RADIO-ELECTRONIC ENGINEERING EDITION

RADIO & TELEVISION NEWS

SEPTEMBER 1953

IN THIS ISSUE

A ZIFF-DAVIS PUBLICATION

The "big moment"

...but whose big moment is it?

YOU FLICK THE SWITCH. This is the moment . . . the final check.

And this is the big moment your customer has been waiting for.

But, it's a big moment for you, too . . . because your reputation rests on the job the new tubes do from this moment on.

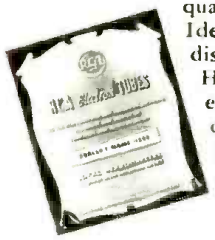
Still, you have no worries . . . for your own experience has proven—time and again—that the superior quality of RCA Receiving Tubes is your best measure of protection against premature tube failures.

So, when your call is completed, you can be confident that you've won *another* steady customer.

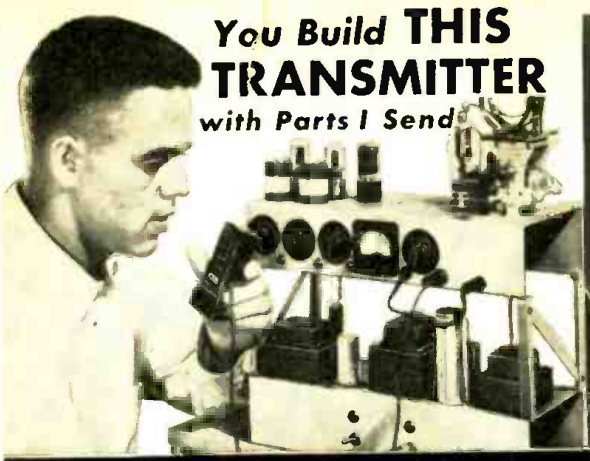
Helping you to safeguard your reputation is a vital, everyday service of RCA Tubes. And that protection is yours at no extra cost.

"Sign up" for Success

Identify yourself with RCA! Ask your *RCA Tube Distributor* today how *you* can qualify for a Dealer Identification Plaque displaying your name. He'll give you all the exciting details on the dynamic new RCA promotion plan to help you build your business.



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



You Build THIS TRANSMITTER with Parts I Send

Learn RADIO-TV Broadcasting by Practicing at Home in Spare Time

Use parts I send for Actual Experience

My Training Leads to Jobs Like These

BROADCASTING: Chief Technician. Chief Operator, Power Monitor. Remote Control Operator. SHIP AND HARBOR RADIO: Chief Operator, Radiotelephone Operator. GOVERNMENT RADIO: Operator in Army, Navy, Coast Guard. Forestry Service Dispatcher. POLICE RADIO: Transmitter Operator, Service Technician. AVIATION RADIO: Plane Radio Operator. Airport Transmitter Operator. TELEVISION: Pickup Operator, Voice Transmitter Operator. TV Technician.

I TRAINED THESE MEN AT HOME

"Am employed as transmitter engineer-studio operator at KPAT. Most important day of my life was when I enrolled with NRI."—Elmer Frewaldt, Madison, S. Dak.

"I did not know a thing about Radio before I enrolled for your training. Now I have a job as Studio Engineer at Radio Station KMMJ."—Bill Delzell, Central City, Nebr.

"A former employer recommended National Radio Institute training to me. Now employed as transmitter operator in Harrisburg."—Albert Herr, New Cumberland, Pa.

"My position with WNBT is video control engineer on the RCA color project. I owe a lot of my success to your textbooks."—Warren Deem, Malverne, N. Y.

"Am with WCOC. Happy with my job. NRI course can't be beat. Passed exam for 1st class Radio-phone license with no trouble."—Jesse W. Parker, Meridian, Miss.

AVAILABLE TO VETERANS UNDER G.I. BILLS

I Also Have a Course in Radio-TV SERVICING

If you prefer a career in Radio-Television Servicing, I'll train you at home for it. Course includes many Kits of parts. My book shows that many make $10, $15 a week EXTRA fixing sets while training.

The Communication Course I offer you is backed by NRI's 40 year record of training men at home. My well-illustrated lessons give you the basic principles you must have to assure success. My skillfully developed kits "bring to life" what you learn from my lessons, give you practical experience on circuits common to BOTH Radio and Television. You build the low-power Broadcasting Transmitter shown above (at left). You put this station "on the air," and conduct procedures required of Broadcasting Station operators. My book shows other valuable equipment you build and keep.

Television's Rapid Growth Making Good Jobs, Prosperity

Radio is bigger than ever with over 3000 Broadcasting Stations on the air making good jobs for Chief Operators, Recording and Remote Control Operators, Power Monitors, Technicians, etc. Now there's Television, too. About 200 TV Stations are on the air with many more being built, construction of hundreds of additional stations authorized, and new TV Station applications being filed every month. Think of the demand this is creating from coast to coast for Pickup and Voice Transmitter Operators, Remote Control Operators, Service and Maintenance Technicians, etc. Mail Coupon. Find out, without obligation, what I offer. NRI training can assure you more of the better things of life; can help you qualify for high pay and promotion when times are good, enjoy greater security when jobs are scarce. Progressive, ambitious men consider Radio-TV an outstanding field for their life's work. My 64-page book, "How to Be a Success in Radio-Television," gives important facts about America's fast growing industry, details of job opportunities, tells about kits I furnish for practical experience, shows what my graduates are doing and earning. You don't have to leave home or give up your job to take NRI courses. You learn at home in your spare time, at low cost, on terms as low as $5 a month. Many of my graduates make more than the total cost of my training in just two weeks. Mail coupon now. J. E. SMITH, President, National Radio Institute, Dept. 3JE, Washington 9, D. C. OUR 40th YEAR.

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PRESIDENT,
National Radio Institute
For 40 years, the leader in training men at home.

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Mr. J. E. SMITH, President, Dept. 3JE
National Radio Institute, Washington 9, D. C.

Mail me 64-page Book FREE. (No salesman will call. Please write plainly.)

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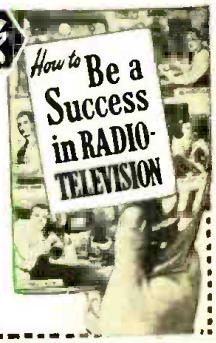
VETS write in date of discharge



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COVER PHOTO: Part of the elaborate audio installation in the Radio-Television Building at the Los Angeles County Fair grounds in Pomona. All types of sound gear are available. (Ektachrome by P. J. Samerjan)

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

RADIO & TELEVISION NEWS

Reg. U. S. Pat. Off.

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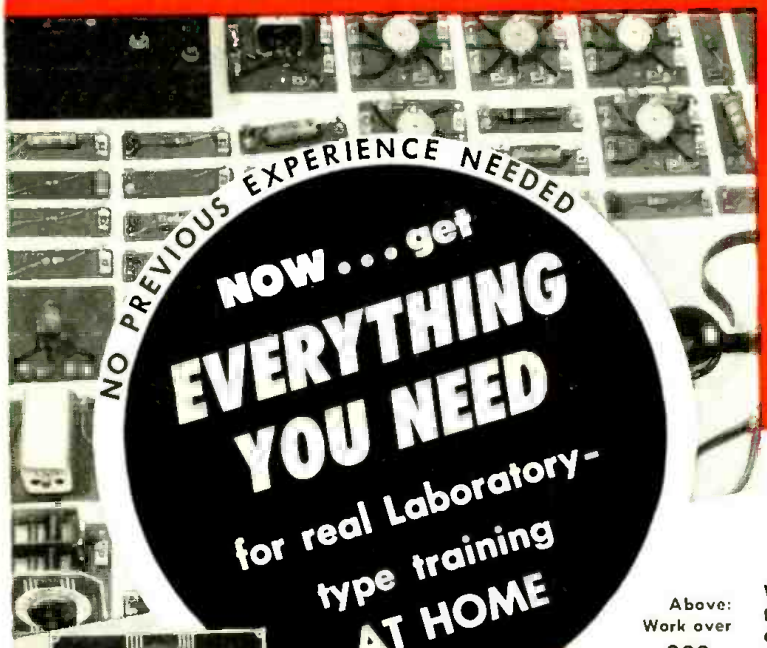
Now IN YOUR OWN HOME Learn TELEVISION RADIO ELECTRONICS

the Amazingly Effective

D. T. I. WAY

—with the aid of BOTH HOME EQUIPMENT and HOME MOVIES



NO PREVIOUS EXPERIENCE NEEDED

NOW . . . get EVERYTHING YOU NEED for real Laboratory-type training AT HOME

Above: Work over 300 fascinating experiments with this equipment

1. Build over 300 fascinating experiments from 16 BIG SHIPMENTS of Electronic-Radio parts which you KEEP.

2. Build valuable commercial-type test equipment—as shown to the left—which you KEEP. This includes a quality 5 INCH oscilloscope and jewel bearing Multi-Meter—both highly useful for Television work.

3. Build and keep a big 21 INCH TV Set. (D.T.I. offers another home training in Television-Radio-Electronics, but without the TV set.)

4. Use a 16 mm. movie projector and new series of highly instructive movies—a wonderful aid to help you grasp important fundamentals faster . . . easier . . . better.

5. Enjoy well-illustrated, easy-to-read lessons with handy FOLD-OUT diagrams.

6. Get an honest-to-goodness EMPLOYMENT SERVICE to help you get a good job after graduating—or assistance in starting your OWN SALES AND SERVICE BUSINESS. Mail coupon today for the complete details.

What will mailing the coupon below *do for YOU?* Just this! You'll find out about one of today's most remarkable . . . practical ways to prepare to get into America's amazing billion dollar opportunity field of TELEVISION-RADIO-ELECTRONICS. You'll see how to get into fascinating work that pays well . . . that offers one of America's most promising futures . . . that enables you to start your own business almost "on a shoe string," if you prefer this to a job opportunity.

And above all, you'll get some GOOD NEWS especially welcomed by men anxious to earn REAL MONEY in this thrilling field. For you'll see that NOW you can get the kind of practical, laboratory-type training so desirable for making real progress in Television-Radio-Electronics *AND WITHOUT* LEAVING HOME.

You'll see that DeForest's Training, Inc. sends everything needed to set up your own HOME LABORATORY. You get and keep the same type of basic electronic equipment used in our modern Chicago Training Laboratories. You get home training that includes the knowledge and experience gained from training thousands of students first hand in Chicago. And to top it all, you use DTI's amazingly effective and exclusive home training aid—INSTRUCTIVE MOVIES. But why not get the complete story? Mail coupon today for information-packed literature.

MODERN LABORATORIES

If you prefer, get all your preparation in our new Chicago Training Laboratories—one of the finest of its kind. Ample instructors, modern equipment. Write for details!

