager of the broadcast equipment department, **H. BRAINARD FANCHER** is the new manager for germanium products, while **HARRISON VAN AKEN, JR.** will be in charge of communication equipment . . . Promotion of **JACK D. HUGHES** to the position of vice-president and operations general manager has been announced by *Littelfuse, Inc.* He was formerly vice-president in charge of sales. He will continue to supervise sales in his new post . . . **S. W. GROSS** has been named vice-president in charge of sales for the *Emerson Radio and Phonograph Corporation.* He

is returning to the company after an absence of nine years during which he engaged in his own business in the electronics field . . . The Rectifier Division of *Sarkes Tarzian, Inc.* has made several new appointments of interest to the industry. **STANLEY NICIEJEWSKI** is the new sales manager, **ALFRED D'URSO** is the new assistant sales manager of distributor sales, while **FRED LUCAS** has been named assistant sales manager of industrial sales . . . **ALLEN N. WHITE, JR.** has been appointed sales promotion manager of the *Westinghouse* Television-Radio Division at Metuchen, N. J. He succeeds **FRED McCARTHY** who has resigned . . . **ROBERT D. HALLOCK** is the new plant manager for *American Microphone Company* of Pasadena. He will be in charge of engineering and production and will be responsible for the development and design of new models in the company's line . . . *Pyramid Electric Company* has appointed **WILLIAM J. SLAWSON** to the post of assistant sales manager of its jobber division. He formerly held a similar post with *Federal* . . . **LOUIS W. SELSOR** is now handling distributor sales for the *Jensen Manufacturing Company* of Chicago. He was formerly sales manager for the *National Video Corp* . . . **WOODRUFF BURR** has been appointed buyer of cabinets for the radio and television division of *CBS-Columbia, Inc.* He was formerly with *General Electric Company* and for the last five years with *Allen B. Du Mont Laboratories, Inc.* . . . **WALTER H. HAWK** has been named manager of television operations for *Federal Telecommunication Laboratories.*

* * *

DAVID GNESSIN has been named educational director for *Transvision, Inc.* He has been serving as editor of the company's television kit instruction booklets.



He is well-known in the service industry both for his lectures and for his articles in the technical press. He has served as editor of the company's "Television Notes" magazine for the past four years.

In his new post, Mr. Gnessin has planned many more publications to acquaint the public with the true picture of television and to counteract adverse publicity about television servicing.

* * *

THE SECOND ANNUAL International Sight and Sound Exposition has been scheduled for September 30, October 1 and 2, 1954 at the Palmer House in Chicago.

This year's event, which drew more than 21,000 hi-fi enthusiasts, will be expanded in both size and scope. An additional floor will be reserved for exhibition purposes.

Plans for the 1954 event will be announced shortly. —30—

Mac's Service Shop

(*Continued from page 72*)

cent of the time at 50 per-cent of the locations. A rural location free from man-made noise is assumed. Instead of our dipole we use an antenna with a 6 db gain on channels 2-13 and one with a gain of 13 db on channels 14-83. Under those circumstances required signal strengths can be reduced to 47 db above 1 microvolt-per-meter on the low channels, 56 db on the high channels, and 64 db on the u.h.f. channels."

"Which looks like about 224 microvolts on the lows, 630 on the highs, and 1600 microvolts on the u.h.f. channels," Barney quickly translated.

"A lot of information is given in the pamphlet put out by the FCC on the methods used to arrive at these figures," Mac contined; "but one of the most interesting was the fact that the visual carrier had to be 30 db above the r.m.s noise level for a satisfactory picture. The noise sources include those external to the receiver as well as noise generated within the receiver itself. The difference between 30 db and our minimum of 47 db for Grade B service in channels 2-6 is 17 db. This 17 db of maximum noise is equivalent to about seven microvolts-per-meter; so we can arbitrarily say that the noise level should not exceed 7 microvolts-per-meter at any location where a television receiver is to be used in a rural location."

"Have we got that much noise around here?"