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

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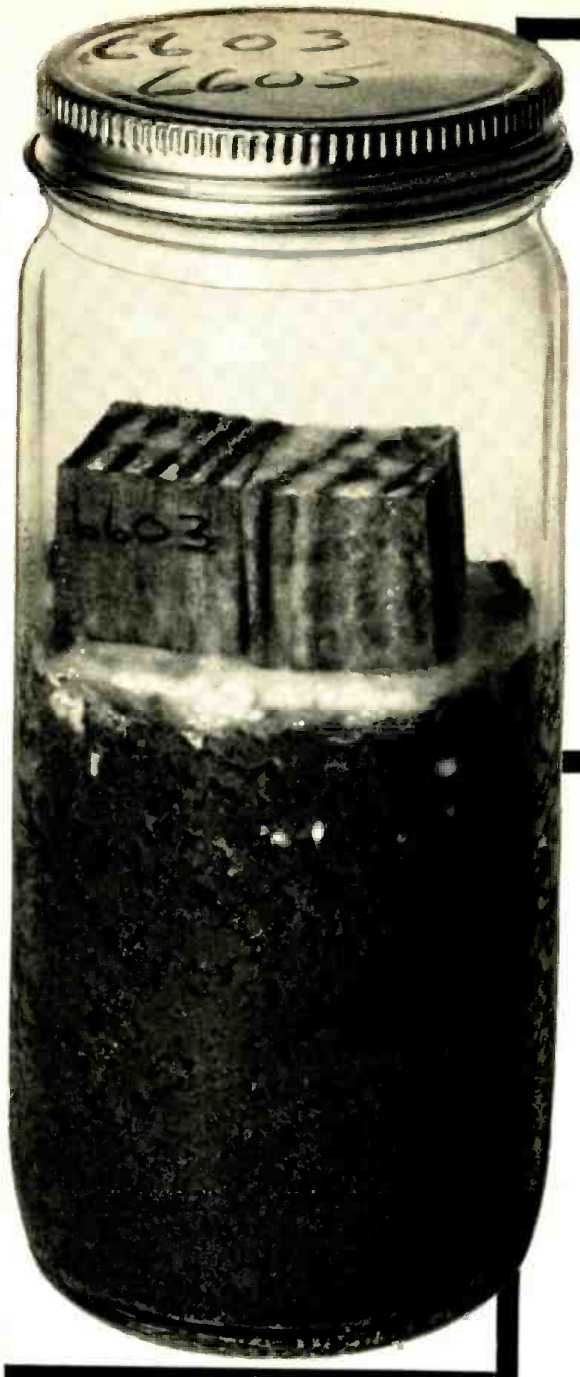


Test blocks of pole wood are fed to destructive fungi in bottles like this at Bell Laboratories. Wood rests on soil which controls moisture conditions and promotes fungus growth. Test speeds search for better preservatives.

THIS BOTTLE TURNS SEVEN YEARS INTO SEVEN MONTHS

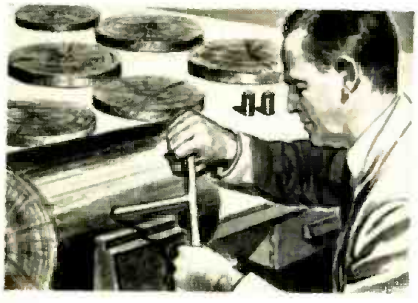
This year the Bell System is putting 800,000 new telephone poles into service. How effectively are they preserved against fungus attack and decay?

Once the only way to check a preservative was to plant treated wood specimens outdoors, then wait and see—for seven years at least. Now, with a new test devised in Bell Telephone Laboratories most of the answer can be obtained in seven months.

Cubes of wood are treated with preservatives, then enclosed in bottles with fungus of the most destructive kind, under temperature and humidity conditions that accelerate fungus activity. Success—or failure—of fungus attack on cubes soon reveals the best ways to preserve poles.

The new test has helped show how poles can be economically preserved for many years. It is another example of how Bell Telephone Laboratories works to keep down the cost of your telephone service.

A boring is taken from a pole section to see how far preservative has penetrated. For poles to last, it must penetrate deeply and be retained for a long time.



BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields

Check the specs...

Check performance...

Then, They'll Choose Hallicrafters

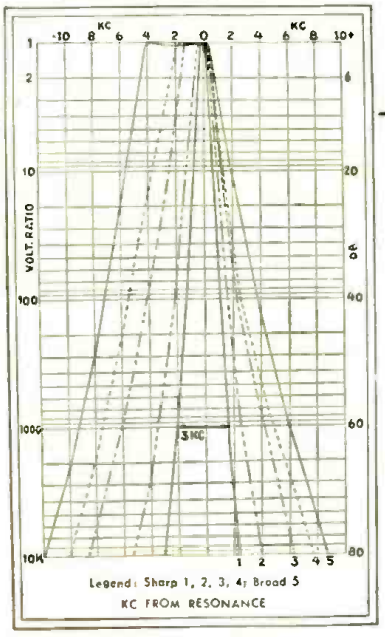
Model S-76

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.

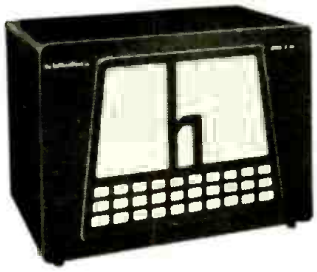
Model HT-20. T.V.I. suppressed 100 watt AM-CW transmitter with all spurious outputs above 40 Mc at least 90 db. below full rated output.

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).

Satin black steel cabinet. 18½" x 8⅞" x 12" deep. 11 tubes plus regulator, rectifier. For 105/125 V. 50/60 cycle AC. Use R-46 speaker. **$249.95**



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

HI-FI MAGICIANS

IT HAS seemed, in recent weeks, that hardly a day goes by that we don't recall the phrase, "Nothing is certain but death and taxes" and each time this phrase comes to mind we are more and more tempted to add "and the audiophile's dilemma." Sometimes we wonder just how far the audio industry can go in making all sorts of fancy performance claims for their products. The majority of manufacturers of audio equipment have apparently made a very honest attempt to follow an intelligent pattern and adhere to accepted engineering practice when publishing specifications for their equipment. Recently, however, there has been a steady influx of new companies entering the so-called high-fidelity market. All too often these manufacturers are guilty of misleading the public in their attempts to sell run-of-the-mill audio gear as high-fidelity equipment.

For example, we have just attended a press conference to see and hear a new tape recorder (one of three announced in four days) priced for mass-production and publicized as high-fidelity equipment. This machine, and we shall name no names, is manufactured by a well-known producer of photographic equipment; a company long respected in that field for its quality products. We spent the first moments of our visit in listening to some recorded classics from this new "Hi-Fi" portable. Being technically minded, we were most anxious to see the specifications for the new models. There were two; one employing a tape speed of 3¾"/sec., the other, tagged as a "Hi-Fi" with a tape speed of 7½"/sec. We drew a mental comparison between many other tape recorders we had heard in the past and came to an immediate conclusion that the over-all frequency range was sadly lacking at the high and low ends.

In studying the published specifications for this "Hi-Fi" model, we were startled to find the following: "frequency response: 30 to 13,000 cycles." The specifications, however, did not qualify this claim by stating "plus or minus so many db" but simply stated "30 to 13,000 cycles." Our curiosity was greatly aroused when we came across the specifications showing the amplifier tube complement. The power tube is the well-known 6AQ5 having a power output of 3.2 watts.

Any audio engineer or experimenter worth his salt knows full well that a 6AQ5 beam power amplifier producing that output has a known total harmonic distortion of 8%. This is not "high-fidelity" in our book.

And, we have never in our experience been able to find a 6" x 9" elliptical loudspeaker, selling at catalogue prices for $3.44, capable of producing the high-fidelity audio range stated by this manufacturer for this model to be from 30 to 13,000 cycles. We'd expect to pay many times that amount for a good 15" woofer to give us 30-cps. response, plus a good tweeter to reproduce 13,000-cps. response clearly.

Upon returning to our desk the next morning, we checked the specifications on seven leading tape recorders to determine what claims were made for their performance. Here are the results: Recorder A, 50-7000 cycles at 7½"/sec.; Recorder B, 40-10,000 ± 2 db at 7½"/sec.; Recorder C, 40-12,000 cycles at 7½"/sec.; Recorder D, 50-9000 cycles ± 2 db, 7½"/sec.; Recorder E, 50-7000 cycles ± 2 db, 7½"/sec.; Recorder F, 60-15,000 cycles ± 3 db, 7½"/sec.; and Recorder G, 70-7500 cycles, 7½"/sec. We averaged these specifications to find that our "composite recorder" would have a frequency response of 60 to slightly less than 10,000 cycles at 7½"/sec. Our "composite recorder" having this response would sell for $397.93, this being the average cost of the seven models.

The recorder discussed in preceding paragraphs was intended to be marketed for approximately $250.00. The point we should like to make is that the purchaser of an audio tape recorder could be very easily misled when comparing specifications of respective machines. He would come to the conclusion that he could purchase a home hi-fi tape machine having a frequency response of 30 to 13,000 cycles, using the same tapes and speed employed by the other machines and at a price far less than the others.

Even the *"Cadillacs* and *Lincolns"* of the tape recorder industry only claim a frequency response of 40 to 10,000 cycles at 7½"/sec.

This is but one of many examples we see and hear about each week in this business of technical publishing. There is a great need for a clear understanding within the industry and a code of ethics in advertising claims for what we call "high-fidelity."

The American public has always been a bit gullible when it comes to things technical or electronic. Let's quit calling every audio component and system "a new super ultra high-fidelity" product. If we don't pull in the reins pretty soon—the term will die out as an acceptable description of a quality sound reproducing system . . . . . O.R.

GENERAL ELECTRIC ANNOUNCES

Custom Music Ensemble

A new line of High-Fidelity Reproduction Equipment for Volume Sales...Record Profits!

HERE'S THE LINE of high-fidelity reproduction equipment that will bring customers to you! It offers the ideal answer to the growing demand for matched units in home sound systems. For the first time quality voice and music reception is available to *every* family... at prices they can afford!

The General Electric Variable Reluctance Cartridge started this business of high-fidelity. Today's G-E announcement of a new line of reproduction equipment completes the home sound picture. Your customers get the dual advantage of purchasing individual components or the complete ensemble for a home decorator installation.

Whether you sell or install high-fidelity sound equipment you'll want to have these units on hand. Be ready for the tremendous market they'll create...order today! Call the local General Electric distributor or write today to: *General Electric Company, Section 993, Electronics Park, Syracuse, New York.*

You can put your confidence in—

1876 75 1951 YEARS OF ELECTRICAL PROGRESS

GENERAL ELECTRIC

G-E DUAL COAXIAL
Model A1-400

New approach to coaxial sp... sign—high sensitivity at low c... ceptional balance between spe... with G-E baffle plate developm... Revolutionary Tweeter Heart... wavefront shaping plug... provides smooth tweeter response.

G-E PREAMPLIFIER-CONTROL UNIT
Model A1-200

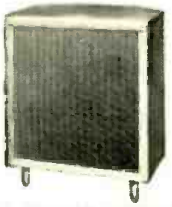
Combines functions of equalized preamplifier plus adjustable record compensation, program input selection, tone controls and volume control. Matching unit for the "Custom Music" amplifier. Self-powered for use with any installation.

G-E POWER AMPLIFIER **Model A1-300**

The G-E A1-300 is a medium power, compact amplifier designed to provide needed speaker power. An essential element in the new General Electric "Custom Music" Ensemble. It will deliver high-fidelity performance at very low cost.

G-E DELUXE TONE ARMS
Model A1-500 (12") **Model A1-501 (16")**

For home or broadcast station use. Compatible with the exceptional quality of G-E cartridges. Calibrated stylus pressure adjustment... 1 gram to 10 grams. They were developed to improve record reproduction in any home or broadcast studio installation.

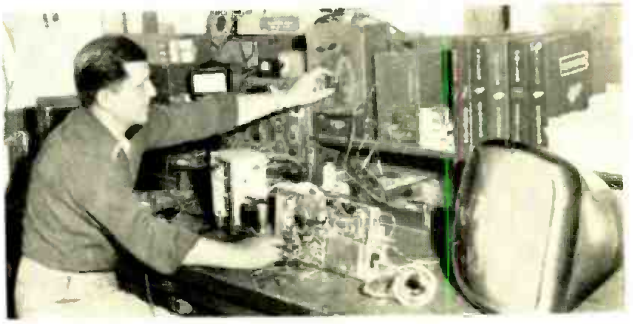


G-E SPEAKER ENCLOSURE
Model A1-406 (6 cu. ft.)

Attractive corner or wall cabinet in hand-rubbed blond or mahogany veneers. "Distributed port" design offers tone realism from 40 to 15,000 cycles.

Here comes opportunity

...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!*

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- ☐ Structural Engineering
- ☐ Surveying and Mapping
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- ☐ Highway Engineering
- ☐ Reading Blueprints
- ☐ Concrete Construction
- ☐ Sanitary Engineering

DRAFTING
- ☐ Aircraft Drafting
- ☐ Architectural Drafting
- ☐ Electrical Drafting
- ☐ Mechanical Drafting
- ☐ Structural Drafting
- ☐ Sheet Metal Drafting
- ☐ Mine Surveying and Drafting

ELECTRICAL
- ☐ Electrical Engineering
- ☐ Electrician
- ☐ Electrical Maintenance
- ☐ Electrical Drafting
- ☐ Electric Power and Light
- ☐ Lineman

HIGH SCHOOL
- ☐ High School Subjects
- ☐ College Preparatory
- ☐ Mathematics
- ☐ Commercial
- ☐ Good English

MECHANICAL AND SHOP
- ☐ Mechanical Engineering
- ☐ Industrial Engineering
- ☐ Industrial Supervision
- ☐ Foremanship
- ☐ Mechanical Drafting
- ☐ Machine Design-Drafting
- ☐ Machine Shop Practice
- ☐ Tool Design
- ☐ Industrial Instrumentation
- ☐ Machine Shop Inspection
- ☐ Reading Blueprints
- ☐ Toolmaking
- ☐ Gas—Electric Welding
- ☐ Heat Treatment—Metallurgy
- ☐ 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
- ☐ General Radio
- ☐ Radio Operation
- ☐ Radio Servicing—FM
- ☐ Television
- ☐ Electronics
- ☐ Telephone Work

RAILROAD
- ☐ Locomotive Engineer
- ☐ Diesel Locomotive
- ☐ Air Brakes ☐ Car Inspector
- ☐ Railroad Administration

TEXTILE
- ☐ Textile Engineering
- ☐ Cotton Manufacture
- ☐ Rayon Manufacture
- ☐ Woolen Manufacture
- ☐ Loom Fixing
- ☐ Finishing and Dyeing
- ☐ Textile Designing

YEAR OF THE SIX MILLIONTH STUDENT

Name_____ Age_____ Home Address_____

City_____ Zone_____ State_____ Working Hours_____ A.M. to_____ P.M.

Occupation_____

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

NICE GUY... with an undeserved black eye

If you understood what your
RADIO AND TELEVISION SERVICE DEALER
is up against, you'd buy him a steak for his eye

WE'LL WAGER DOLLARS to doughnuts you approach a TV-Radio Service Dealer with apprehension — feeling sure he's scheming to "do" you out of an unfair portion of your hard-earned money. This mental black eye given the TV-Radio Service profession by the public is undeserved. When TV-Radio Service Dealers were swept into the spectacular growth of the nation's fastest developing new industry, some made mistakes, but the misguided were mighty few. The vast majority of Television and Radio Service Technicians are capable, efficient, thoroughly trustworthy businessmen doing a magnificent job of keeping pace with a rapidly expanding new industry.

And we know what we're talking about. Since 1945 — that's way back before nationwide TV — the Raytheon Manufacturing Company, through several of America's largest surety companies has been Bonding the repair work of Radio and Television Service Dealers. More than 30,000 Registered Bond Certificates have been issued to service dealers all over the United States, and of the millions of jobs these qualified Bonded dealers have handled *we've received less than 50 complaints.* We consider this amazing record a marvelous indication of the skill, integrity and ability of these selected service dealers.

The service dealers that are bonded through Raytheon are nationally known as *RAYTHEON BONDED ELECTRONIC TECHNICIANS.* They must be skilled technicians, have modern, efficient test equipment, and a wealth of experience to qualify for this coveted classification. They adhere to a strict 8-point Code of Ethics designed to protect you. Here it is:

1. Guarantee all Radio and Television repair work for 90 days.
2. Use only parts of recognized quality.
3. Charge not more than list price for parts installed.
4. Test customers' tubes as accurately as possible.
5. Keep labor charges at a reasonable level.
6. Perform only such work as is necessary.
7. Maintain proper equipment for good repair work.
8. Maintain the highest quality service.

Whatever the make and model of your radio or television sets, next time you need service we'd like to suggest you call a *Raytheon Bonded Electronic Technician.* Look for his seal. It's the symbol of a service man whose work, way of doing business, and integrity are above reproach. We're sure he'll satisfy you.

RAYTHEON
Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY, RECEIVING TUBE DIVISION
NEWTON • CHICAGO • ATLANTA • LOS ANGELES

RAYTHEON Bonded ELECTRONIC TECHNICIANS CCC

RAYTHEON MANUFACTURES TELEVISION AND RADIO TUBES, INDUSTRIAL AND POWER TUBES, TELEVISION AND RADIO SETS, GERMANIUM PRODUCTS, DIATHERMY EQUIPMENT, ELECTRONIC COOKERS, ELECTRONIC MARINE EQUIPMENT, ELECTRONIC DUPLICATORS, INDUSTRIAL EQUIPMENT, ULTRASONIC MACHINE TOOLS AND ELECTRONIC TUBES, SONAR, RADAR AND COMMUNICATIONS EQUIPMENT FOR THE UNITED STATES GOVERNMENT

Raytheon Is Telling Your Side of the Story to over

25,000,000 Readers of LIFE

The September 21st issue of LIFE will carry the full page, two color advertisement pictured above, telling your side of the Radio-TV Service story to LIFE'S vast audience. We gladly run this advertisement to help you combat the unjust attacks that have been made on your profession and to give the public a true picture of the really good job you are doing. It's our way of saying "thank you" for your loyalty to *Raytheon Radio and Television Tubes.* We assure you their quality and performance will continue to meet your most exacting requirements.

RAYTHEON
Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY
Receiving Tube Division
Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Calif.

RAYTHEON MAKES ALL THESE:
RECEIVING AND PICTURE TUBES • RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES

Compare these features with any oscilloscope

TRIPLETT

3441

- **Vertical Sensitivity,** 10 MV with 2 MC band width. 4 MC band width at 20 MV.
- **Vertical Amplifier.** Response usable beyond 4 MC. Shows a 300 KC square wave with no distortion.
- **Direct reading** peak to peak voltmeter included, with eight ranges.
- **Vertical reversing switch** for changing polarity—wave form shows in conventional manner.
- **Linear Time Base,** 10 cps to 60 KC seconds linear available at panel.
- **Dual control** for perfect focus over entire screen.
- **Phone jack on front panel** connected to output or vertical amplifier, so you can hear as you see.

For this great combination of service values, see this oscilloscope with all the extra features at your distributor's.

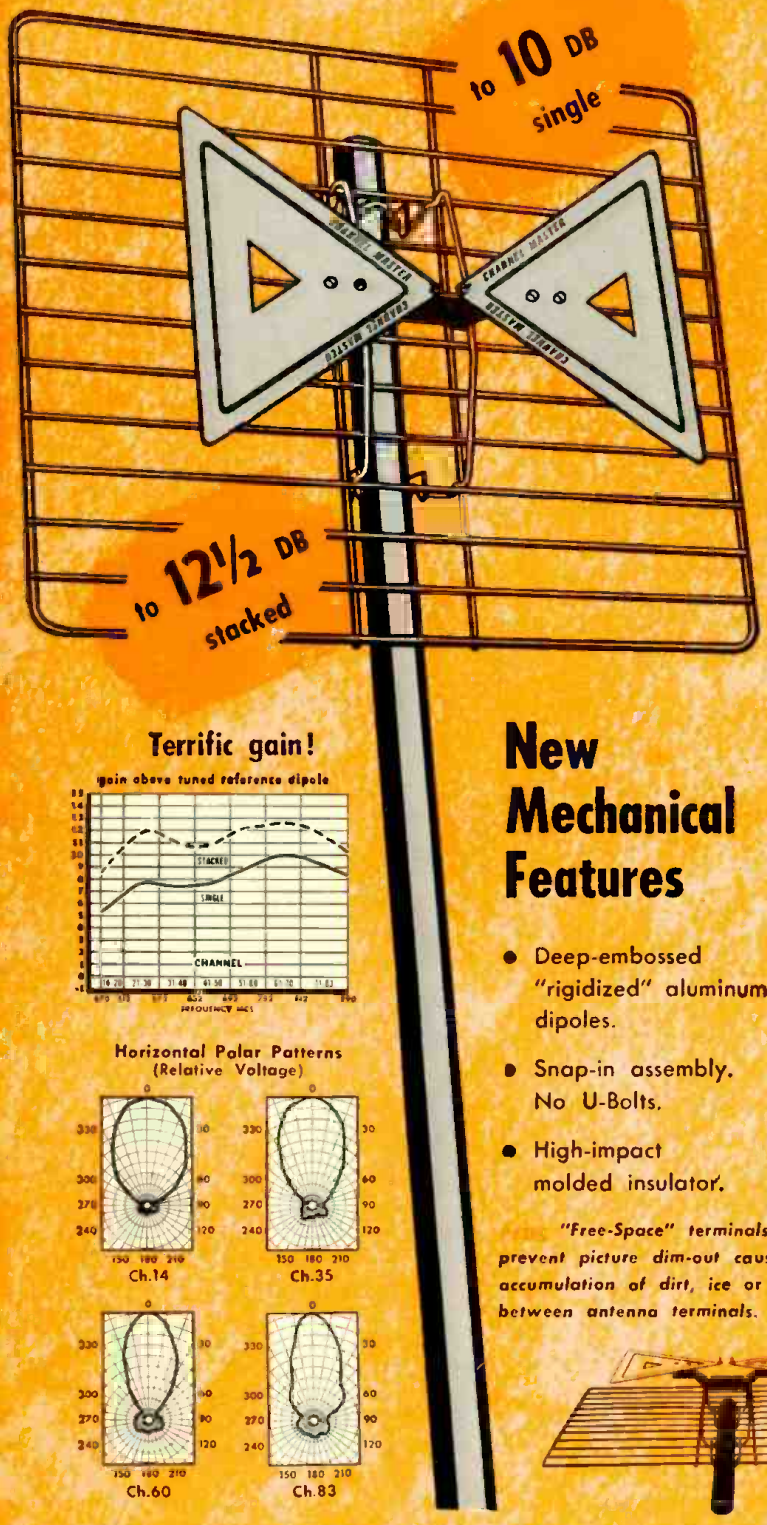
and now Compare Quality per Dollar

USA DEALER NET $199.50

TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON, OHIO

TRIPLETT

3 New Electrical Advances!



CHANNEL MASTER'S all-new UHF BOW-FLECTOR

model no. 408

The highest gain Bow and Screen antenna ever developed — single or stacked!

1. ***Enlarged Reflecting Screen.*** 53% more reflecting area — higher, flatter gain level.

2. ***Full-Wave Spacing*** of stacked antennas. Provides highest stacking gain ever obtained in an antenna of this type.

3. ***2-Stage Stacking Transformers*** for broad-band impedance match. Delivers high stacking gain over *entire UHF band.*

Terrific gain!

gain above tuned reference dipole

Horizontal Polar Patterns
(Relative Voltage)

Ch.14

Ch.35

Ch.60

Ch.83

New Mechanical Features

- Deep-embossed "rigidized" aluminum dipoles.
- Snap-in assembly. No U-Bolts.
- High-impact molded insulator.