"Personally, I do not think we have anywhere near that much noise at the average location here in town. To be sure of this, the noise would have to be measured with a special noise meter; but we can get a rough idea by using our service field strength meter to measure the signal delivered to the set and noticing how much signal strength is needed to overcome all noise interference. As you know, any time we get a signal of even 100 microvolts here, noise ceases to be a problem at all. From this I deduce that the average noise present must be considerably less than 7 microvolts-per-meter. To verify this, whenever we connect our field strength meter to an antenna and set it to an empty channel, we seldom get a reading of more than a microvolt or so. Everything seems to indicate that the noise level in this urban area is fairly close to what would be expected in a rural area."

"What kind of noises were they hollering about?"

"All kinds: auto ignition, electric drills, electric razors, sweepers, food mixers, electric sewing machines, x-rays, diathermy, high tension lines, diesel engines, and—I must not forget to mention—interference produced by you radio amateurs. I tried to point out that silencing all these noise sources would mean the stopping of

all cars, building, cleaning, power transmission, bone-setting, etc., etc. A certain amount of noise is bound to be with us always, and any attempt to reduce it to absolute zero is foolish and impractical.

"As long as it stays within reasonable limits, the way to better reception lies in increasing the signal delivered to the set and in improving the set's ability to make the most of that signal after it gets it. Increased transmitter power, higher gain antennas, and improved signal-to-noise ratio in receivers are three factors that have already helped fringe area reception tremendously. The Johnny-come-lately in television reception would not know this; but those of us who have been trying to get a decent picture in the same fringe area location for several years can appreciate the tremendous improvement that has been made by the introduction of the cascode tuner alone."

"What else did you say to the assembled multitude?"

"As a clincher, I pointed out something that seemed to come as a rude shock to most of them: the fact that they were producing interference with their TV sets that not only caused trouble to each other but that also interfered with the enjoyment of radio reception in the homes of their neighbors. I explained how oscillator radiation from a TV set often wipes a picture entirely off the screen of a nearby set tuned to a weak signal on another channel. (Incidentally, I think you amateurs are getting full and false credit for most of this kind of interference.) On top of that I told them that hardly a day goes by without our getting a call from a radio listener who wants to know if we can remove the squeals and whistles from his radio that are only present when his neighbor's TV set is running. While most of the TV owners had noticed their sets interfered with their own radios, they did not realize the signal put out by the horizontal deflection system often travels several hundred feet. I thought that perhaps when they realized they were living in glass houses as far as producing television interference was concerned, they would not be quite so ready to reach for a stone to shy at the other fellow."

Barney shook his head doubtfully. "I quote from Mark Twain," he said. "'There is no sadder sight than a young pessimist, except an old optimist.'" —30—

WISCONSIN CLUBS

THE Wisconsin Council of Radio Clubs recently held its annual meeting at Watertown, Wisconsin and elected new officers for the coming year.

John C. Doyle, W9GPI of Milwaukee was named president of the Council; Victor Stroebel, W9XAS of Rio was elected vice-president; Harold Peterson, W8NLH of Sturgeon Bay was named secretary; while Wm. Kerswill, W9LED of Wausau is the new treasurer. —30—

SERVICE HINTS ON WESTINGHOUSE TV SETS

MODEL H-196

Insufficient picture width.

If, under very low line voltage conditions the picture width is not sufficient, even though the width control is set at maximum, check the code number on the deflection yoke. (This number is located under the "V" number on the yoke.) If the number is 98, 108, or 118, replace the yoke with one carrying any other code.

Poor vertical hold.

In weak signal areas, the vertical sync may be improved by replacing the 12AU7 sync amplifier tube (used in early production chassis) with a 12AT7. The 12AT7 is a medium-mu tube and will provide greater sync amplitude than will the 12AU7, which is a low-mu type. This change is a direct substitution; no wiring changes are necessary.

Prolonging tube life.

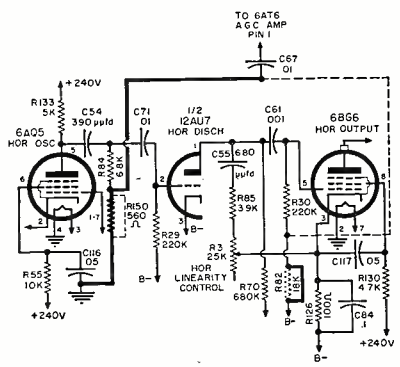
To prolong tube life in this model, replace the 5Z4 low-voltage rectifier by a 5V4G. The 5V4G has a higher current rating than the 5Z4 used in early production chassis. This is a direct substitute; no wiring changes are necessary.