"Free-Space" terminals that prevent picture dim-out caused by the accumulation of dirt, ice or rainwater between antenna terminals.

Only 20 seconds to install!

Just snap Bow into Screen, then fasten entire assembly to mast with Channel Master's exclusive "SPEED-NUTS." The antenna cannot move, twist, flutter, or vibrate! The light-weight Bow Flector is the most rugged, fastest-installing antenna of its type.

One of 5 Great New Channel Master Products For Fall!

CHANNEL MASTER CORP.
ELLENVILLE, N. Y.

Ask your Channel Master distributor for complete technical literature.

You've never seen a mast like it!

CHANNEL MASTER'S

all-new

STRATO-MATIC

TELESCOPING MAST

One of 5 Great New Channel Master Products For Fall!

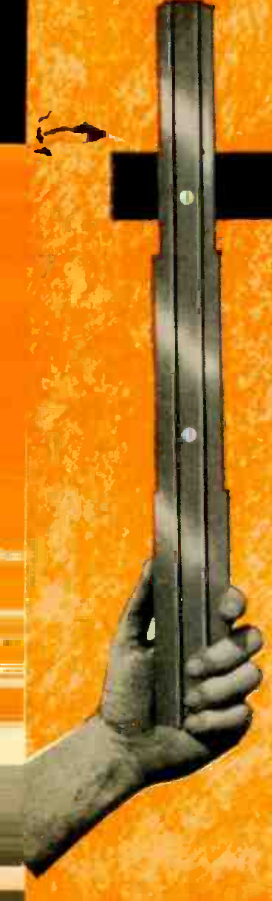
for antenna installations that are

• *easier* • *faster*

• *safer*

Featuring the Amazing "Third Hand!"

— an automatic, removable locking device that actually acts as your "third hand," *holds* mast sections up when you let go! The Third Hand converts each guy ring, in turn, into a "safety lock." This permits you to raise sections freely, *using only one hand*. And . . . sections *cannot* slide down when you let go.



Automatic Mast Extension

The Step-Up Key, inserted thraugh the bottam of the mast tubing, automatically extends each mast sectian 6 inches. Mast sections are kept partially extended even *after* mast is placed in vertical position — *without using hardware or locking bolts!*

World's Finest Mast Protection!

16-Gauge Masting
HOT-DIP GALVANIZED

Most permanent type of mast corrosion protection available today. Sections are immersed in cauldron of molten zinc, until a thick layer of pure zinc is fused to inner and outer surfaces — so thick it actually adds to the weight of the mast; gives long-term protection!

ZINC IS SELF-HEALING!

When the protective zinc coating is scratched or broken, the surrounding zinc actually goes to work to "heal" the wound. Thus, the base metal is automatically protected against damage due to installation or handling. The only coating with this ability.

18-Gauge Masting
HEAVY ZINC ELECTRO-PLATING

Heavy layer of bright zinc, exceeding Army-Navy specifications, provides effective long-lasting protection against elements. A chromate dip adds brightness; increases corrosion resistance. The strongest, most durable protection jacket of its type.

Inter-Locked Sections

Safety Rings prevent sections from pulling out of each other. Notches in sections engage bolt — no twisting.

No Hidden Holes

Step-Up Key automatically extends mast sections high enough to provide easy access to bolt holes. You don't have to pull up next section to insert bolt!

Model No.		Sections	Lengths	Weights	
16-Gauge	18-Gauge			16-Gauge	18-Gauge
1620	1820	A, B	20′	16 lb.	13 lb.
1630	1830	A, B, C	30′	26 lb.	22 lb.
1640	1840	A, B, C, D	40′	38 lb.	33 lb.
1650	1850	A, B, C, D, E	50′	52 lb.	48 lb.

CHANNEL MASTER CORP. ELLENVILLE, N. Y.

Ask your Channel Master distributor for complete technical literature.

Spot Radio News

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

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THE COLOR AGE, heralded about two years ago after winking at destiny for years, and then spun back to oblivion, is now being boomed for a new glittering, golden debut before the year is out. The approval of two encyclopedic documents, petitioning the government for approval of compatible standards will signal the epic moment. At this writing one such monumental text is being studied by the Commission and another will be on the desks in Washington, just as this column goes to press. The former, prepared by *RCA*, represents an application from a manufacturer; the latter, a brief from industry in general, as members of the National Television Systems Committee.

The standards proposed in the first petition were described as technical signal specifications approved by outstanding engineers and scientists of the radio and television industry, including members of the petitioner's staffs, through the NTSC. In supporting the plea for an OK, Mr. Sarnoff declared that his company and its broadcast unit are prepared to invest as much as $15-million during color TV's introductory year to establish this new service on a solid foundation. Defending the early transmittal of the brief, before NTSC filed, attorneys for the company said that such a move was necessary in view of the barrage of statements accusing some of holding back color, commitments made in the Spring to the chairman of the Senate Interstate and Foreign Commerce Committee that a petition would be filed within six months or sooner if a system were ready, and a question of public law, it being doubted if the NTSC, as a body, had the legal authority to appear before the Commission with its standards. The latter point was argued by many who cited the standards evolved by the first NTSC group for black and white and approved by Washington; in that instance, it was admitted that the Commission had sought such standards and

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL**	CHANNEL	FREQUENCY (mc.)	POWER* (Video)
Arizona	Phoenix	KOOL-TV	10 (sharing air time with)	192-198	316
"	Phoenix	KOY-TV	10	192-198	316
Arkansas	Little Rock	KARK-TV	4	82-88	100
"	Pine Bluff	.....	7	174-180	24.5
California	Bakersfield	KERO-TV	10	192-198	11.7
"	San Jose	.....	48	674-680	107
Connecticut	New Haven	WELI†	59	740-746	19.5
"	Stamford	.....	27	548-554	19.48
Florida	Jacksonville	WJHP-TV	36	602-608	120
"	Pensacola	WEAR-TV	3	60-66	47.9
Illinois	Quincy	WGEM-TV	10	192-198	316
Indiana	Elkhart	WTRC-TV	52	698-704	215
Kansas	Topeka	WIBW-TV	13	210-216	95.5
Mississippi	Meridian	WTOK†	11	198-204	31
Missouri	Kansas City	KMBC-TV†	9 (sharing air time with)	186-192	316
"	Kansas City	WHB-TV†	9	186-192	316
"	Kansas City	KCMO-TV	5	76-82	100
New Mexico	Albuquerque	KOAT-TV	7	174-180	22.9
Ohio	Cleveland	WERE-TV	65	776-782	204
South Carolina	Camden	WACA-TV	14	470-476	78
Texas	Houston	KXYZ-TV	29	560-566	1000
"	Marshall	.....	16	482-488	18.6
West Virginia	Beckley	.....	21	512-518	19.5
Wisconsin	Milwaukee	WOKY-TV	19	500-506	17.4

*ERP = (effective radiated power, kw.). . . = Call letters to be announced
† = Temporary call letters.

GOLD-COLORED ANTENNA...
FULL-YEAR GUARANTEE AGAINST RUST AND CORROSION...
ADVANCED HIGH-GAIN ANTI-VIBRATION DESIGN...

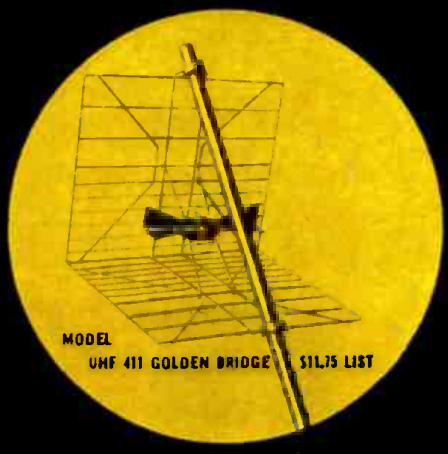
These revolutionary features are your identification of the new JFD "Gold Shield" UHF antennas—introducing to the TV antenna field an unprecedented consumer attraction.

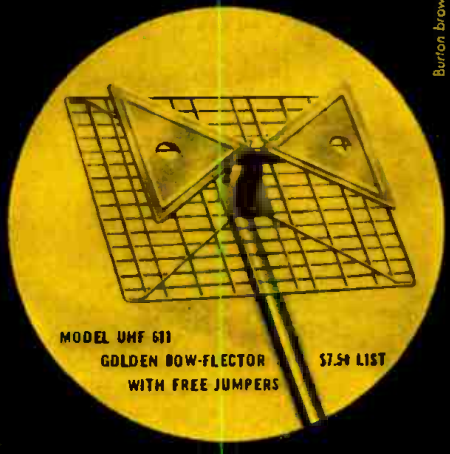

MODEL
UHF 902 PARA-STAK
$10.95 LIST


MODEL
UHF 400 GOLDEN MAXI-COR
$14.95 LIST


MODEL
UHF 900 PARA-BOW
$14.95 LIST


MODEL
UHF 633 GOLDEN MINI-COR
WITH FREE JUMPERS
$7.50 LIST


MODEL
UHF 411 GOLDEN BRIDGE
$11.75 LIST


MODEL UHF 611
GOLDEN BOW-FLECTOR
WITH FREE JUMPERS
$7.50 LIST

Burton browne advertising.


MODEL UHF 300 GOLDEN YAGI $5.50 LIST
WITH FREE JUMPERS

JFD Electronics

Here's what the JFD "Gold Shield" UHF antennas offer you: An individual antenna for each installation requirement, ranging from the "Golden Para-stak" with 15 DB. gain and 20.5 DB. front-to-back ratio for fringe areas to the "Golden bow-flector" with 6.5 DB. gain and 10 DB. front-to-back ratio for local signal areas. Add "Bronzidite" protective plating, and you have the antennas for greater UHF profits—without call-backs. See them at your jobber.

BRONZIDITE

JFD MANUFACTURING CO., INC.

BROOKLYN 4, N.Y.

World's largest manufacturer of TV antennas and accessories

asked industry to prepare them, and actually no general petition was involved.

Those at the helm of NTSC were deeply concerned with the prior filing, indicating that simultaneous or general petitioning would have been more prudent. Accompanying letters, particularly those explaining technicalities in the makeup and operation of the system, and employing a company identity, instead of NTSC, in referring to the system angered the industry color system headman. In one sizzling comment, the NTSC chairman declared . . ."such claims". . . could result in . . ."controversy". . . and it would be best if . . ."such claims were not made in the future, at least until the NTSC finishes its job."

The color system detailed in the company brief was said to meet all of the criteria established by the Commission for a satisfactory operation. Public reaction tests, for example, were cited as confirming the fact that the system offered a picture with a high degree of color fidelity, adequate apparent definition, good picture texture and was not marred by such defects as misregistration, line crawl, jitter, or unduly prominent dot or other structure. In a qualifying statement on picture texture, the brief pointed out that there are a number of factors that enter into the broad classification of this characteristic. In the system under consideration, it was noted, there are the same number of lines in the picture as in standard black and white TV, and the line structure is the same. Since this line structure has been satisfactory in the present service, there is no reason to believe that it will not be satisfactory for color, the petition continued. The diameter of an individual dot in the 16-inch tri-color picture tube was said to be about the same as about 70 per-cent of the thickness of a scanning line. Since lines are not usually visible at normal viewing distances, the individual red, green, and blue phosphors were described as even less visible.