120-cycle modulation.

This condition may be eliminated by feeding the saw-tooth voltage to the 6AT6 a.g.c. amplifier from a different point.

To effect this change, do the following:

1. Remove the lead between the junction of R_{82} (18,000 ohms) and R_{80} (220,000 ohms), resistors in the grid circuit (pin 5) of the 6BG6 horizontal



output tube, and C_{67}, the .01-µfd. condenser, to pin 1 of the 6AT6. (See accompanying diagram.)

2. Remove R_{82}, replacing it with a piece of solid wire.

3. Disconnect R_{84}, 6800-ohm resistor in the plate circuit (pin 5) of the 6AQ5 horizontal oscillator, from ground. Add a 560-ohm resistor (R_{150}) between R_{84} and ground.

4. Connect one end of a wire to the junction of R_{84} and R_{150} and the other end to C_{67}.

MODELS H-196 & H-207

Audio hum.

This condition may be reduced by adding a 30-µfd. condenser across C_{99}, the 10-µfd. condenser, connected between the screen (pin 6) of the 6AQ5 audio output tube and ground.

MODELS H-196, H-207 & H-217

Sensitivity control adjustment.

The correct method of setting the sensitivity control on these models is as follows:

If the chassis is on the bench, set the control for .6 volt on the picture i.f. a.g.c. line with no signal input. If the set is in the customer's home, set the channel selector to an unused channel; turn the contrast control to maximum and the sensitivity control fully counterclockwise for maximum sensitivity. The screen should then be well filled with snow. The sensitivity control should then be turned clockwise very slowly, until the amount of snow just begins to decrease. The screen should still be saturated with snow, and the control should be locked at this position. The slot in the control will be approximately horizontal.

MODELS H-207A, H-207B & H-217

Tube replacements.

For best results, replace the 12AX7 horizontal and vertical sync separator tube with an *RCA* type only, when replacement is necessary.

MODEL H638K20

Vertical foldover.

To improve the horizontal linearity and eliminate foldover at the left of the raster, add a 33-ohm resistor in parallel with a .1-µfd. condenser between the cathode (pin 3) of the horizontal output tube and ground.

Beat pattern in picture.

To prevent the appearance of an r.f. "tweet" on the low band channels, add an inductance (*Westinghouse* Part No. V-4886-2) in series with the heater lead between pin 4 of the 6C4 audio phase inverter, and pin 4 of the 6T8 ratio detector.

MODEL H652K20

R.f. interference in picture.

Harmonics of the 4.5-mc. sound signal may, in some cases, be coupled into the a.g.c. line causing r.f. "tweet" on the picture.

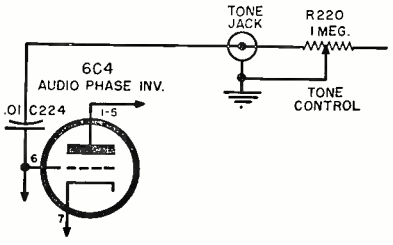
To eliminate this condition, insert a 560-ohm resistor in the lead running from the a.g.c. diode (pin 6) of the 6T8 tube.

MODELS H660C17 & H661C17

Sound in picture.

This condition may be due to a 4.5 mc. sound signal radiating from the tone

control and jack. To eliminate this possible source of 4.5 mc. "tweet" interference on the picture, decouple the tone control by adding a 150-ohm resistor between the tone control jack and C_{224}, the .01-μfd. condenser, con-



nected to pin 6 of the 6C4 audio phase inverter. (See accompanying diagram for circuit before change.)

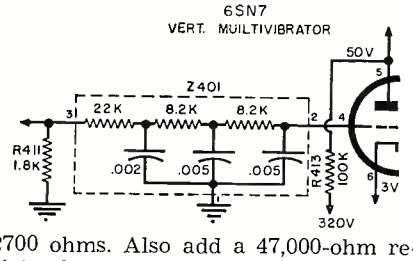
Also add a 560-ohm resistor in series with the wire running from pin 6 of the 6T8 audio amplifier.