Some minor misregistration as may, from time to time, be perceptible in present color receivers, will not, it was indicated, interfere with enjoyment of color pictures, and in addition is not a system limitation. In a comprehensive report on the subject, the petition reviewed why such misregistration might occur. In the camera used, although it is necessary to register accurately three scanning rasters, an unusual amount of success has been attained. Test pictures have been made by scanning a line and RTMA pattern; misregistration would be indicated by a thickening or multiplicity of some lines near the outer extremities of the pictures. Essentially no deleterious effects due to misregistration were observed, it was noted, although there may have been a slight tendency for a thickening of some lines near the outer edges, but there were no signs of multiple lines. In a questionnaire, it was

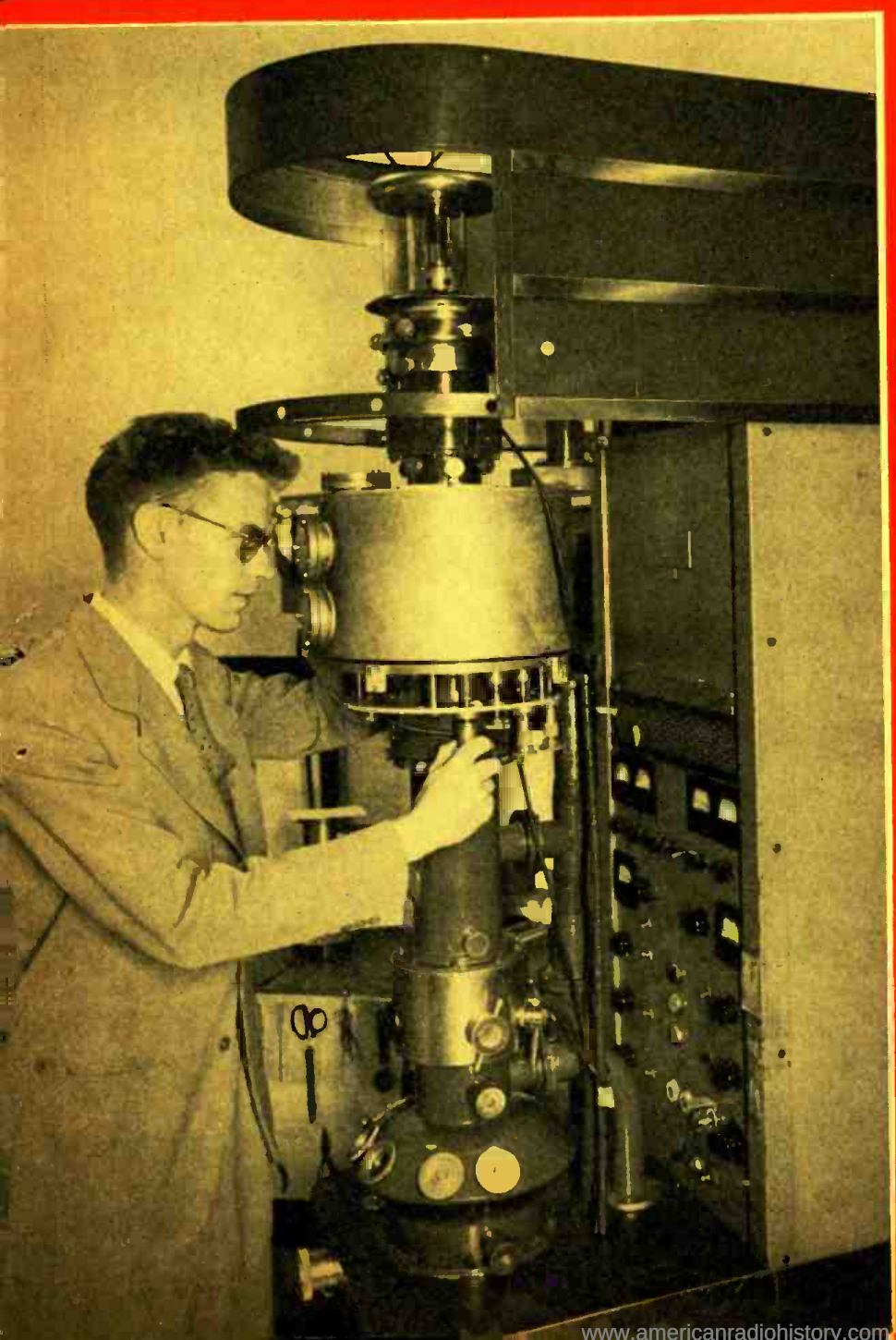
(*Continued on page* 170)

RADIO-ELECTRONIC Engineering SECTION

Reg. U. S. Pat. Off.

RADIO & TELEVISION NEWS

TELEVISION • RADAR • ELECTRONICS • RESEARCH • COMMUNICATIONS • MICROWAVES



SEPTEMBER, 1953

DEPARTMENTS

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

In the National Bureau of Standards electron-beam interferometer, diffraction from extremely thin crystals is used to split and recombine electron beams. A conventional electron microscope is used for viewing the resulting interference fringe phenomena.

NEW "M" TYPE TOROIDS Maximum Q Minimum Size

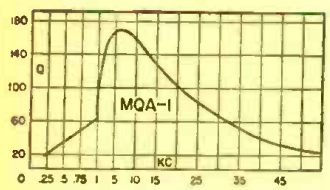
UTC Permalloy Dust Toroids have been the standard of the industry for over 15 years. The MQ series of coils provide the highest Q factor in their class (see curves below), with miniaturized dimensions. All units are hermetically sealed to MIL-T-27 Specifications.

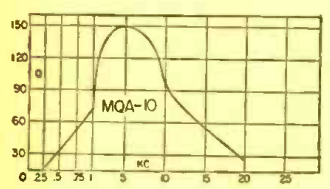
The **stability** is excellent. For the MQE-7 the inductance change is less than 1% for voltages from .1 to 3 volts. The MQA-13 change is less than 1% for applied voltages from .1 to 20 volts. The MQB-5 change is less than 1% for applied voltages from .1 to 50 volts. DC is permissible through the coil (values listed below). Inductance is virtually independent of frequency temperature and vibration.

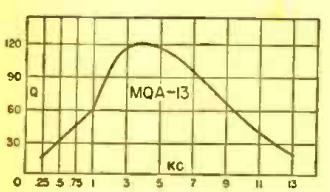
Hum pickup is extremely low due to the toroidal winding structure, with windings uniformly spread over the core. The case is of high permeability, affording additional shielding such that close spacing of units can be effected, the coupling attenuation being approximately 80 DB.

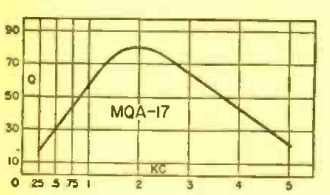
Other values of inductance than those listed are available on special order at the price of the next higher listed value.

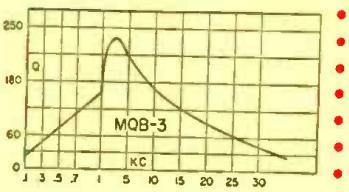
TYPICAL Q CURVES

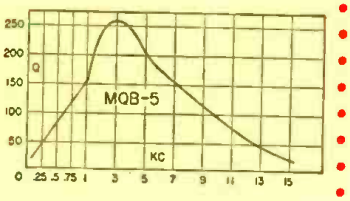


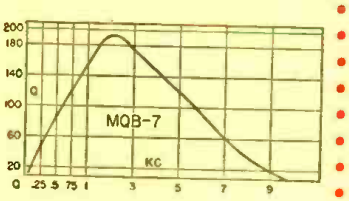


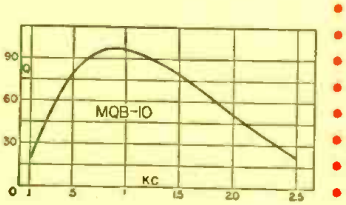


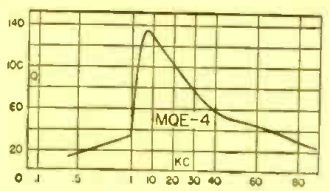


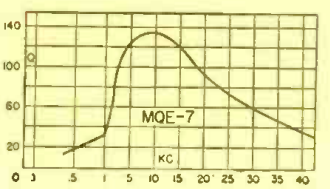


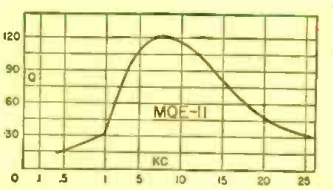


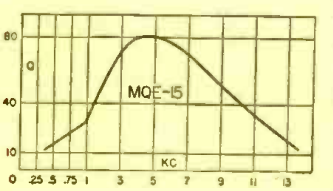












MQA TYPES

Type No.	Inductance	*DC Max.
MQA-1	7 mhy.	250
MQA-2	12 mhy.	200
MQA-3	20 mhy.	150
MQA-4	30 mhy.	125
MQA-5	50 mhy.	100
MQA-6	70 mhy.	80
MQA-7	120 mhy.	60
MQA-8	.2 hy.	50
MQA-9	.3 hy.	40
MQA-10	.5 hy.	30
MQA-11	.7 hy.	25
MQA-12	1 hy.	20
MQA-13	1.5 hy.	17
MQA-14	2.5 hy.	13
MQA-15	4 hy.	10
MQA-16	6 hy.	9
MQA-17	10 hy.	7
MQA-18	15 hy.	5
MQA-19	22 hy.	4

*This value of D.C. (MA) will drop the coil inductance 5%. Values of D.C. below this will show proportionately (linear) less inductance drop. For example, MQE-1 will drop ½% in L with 13.5 MA.

MQB TYPES

Type No.	Inductance	*DC Max.
MQB-1	10 mhy.	400
MQB-2	30 mhy.	250
MQB-3	70 mhy.	170
MQB-4	120 mhy.	120
MQB-5	.5 hy.	60
MQB-6	1 hy.	40
MQB-7	2 hy.	30
MQB-8	3.5 hy.	22
MQB-9	7.5 hy.	16
MQB-10	12 hy.	11
MQB-11	18 hy.	9
MQB-12	25 hy.	8

MQE TYPES

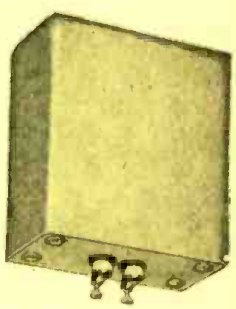
Type No.	Inductance	*DC Max.
MQE-1	7 mhy.	135
MQE-2	12 mhy.	100
MQE-3	20 mhy.	80
MQE-4	30 mhy.	65
MQE-5	50 mhy.	50
MQE-6	70 mhy.	40
MQE-7	100 mhy.	35
MQE-8	150 mhy.	30
MQE-9	.25 hy.	22
MQE-10	.4 hy.	17
MQE-11	.6 hy.	14
MQE-12	.9 hy.	12
MQE-13	1.5 hy.	9
MQE-14	2 hy.	8
MQE-15	2.8 hy.	7.2

MQE CASE

Length ..... 1 1/16"
Width ..... 1/2"
Height ..... 17/32"
Unit Weight ..... 1.5 oz.

MQA CASE

Length ..... 1 9/32"
Width ..... 11/16"
Height ..... 1 23/32"
Unit Weight ..... 4 oz.

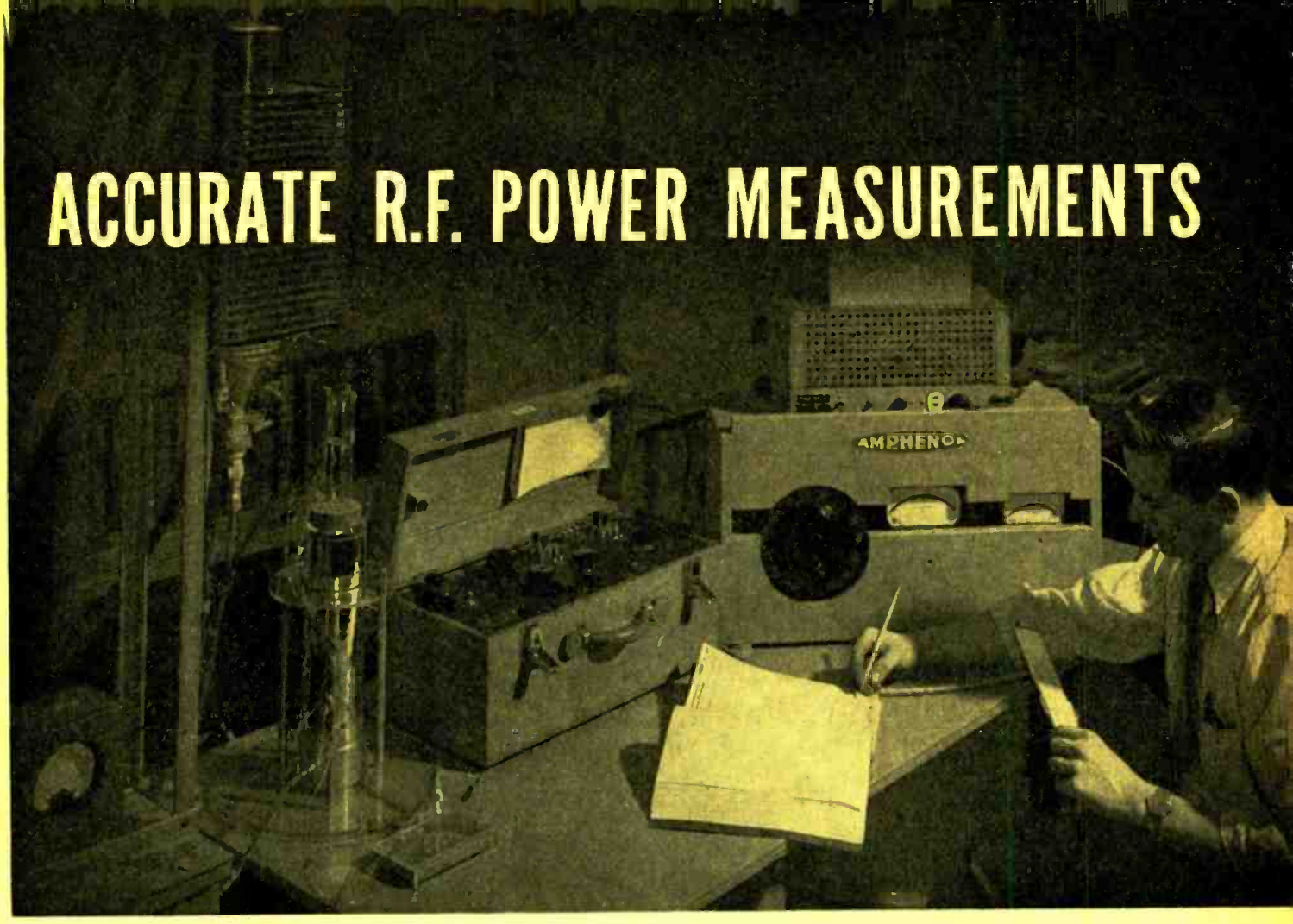


MQB CASE

Length ..... 2 9/16"
Width ..... 1 13/16"
Height ..... 2 13/16"
Unit Weight ..... 14 oz.

United Transformer Co.
150 VARICK STREET NEW YORK 13, N. Y.
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y.. CABLES: "ARLAB"

ACCURATE R.F. POWER MEASUREMENTS



Setup for calorimetric calibration of water load and for making r.f. power measurements.

By **R. M. SORIA,** Director of Research, and
J. G. KRISILAS, Senior Research Mech. Engr.
American Phenolic Corporation

Calorimetric method is used to measure r.f. power output and to calibrate an input power indicator.

MEASUREMENT of radio frequency power in the range of 2 to 5000 watts is often accomplished by means of the temperature-rise or calorimetric method. Both input (through) and output (absorbed) power may be conveniently and accurately measured by this method, provided that proper impedance matching of the calorimeter to the component under test has been observed and that an accurate calibration of the water load exists. Need for the development to be discussed here arose in the course of measuring the r.f. power-handling capacities of coaxial cables having polyethylene, Teflon, and liquid dielectrics, and in the measurement of other components developed for airborne applications in the current miniaturization program. This article presents the results of an investigation by means of which a commercially available r.f. wattmeter load has been converted into a sensitive, closed-system calorimeter used for accurate r.f. power measurements up to 5000 watts.

Existing methods for measuring r.f. power have in common the conversion of r.f. energy into heat in some type of resistive material in which the effects of the dissipated heat are compared to equal effects produced by an easily measured a.c. or d.c. power source. These existing methods may be classified as follows:

1. *Resistance change*—bolometers and thermistors having a range from one microwatt to several milliwatts
2. *Light*—lamp loads having a range from approximately 200 mw. to 200 watts
3. *Temperature rise*—calorimetric loads having a range from approximately 2 to 5000 watts

As the calorimetric or water-load method primarily measures output power, the load is usually inserted at the terminating end of the component being measured. Power is absorbed in a matching resistor which, in turn, is immersed in a circulating liquid cooling bath. The heat absorbed by the liquid is equal to the heat dissipated in the terminating resistor, and thus the rise in temperature of the liquid is a measure of power being dissipated.

If water is utilized as the circulating liquid, the power absorbed may be represented ideally by the equation:

$$P = 0.307\ Wc\ (\Delta t) \quad \ldots\ldots\ldots\ldots (1)$$

where:

P = power absorbed = power dissipated, watts
W = weight rate of water flow, lb.-hr.$^{-1}$
c = specific heat of water, B-lb.$^{-1}$ °F^{-1}
Δt = temperature rise of water, °F

Although Eqt. (1) is exact for the ideal case, where all the heat is absorbed by the circulating water, correction factors must be added to compensate for the heat losses due to radiation and convection from the calorimeter to the surrounding atmosphere. Deviations from the linear relationship of the dissipated power and the temperature rise of the cooling water are therefore caused by differences between the cooling water temperature and the

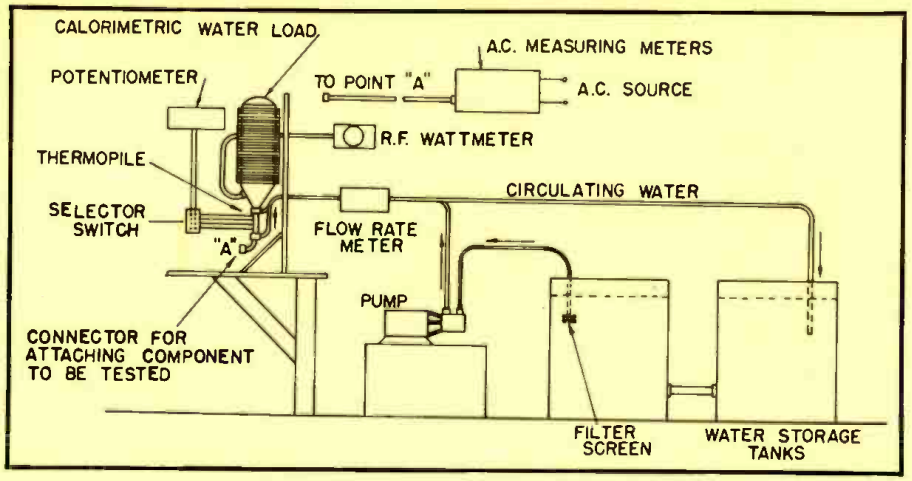


Fig. 1. Schematic diagram of the calorimetric equipment layout.

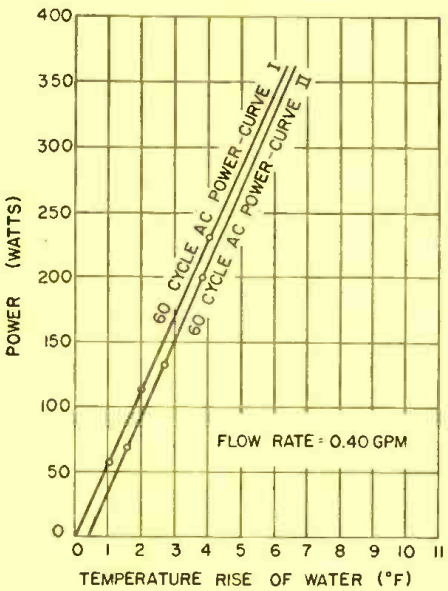


Fig. 2. Calorimeter calibration curves.

environment air temperature. If the cooling temperature is greater than the ambient temperature, the indicated temperature rise of the circulating water will be less than in the ideal case because of the heat losses to the environment caused by convection and radiation throughout the flow length between the hot and cold junctions of the thermopile temperature indicator; and subsequent calculations of the dissipated power will thus be in error. Cooling water at a temperature lower than the ambient will cause similar errors. Optimum results are obtained when the cooling water is initially at room temperature and the temperature increases by only a few degrees as the water flows through the calorimeter.

The above calculations and the inherent errors may be circumvented by substituting a.c. power in calibrating the calorimeter. The temperature rise of the circulating water is first noted when r.f. power is being dissipated by the water load. The r.f. power source is then removed and the same temperature rise is produced in the circulating water by the dissipation of a.c. power. Accurate measurements of the flow rates are not necessary so long as the flow remains constant during both the r.f. and a.c. test runs.

Since the flow rate, the inlet temperature of the circulating water, and the temperature of the environment air are held constant for both cases, the a.c. power dissipated by the calorimetric load is equal to the r.f. power dissipated from the resistor for the same cooling water temperature rise. A calibration curve may then be obtained of the power dissipated vs. the temperature rise of the circulating water.

As it is a requirement in the ideal case to have both the r.f. and a.c. resistors identical in physical dimensions and similarly located in the calorimeter, use of the commercially available r.f. water load in the power substitution method of measuring r.f. power eliminates a common source of error present in most laboratory calorimeters. For reasons of impedance matching, the a.c. calibrating resistor is mounted—in the usual laboratory calorimeter—externally to the r.f. portion of the calorimeter, so that identical heat transfer conditions are not available for both the r.f. and a.c. tests. Therefore, the cooling water temperature will increase in two unequal stages as it flows through the a.c. and r.f. portions of the system, causing a corresponding unequal cooling water temperature difference to be indicated for both the a.c. and r.f. test runs.

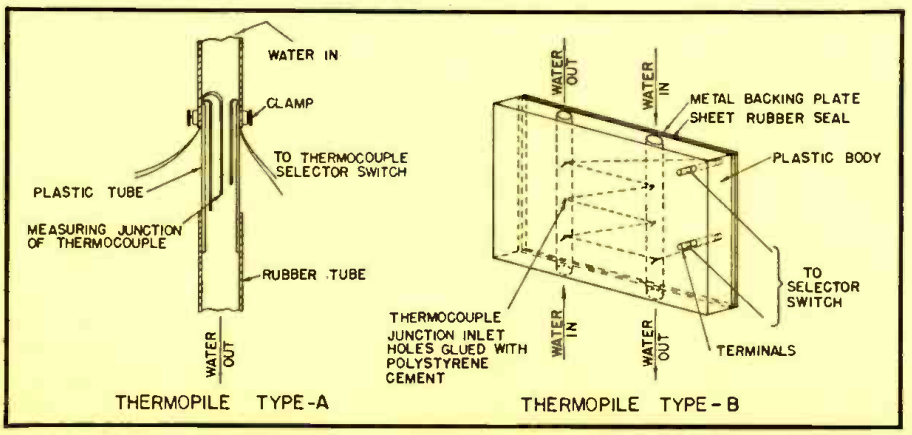
Experimental Installation

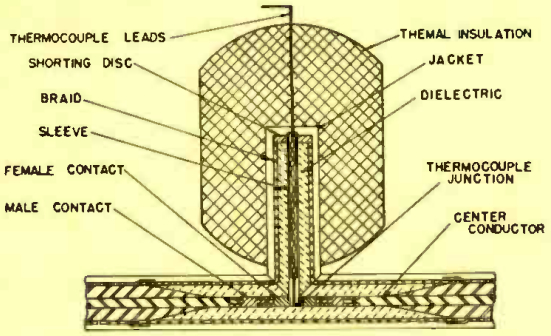
Two systems were designed and tested in the development of the calorimetric water load, one system permitting the use of the calorimetric equation for calculating the power values, the second and more useful system utilizing the power substitution method for obtaining r.f. power values. The latter system is described below.