Insufficient width.

To obtain sufficient width in some chassis, the screen dropping resistance for the 6AU5GT horizontal output tube is decreased to approximately 10,000 ohms by adding a 56,000-ohm, 1-watt resistor in parallel with the 12,000-ohm resistor (R_{112}) on the screen (pin 8) of the 6AU5GT.

Vertical instability.

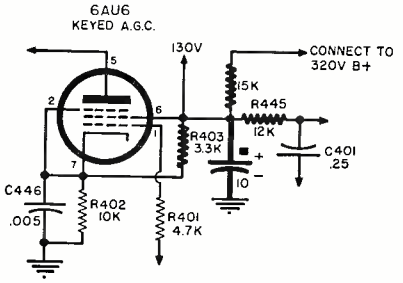
To improve the vertical hold, R_{111}, the 1800-ohm resistor at the input to the integrating network, is changed to



2700 ohms. Also add a 47,000-ohm resistor between the grid (pin 4) of the vertical multi-vibrator (6SN7GT) and ground. (The accompanying diagram shows the circuit before the change.)

Sound modulated picture "bounce."

To eliminate jumpy pictures when the volume control is set for maximum



audio output, do the following and see accompanying diagram:

1. Remove the wire that connects pin 6 of the 6AU6 keyed a.g.c. tube to the 130-volt "B+" line.

2. Connect a 15,000-ohm, 5-watt resistor between the 320-volt "B+" line and the junction of pin 6 of the 6AU6 keyed a.g.c. tube, R_{103} (3300 ohms), and R_{445} (12,000 ohms).

3. Change C_{220} (10 μfd.), connected between pin 6 of the 6AQ5 audio output tube and ground, to 30 μfd. by

disconnecting the 10-μfd. section of the electrolytic condenser and adding a separate 30-μfd., 450-volt condenser.

4. Connect the 10-μfd. section of the electrolytic condenser to pin 6 of the 6AU6 keyed a.g.c. tube.

5. Remove R_{213} (8000 ohms, 10 watts) from the chassis. This resistor was previously connected between pins 2 and 4 of the television-radio socket.

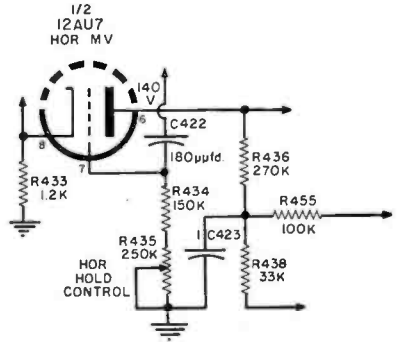
6. Add a 150,000-ohm resistor in series in the line running from pin 5 of the television-radio socket to pin 6 of the 6C4 audio phase inverter.

SERIES V-2192 CHASSIS

Poor focus.

Improved focus may be obtained by increasing the voltage applied to the first anode (pin 10) of the CRT.

This is accomplished by disconnecting pin 10 of the CRT from the 320-volt supply line and connecting it to the junction of C_{423} (.1 μfd.), R_{436} (270,000 ohms), R_{438} (33,000 ohms), and R_{455} (100,000 ohms). This junction is located in the plate supply circuit for



the pin 6 plate of the horizontal multivibrator. (Accompanying diagram shows the circuit before the change.)

Horizontal instability.

The following changes will improve the stability of the horizontal multivibrator (12AU7):

1. Change C_{421} at pin 1 of the horizontal multivibrator from 120 $\mu\mu$fd. to 47 $\mu\mu$fd.

2. Change C_{422} between pins 1 and 7 of the horizontal multivibrator from 180 $\mu\mu$fd. to 120 $\mu\mu$fd.

3. Add a .1-μfd. condenser in parallel with the horizontal hold control.

4. Change R_{434} in series with the horizontal hold control from 150,000 ohms to 270,000 ohms.

Appearing retrace lines.