A Model 67 Termaline wattmeter-load, manufactured by *Bird Electronic Corporation*, was adapted and calibrated for use as a calibrating calorimeter. The wattmeter has an operating range of 0-2500 watts arranged in three steps of 0-100, -500, and -2500 watts at a frequency range of from 30-500 mc.; this range can be extended to 1000 mc. with rapidly decreasing accuracy. The load can be air-cooled up to 200 watts and water-cooled for the higher power levels. Power being measured is absorbed in a terminating carbon-film-on-ceramic resistor enclosed in a bath of oil dielectric which transfers the heat from the terminating resistor to the water flowing in the coils immersed in the oil dielectric. Absorption of the power results in a temperature rise in the water flowing through the wattmeter-load.

The test installation, shown schematically in Fig. 1, consisted of the wattmeter-load, differential thermopile installation, a special a.c. connector to the wattmeter-load, an a.c. wattmeter and power source, and circulating cooling water contained in a closed system consisting of two 55-gallon containers with a positive displacement pump to maintain a constant flow rate.

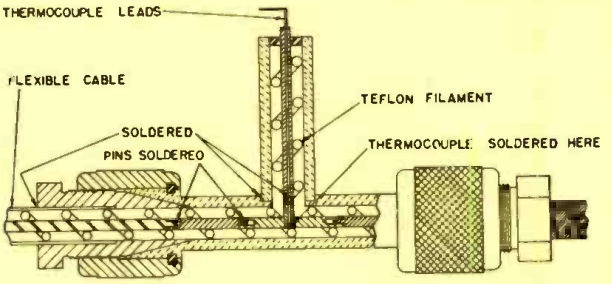
Fig. 3. Sketches showing two different thermopile constructions.





A– QUARTER WAVE TRANSFORMER FOR CENTER CONDUCTOR TEMPERATURE MEASUREMENTS (SOLID DIELECTRIC)

Fig. 4. Two types of temperature-measuring devices.



B– QUARTER WAVE TRANSFORMER FOR CENTER CONDUCTOR TEMPERATURE MEASUREMENTS (LIQUID OR GAS DIELECTRIC)

Two types of thermopile assemblies were developed for use with the calorimetric load to measure the cooling water temperature rise. In both of these assemblies, it was necessary to introduce the thermopiles into the inlet and outlet water streams and to make these points of entry leakproof against pressures of approximately 100 psi.

Thermopile Type A, shown in Fig. 3, was developed to prevent loss of heat from the flowing water while measuring the water temperature. Each tube contains a thermocouple for accurately measuring the water temperature as well as the thermopile for measuring the temperature differential between the two water streams. The thermopile is also used as a check on the thermocouple measurements. Since the thermocouple wire provides a path for heat losses, one to two inches of thermocouple wire should be enclosed in the water stream to insure accurate measurement of the true water temperature. Use of thermopile Type A makes possible utilization of Eqt. (1) for calculating the power absorbed, provided that the environment temperature is close to the mean water temperature.

Thermopile Type B of Fig. 3 was developed for use when the calorimeter is being calibrated by the substitution of a.c. power. This method of construction is more rugged, the apparatus is easier to assemble, and it can withstand higher water pressures than thermopile Type A. The bulk of the thermopile body causes heat losses from the flowing water and thus indicates slightly lower temperature differences than those calculated from Eqt. (1). However, it is not essential to measure the true water temperature since the temperature differences are correlated by means of the substituted a.c. power.

To insure a constant flow rate of water through the calorimeter, a constant-pressure or constant-head water supply is necessary. This may be attained by means of an open or a closed system.

A closed system was designed in which a positive displacement pump, having a capacity of 2 gpm and driven by a ⅓-hp. electric motor, was utilized to circulate the cooling water through the calorimeter. Various constant flow rates were obtained by adjustment of a valve while the flow rate was indicated rapidly and conveniently by a *Fischer and Porter* "Flowrater" meter. As a check on accuracy, however, the flow rates were also measured with a stop watch and container of known volume. Sufficient capacity was available with two 55-gallon drums coupled together to permit the water to cool to room temperature before being recirculated through the calorimeter.

The a.c. calibrating installation consisted of a constant a.c. power source and an ammeter, wattmeter and variable resistance, which were assembled into a self-contained unit for ease in making the test measurements.

Experimental Results

The commercially available water load was calibrated by the a.c. power substitution method and a series of measurements was made to determine its performance as a calorimeter. Calibration test runs of the calorimeter with thermopile Type B are presented in Fig. 5; the a.c. power input to the calorimetric load is plotted as a function of the temperature rise in the circulating water with the various flow rates as parameters. Theoretical curves, calculated from Eqt. (1), are also presented for comparison. The experimental results show that a greater temperature drop can be obtained due to the heat losses from thermopile Type B. The experimental curves of Fig. 5 were checked after the calorimetric load was in operation for a period of time, and these points are indicated by the symbol "B". It may be seen that excellent reliability and repeatability have been attained.

Fig. 5. Calibration of calorimetric water load at various flow rates, using thermopile Type B (Fig. 3). Theoretical and actual curves are given for three different water flow rates.

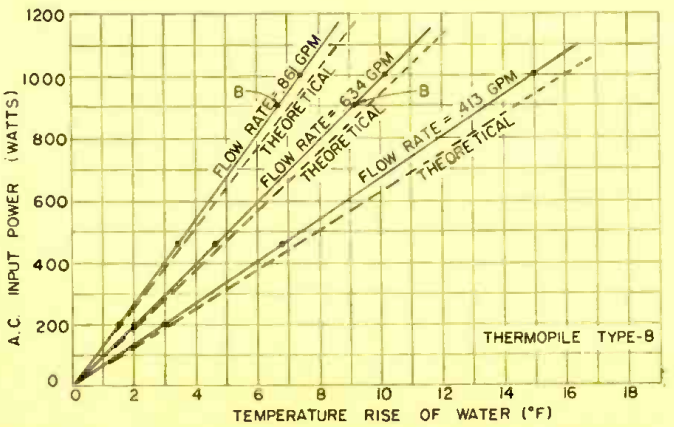
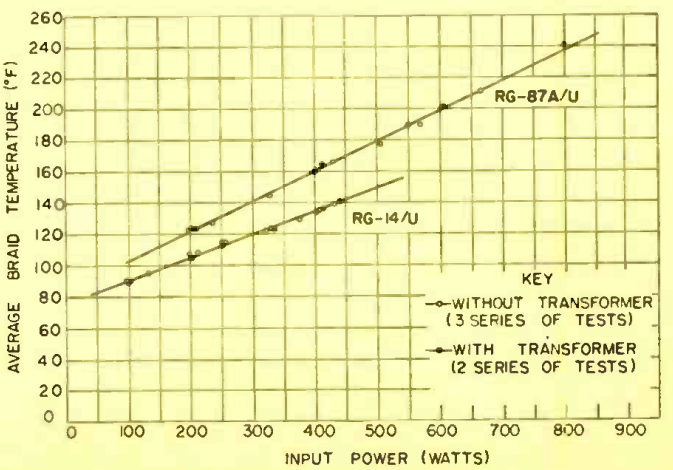


Fig. 6. Calibration of quarter-wave transformer by the braid temperature comparison method.



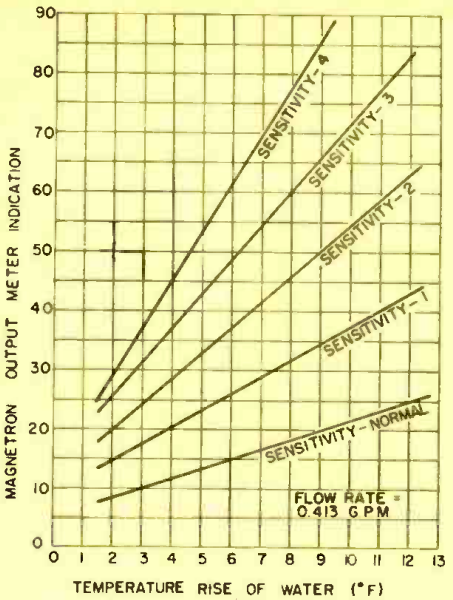


Fig. 7. Magnetron output meter variation with water temperature rise.

A series of tests was also made utilizing thermopile Type A in measuring the cooling water temperature difference, the results of which are presented in Fig. 2. Curve I is a plot of the power vs. the temperature difference as calculated from Eqt. (1) for a flow rate of 0.40 gpm. The results of these test runs, in which the mean water temperature was equal to the environment air temperature, coincided with theoretical curve I, thus confirming the use of thermopile Type A when the power substitution method is not utilized in the calibration of the calorimeter. Curve II is a plot of the results obtained when the environment air temperature was greater than the mean water temperature. Since the amount of heat absorbed by the water from the environment air is approximately constant over the small temperature range, the effect of the environment air is manifested in an initial displacement of the curve.

It is desirable to obtain the power measurements using a flow rate which will give temperature differences of only a few degrees above the ambient temperature, so that heat loss errors to the environment will be kept at a minimum. In addition, the flow rate should be such that slight variations in it will not greatly influence the accuracy of the cooling water temperature difference. Optimum results have been achieved with flow rates maintained between 0.40 and 0.80 gpm.

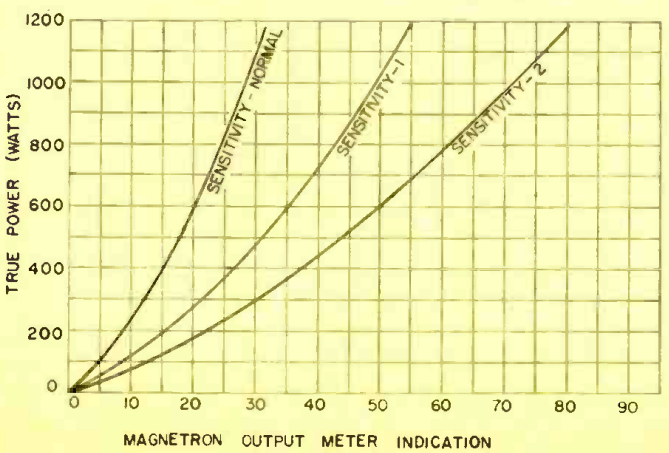
Quarter-Wave Transformer

In conjunction with measurements of output or absorbed power, various indicating devices may be calibrated by the calorimeter for use as input or through power meters. A quarter-wave transformer with enclosed thermocouple was developed to measure accurately internal temperatures of r.f. components which contain solid, liquid or air dielectrics while transmitting r.f. power, and in addition, to indicate input power when so calibrated with the calorimeter.