To eliminate retrace lines from the picture, make the following changes:

1. Remove C_{313}, the .1-μfd. condenser, from its original position at pin 2 of the CRT.

2. Insert a 470,000-ohm resistor between pin 2 of the CRT, and the junction of C_{316} (.005-μfd. condenser), and the arm of the brightness control.

3. Interchange the electrical positions of C_{412} (.1 μfd.) and R_{420} (3300 ohms) at pin 2 of the 6SN7GT vertical multivibrator, so that C_{412} connects to pin 2 of the vertical multivibrator, and R_{420} connects to ground.

4. Reconnect C_{313} between pin 2 of the CRT and the junction of C_{412} and R_{420}.

Vertical instability.
To improve the vertical hold, change R_{411} at the input (terminal 3) to the integrating network from 1500 ohms to 1800 ohms.

CHASSIS V2200-1, V2201-1, V2204-1 & V2206-1
Noise in audio.
To suppress high audio frequency noise, do the following:

1. Change C_{213}, the .002-μfd. condenser connected between the plate (pin 3) and cathode (pin 8) of the audio output tube (6W6GT), to .02 μfd.

2. Change C_{207}, the .001 μfd. condenser in the ratio detector de-emphasis network, to .002 μfd.

3. To increase audio gain, change R_{218} (470,000 ohms) connected between the plate (pin 9) of the first audio amplifier (6T8) and the plate of the audio output tube, to 1 megohm.

CHASSIS V2202-2 & V2202-3
Picture shape distortion.
A tendency toward distortion of the picture shape may sometimes occur when the picture control is advanced beyond a certain point. To eliminate this, do the following:

1. Change C_{420} (.05-μfd. condenser) in the pin 2 grid circuit of the 12AU7 horizontal multivibrator to .1 μfd.

2. Change C_{123} (.1-μfd. condenser) located along the plate supply line for the pin 6 plate of the horizontal multivibrator to a 10-μfd. electrolytic. The negative side of this condenser should be connected to the 310-volt plate supply line to reduce the voltage across the condenser and prevent breakdown.

3. Add a 30-μfd. condenser in parallel with C_{502} (40-μfd. electrolytic) in the filter output of the low-voltage power supply.

4. Add a 100-μμfd. condenser between the grid of the horizontal output tube and ground. This condenser must be grounded at the same point as the cathode bypass condenser and must be dressed away from the chassis.

5. Add a 56-μμfd. condenser in parallel with C_{430}, the 56-μμfd. condenser between terminals 5 and 8 of the horizontal output transformer.

6. Change the two 100,000-ohm resistors, R_{323} and R_{321} in the CRT cathode circuit, to 220,000 ohms.

7. Disconnect R_{155}, the 100,000-ohm resistor in the plate supply circuit for the pin 2 plate of the vertical multivibrator from the "B+" line that goes to pin 10 of the CRT, and connect it instead to the "B+" line for the 6V6GT vertical output stage.

CHASSIS V-2216-1 & V-2216-2
Black streaks in picture.
To remedy this condition, replace the 6W6GT audio output tube. If this is not effective, insert a 2200-ohm resistor in series with the screen grid (pin 4) of the audio output tube, and a 680-μμfd. condenser in series between R_{218} (1 megohm) and the plate (pin 3) of the tube.

—30—

The CBS-Colortron

(*Continued from page 63*)

sets in proper working order, once they have been in the field, are likewise reduced.

The aperture mask is stamped into an arched-shape and six spring clips are welded around the edges. The studs holding three of the spring clips have small v-shaped surfaces on their heads which are designed to fit over three mating domes, or hemispheres, on the inside of the faceplate beyond the picture area. These hemispheres, which are molded into the glass, precisely locate the mask in relation to the screen. The six springs are clipped over the inside lip of the metal flange which is used to attach the faceplate panel to the funnel. These clips provide a small amount of forward thrust to keep the mask pressing down on the mounting hemispheres. There is no other assembly operation to be performed except to bring the faceplate panel and the funnel together and weld their flanges around the edges. The simplicity of this method of assembly is apparent.

Considerable speculation exists as to what size and shape the color picture tube will take in its ultimate form. Up to this time, the only tubes that have been demonstrated have shown relatively small pictures by present day standards and they have been in round bulbs. This is largely because the older, flat mask type of tube becomes exceedingly difficult to design and manufacture as larger sizes are attempted. The problems already mentioned become intensified and do not appear to be a simple linear function. The problem of maintaining dynamic convergence over wider angles than those already attempted in the flat mask type of tube may be considered as almost insurmountable.

The curved mask and faceplate tube, on the other hand, already has a six to one advantage in connection with the convergence problem in the same size of bulb and with the same deflection angle. It, therefore, becomes quite apparent that this type of tube can be expected to be made in larger sizes, having deflection angles comparable to present day black and white tubes. Likewise, we can expect to see these larger size tubes in the rectangular bulb shapes. This will contribute to cabinet economies because of the more efficient use of the space within the cabinets.

In summary, the *CBS*-Colortron appears to be the first such color tube ideally designed for mass production on largely existing manufacturing facilities. It eliminates several components found in earlier models and achieves an improvement in contrast, as well as a simplification of circuit requirements, adjustment time, and a reduction in the amount of really serious field service problems that would be the result of drifting of convergence circuits. —30—

1953 INDEX
VOLUMES 49-50

As a service to our readers we are again presenting a complete listing of all feature articles which appeared in RADIO & TELEVISION NEWS during 1953. We suggest you keep this for reference.

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MISCELLANEOUS

SERVICE NOTES

TEST EQUIPMENT

EDITORIAL CONFERENCE

THE second Conference on Scientific Editorial Problems will be held Dec. 27 in Boston during the annual meeting of the American Association for the Advancement of Science.

The purpose of the meet is to bring before the group some of the important problems that confront those who prepare scientific manuscripts, technical reports, or edit and produce scientific publications. The meet is open to the public. -30-

Electronic Light Control

(*Continued from page 81*)

plate end of the resistor will be negative with respect to the other end.

The second amplifier tube, V_{1B} is hooked up so that its control grid is connected through a large resistor, R_2, directly to the negative end of the plate load resistor of the first amplifier tube V_{1A}, and its cathode is connected to the positive end of the same resistor. Because of the large drop across R_1 when no light shines on the photoelectric cell, the second amplifier tube will be biased beyond cut-off. Inspection of the schematic will disclose a large condenser between the grid and cathode of this tube. The condenser and the resistor, in series with the grid, form a time delay circuit to slow down the action of the circuit. In this way momentary light flashes such as lightning, etc. will not turn the controlled lights off.

Since there is no plate current flowing through the second amplifier tube, V_{1B}, the relay coil is not energized, the contacts are closed, and the controlled lights are on.

Regarding the action when light strikes the phototube, the presence of a bright light on the phototube cathode causes the tube to pass a large current and thus develops a large voltage across the phototube's load resistor R_1. This biases the first amplifier tube, V_{1A}, to beyond cut-off. No plate current through the tube means that no voltage drop will be developed across the plate load resistor, R_4, and no bias will be developed on the second amplifier tube, V_{1B}.

When the second amplifier tube, V_{1B}, has no bias, it draws a large plate current through the relay coil, the relay is picked up, the contacts are opened and the controlled lights are turned off. —30—

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ADDENDUM

In regards to the "Ferri-Loopstick Crystal Receiver" (July 1953 issue) the circuit as published is correct, although reports indicate some readers are having difficulty. One important point not covered in the article is that the phones to be used should be at least 2000 ohms d.c. resistance or up to 24,000 ohms impedance. Low impedance or crystal phones will not work.

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DECEMBER 1953

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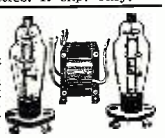

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0B3/VR90	.96	2G33	1.49	3C31/C1B	3.45	6AS7G	3.48	6L6GA	1.08	12AT7	.89
0C3/VR105	.92	2J31	27.00	3C33	9.51	6AT6	.54	6L6GAY	1.98	12AU6	.72
0D3/VR150	.92	2J32	29.48	3C45	14.89	6AU6GT	1.10	6SA7GT	.66	12AU7	.69
1B3/8016	.80	2J33	27.00	3D21A	8.15	6AV6	.54	6SC7	.90	12AV6	.52
1B22	1.89	2J34	13.97	3D22	13.97	6AV5GT	.98	6SF5	.78	12AV7	.98
1B23	8.87	2J37	12.70	3D23	4.90	6AV6	.49	6SG7	.64	12AW6	1.18
1B24	8.98	2J38	69.98	3E29	14.49	6AW6	1.09	6SH7	.61	12AX7	.98
1B26	2.24	2J39	6.98	4C35	21.49	6B4G	1.18	6SJ7	.58	12AY7	1.69
1B27	11.98	2J48	14.98	4D21	18.59	6BA6	.54	6SK7GT	.56	12BA6	.59
1B32/532A	2.48	2J49	24.25	4E27	22.49	6BA7	1.09	6SL7GT	.64	12BA7	.94
1B35	9.15	2J49	84.00	4J22	129.51	6BC5	.63	6SN7GT	.68	12BD6	.59
1B37	14.87	2J50	99.98	4J31	99.51	6BC7	1.23	6SQ7GT	.62	12BE6	.59
1B38	29.45	2J51	238.98	4J52	199.98	6BD6	.83	6SR7	.62	12BF6	.85
1B41	49.95	2J55	84.98	EL5BHD	15.99	6BE6	.54	6SS7	.88	12BH7	1.29
1B42	17.48	2J56	149.00	5C21/C6J	9.89	6BF5	.98	6SU7GTY	2.69	12BL6	.59
1B46	1.98	2J62	49.45	5C22	38.95	6BG6G	1.58	6T8	.96	12BQ6GT	.98
1B63	45.00	2K22	23.48	5D21	14.98	6BH6	.63	6U4	.74	12BR7	.66
1D21/5N4	3.99	2K25	11.48	5J29	11.92	6BJ6	.69	6U8	.98	FG17	3.00
1L4	.48	2K25	28.49	5R4GY	1.20	6BK7	1.58	6V6	1.39	24G/3C24	1.32
1L6	1.35	2K25/		5R4GYW	1.75	6BL7GT	1.19	6V6GT	.59	25BQ6GT	.98
1LD5	.98	723AB	23.88	5U4	.55	6BN7	1.98	6W4GT	.52	25L6GT	.58
1LN5	.78	2K28	27.48	5V4G	.95	6BQ6GT	1.20	6X5GT	.54	25Z5	.78
1P5	.78	2K29	22.88	5Y3GT	.43	6BQ7	1.65	6Y6G	.88	25Z6GT	.58
1P21	33.00	2K33	219.48	6AG5	.71	6C21	24.50	7A8	.68	FG27A	8.24
1U4	.52	2K39	134.99	6AG7	1.14	6C4	.52	7F7	.76	28D7	1.94
1U5	.78	2K41	126.00	6AH6	1.41	6C6	.68	7F7	.82	35B5	.52
1X2A	.98	2K48	99.48	6AJ5	1.40	6C8G	.59	7F8	1.24	35L6	.52
2A4G	1.18	2X2	.42	6AK5	.77	6CD6G	1.69	7H7	.72	35T	4.88
2C36	27.00	3B22	2.48	6AK6	.92	6D4	2.70	7N7	.92	35Y4	.68
2C39A	26.98	3B24	4.95	6AL5	.48	6DJ/5C21	89.95	7V7	1.06	35Z5	.54
2C40	7.40	3B24	4.70	6AL7GT	.98	6J4	6.66	7Y4	.68	41	.72
2C43	17.48	3B25	4.39	6AN5	2.90	6J5	.54	8D21	298.00	42	.68
2C44	1.15	3B26	3.70	6AQ5	.52	6J6	.58	12U6	.48	45Z3	.88
										48	1.98
										50A5	.54
										50B5	.54
										50C5	.54
										50L6GT	.62
										RK61/	
										RK62FG1	2.65
										FG67	14.68
										HY69	4.98
										71A	.74
										77	.64
										78	.78
										80	.58
										81	1.38
										83	1.15
										83V	1.22
										84/6Z4	.62
										100TH	9.88
										FG105	18.95
										FG116	17.64
										117L/M7GT	1.98
										117Z6GT	.96
										CV148	4.98
										211/VT4C	48.49
										FG172	29.00
										250TH	18.97
										250TL	17.75
										304TH	13.95
										304TL	8.90
										388A	1.48
										WL417A	8.48
										417A/ 5842	18.50
										GL434A	12.69
										446B	3.48
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										460/ HF200	15.95
										CK502AX	1.49
										CK503AX	1.49
										CK505AX	1.79
										CK512AX	1.45
										CK531DX	1.89
										531	1.72
										CK532DX	1.89
										WL532A	3.68
										CK533AX	1.29
										CK534AX	.99
										CK536AX	.98
										CK538DX	.98
										CK539DX	2.19
										CK541DX	1.99
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										CK571AX/ 6029	2.49
										CK573AX/ 6029	3.49
										WL676	34.98
										703A	4.72
										705A	1.88
										707A	7.90
										707B	14.88
										715A	4.96
										715B	7.94
										715C	17.98
										717A	.88
										719A	24.48
										721A	3.92
										722A/287	1.94
										723A/B	16.98
										724A	3.95
										724B	2.74
										725A	9.98
										726A	14.48
										726B	44.88
										726C	64.88
										801A	.42
										803	3.48
										805	3.22
										807	1.98
										808	2.62
										809	3.58
										810	10.88
										811	2.70
										812	2.70
										813	11.48
										814	4.98
										815	5.98
										829	.95
										829	7.94
										829B	12.48
										832	7.72
										832A	9.85
										833A	39.45
										834	5.95
										836	5.95
										837	1.42
										860	29.45
										861	4.48
										862	22.48
										865	1.25
										866A	1.50
										872A	3.29
										CK1005	.68
										1613	.32
										1614	1.95
										1619	.36
										1625	.32
										1632	.68
										1633	.98
										1634	1.18
										1635	.48
										1636	3.08
										1642	.62
										1644	.92
										2050	1.48
										2050W	1.48
										6654	1.72
										5670	3.44
										CK5672	1.20
										CK5678	1.25
										5687	3.74
										CK5702	2.90
										CK5703	1.29
										5713	120.00
										5812	2.99
										5814	2.08
										5840	7.98
										8012	2.28
										8013A	3.92
										8025A	4.68
										9001	1.12
										9002	.82
										9003	1.12

XTAL DIODES

1N21A	1.55
1N21B	1.92
1N22	1.22
1N23	1.35
1N23A	1.98
1N23B	2.22
1N25	4.98
1N26	8.75
1N34	1.55
1N34	.64
1N34A	.90
1N35	1.85
1N39A	2.29
1N41	8.95
1N42	16.95
1N43	1.75
1N45	1.45
1N46	.69
1N47	4.00
1N48	.55
1N51	.45
1N54	.78
1N54A	1.00
1N58A	1.15
1N60	.60
1N63/K63	2.49
1N64	.69
1N69	.98

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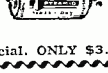

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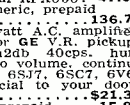

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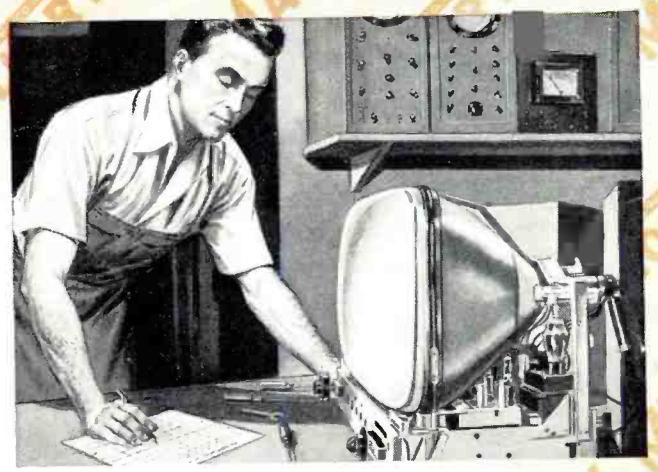

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