This quarter-wave transformer was utilized to isolate electrically the effect of the thermocouple insertion into the component being tested. The condition of electrical similarity was achieved by constructing the transformer exactly like the component being tested. Thermal stability was achieved when necessary by the addition of thermal insulation (in the form of asbestos powder) to prevent heat losses from the quarter-wave stub from becoming greater than the heat losses from the component before the insertion of the transformer.

By assuming that the quarter-wave transformer would act like a cooling fin at the point of insertion into the component, a measure of the additional heat losses was obtained from theoretical calculations. The values of calculated surface temperatures along the quarter-wave stub were confirmed by actual measurements which showed that the transformer insertion would alter the condition of heat transfer and would indicate a lower center conductor temperature when solid and stationary liquid or gaseous dielectrics were utilized. Therefore, for precise center conductor measurements, thermal insulation should be added to the quarter-wave stub to decrease the heat losses to a negligible value. Insulation may be omitted when the component utilizes a flowing liquid or gas which has a dual role as dielectric and coolant.

Fig. 8. Calibration curve of magnetron input meter indication vs. the true output power.



Two models of the quarter-wave transformer, developed particularly for the measurement of power-handling capacities of solid and liquid dielectric coaxial cables, are shown in Fig. 4. Similar quarter-wave transformers can be designed for other electronic components.

Two methods exist for the insertion of the particular quarter-wave transformer into the component circuit. The first method consists of custom-fitting the quarter-wave transformer into the component and then reconstructing the assembly to conform to the original, an example of which is shown in Fig. 4A. The other, and more general method, consists of constructing a transformer assembly with connectors on each end, as shown in Fig. 4B, to facilitate its insertion into any component circuit being tested.

The transformer (Fig. 4B) is connected to the center conductor of the component being tested by means of a double female contact having the same dimensions as the component center conductor. The quarter-wave stub, consisting of a brass sleeve 2.25" long, is screwed into the double female contact. The thermocouple (No. 30 AWG wire) is inserted through a 0.028" axial hole in the sleeve and soldered at the junction along the axis of the center conductor. The stub is then assembled exactly like the component in which it is inserted, provision being made for a shorting disc which is screwed to the sleeve and adjusted to the proper quarter-wavelength.

Construction of the quarter-wave transformer may be improved for large-size components by utilizing the center conductor of the component rather than replacing it with the double female contact. In the case of large-diameter coaxial cable, a tapered hole was first drilled through the jacket, braid and dielectric, exposing a small area of the center conductor surface. Using a bottoming tap, the center conductor was then tapped with a 0-80 thread. The vertical sleeve of the transformer was screwed directly into the center conductor of the cable, and the vertical portion of the transformer was then constructed as before. This procedure is especially recommended for power testing at high power levels where unequal thermal expansions of the various component materials may sometimes force the center conductor from the double female contact.

Limitations of space preclude the presentation of the electrical calibrations. It will suffice to state that the quarter-wave transformer is calibrated

(*Continued on page* 29)

TRANSISTOR CHARACTERISTICS*

By F. M. DUKAT
Raytheon Manufacturing Company

Production variations in the small signal and d.c. parameters of type PNP junction transistors.

THIS ARTICLE concerns the small signal and d.c. parameters of the *Raytheon* CK721 and CK722 transistors, the distributions of these parameters, and the effect of such distributions in the three amplifier connections. The parameters will be illustrated in the form of graphs which will indicate the spread in parameter values on a group of typical production units.

First of all, it might be well to acknowledge that at the present state of transistor development no manufacturing techniques are known which can control transistor parameters within close limits. Selection after manufacture is necessary. Therefore, if transistors are to be used commercially today, a knowledge of the extent of their variability is very important in order to minimize this variability by suitable circuit design.

Two *Raytheon* junction types are now available to the military and general trade: the CK721, which can be considered a relatively high grade unit; and the CK722, a medium grade unit which is useful in many applications. The basic difference between the CK721 and the CK722 is one of current amplification, the CK721 having an α of about .95 or greater while the α of the CK722 runs from about .85 to .95.

Distributions of the small signal parameters and tentative limits, where applicable, are given in Figs. 1 through 7 for 100 units taken from the production line during the last quarter of 1952. It can be expected that both limits and distributions will change as manufacturing processes improve. All measurements except cutoff have been made with a fixed emitter current of 2 ma. d.c. and a collector voltage of -6 volts—an operating point that is not necessarily optimum but which has been selected as a reasonable compromise between small signal and large signal applications.

A distribution for emitter resistance, R_e, in both transistor types is shown in Fig. 1. It appears that in general the CK721 approaches more nearly the theoretical value of 25.9 ohm-ma. for an ideal unit.

The variation in base resistance (Fig. 2) indicates that the base resistance of the CK721 is higher than that of the CK722. This is in accord with observations that high alpha units generally have higher base resistance, although such is not always the case. Figure 3 gives alpha cutoff as a function of frequency. Approximately 50% of the CK721 transistors show an alpha cutoff greater than 800 kc. However, this does not imply that good performance can be obtained up into these frequencies; alpha cutoff is only one of several factors governing high frequency performance.

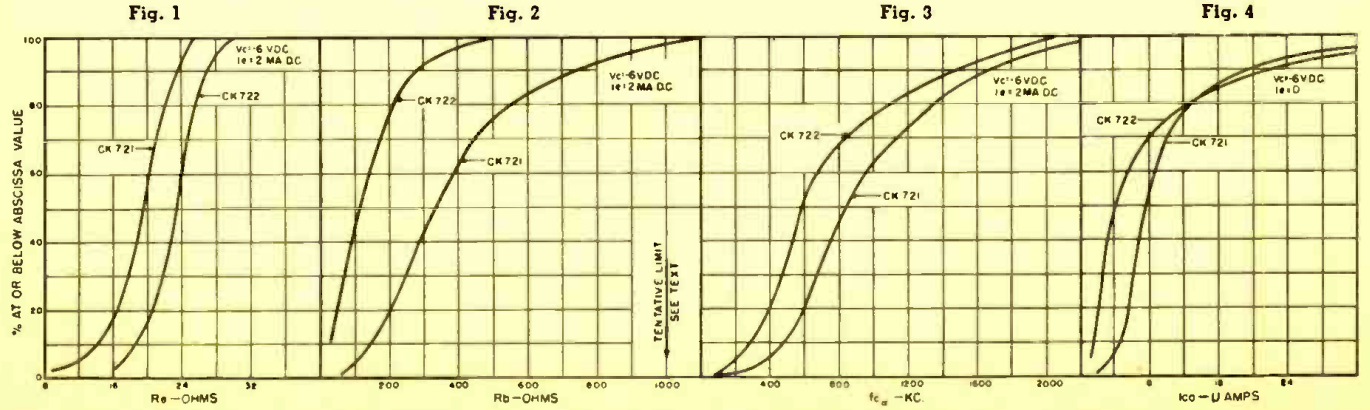
Cutoff current, I_{co}, for both types is shown in Fig. 4. Cutoff current is an excellent indication of the surface cleanliness of the junction, and production has improved enormously in this regard since the present data was taken.

Figure 5 gives alpha distributions. Here is the major item that one buys in the CK721. While the CK721 curve cuts off quite sharply around .99, some units have been observed with an alpha as high as .999.

Distributions of collector capacitance, C_c, are presented in Fig. 6. The capacitance, as measured, is the output capacitance in the grounded base circuit. In the grounded emitter circuit, the effective output capacitance is much higher than that in the grounded base circuit because it is an inverse function of $(1-\alpha)$. This does not necessarily mean that the frequency response of the grounded emitter circuit is worse in audio service; the output resistance of the grounded emitter circuit is reduced by the same factor that the output capacitance has increased. Thus, for matched conditions, frequency response of the two connections is identical.

*This article is based on a paper presented at the 1953 *Airborne Electronics Conference, Dayton, Ohio, May* 11-13.

Fig. 1 Fig. 2 Fig. 3 Fig. 4



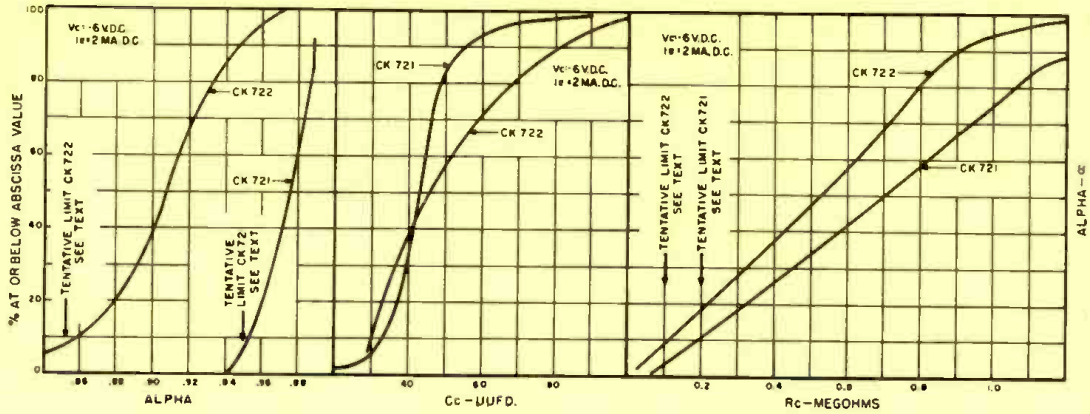


Fig. 5 Fig. 6 Fig. 7

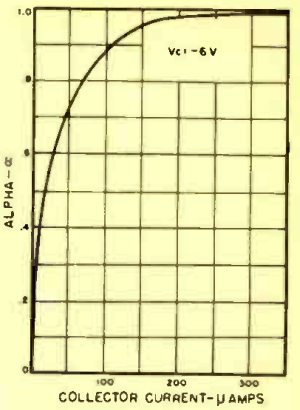


Fig. 8

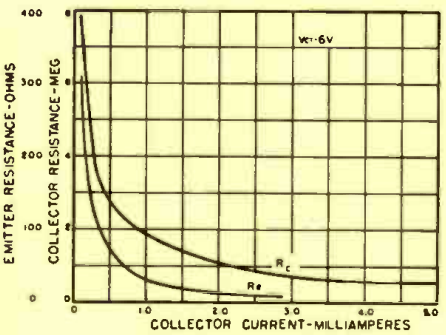


Fig. 9

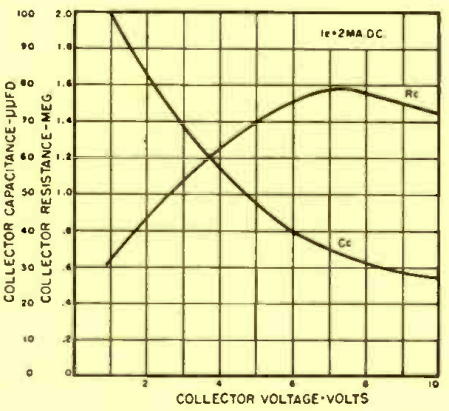


Fig. 10

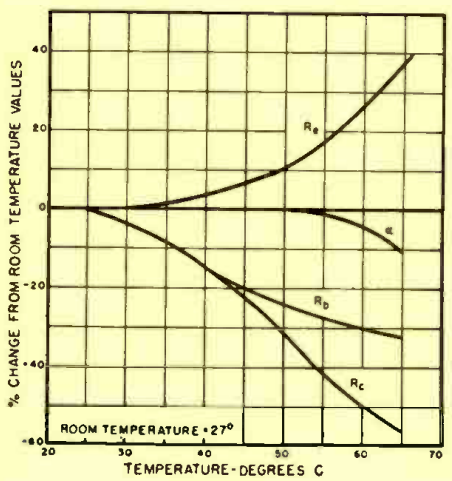


Fig. 11

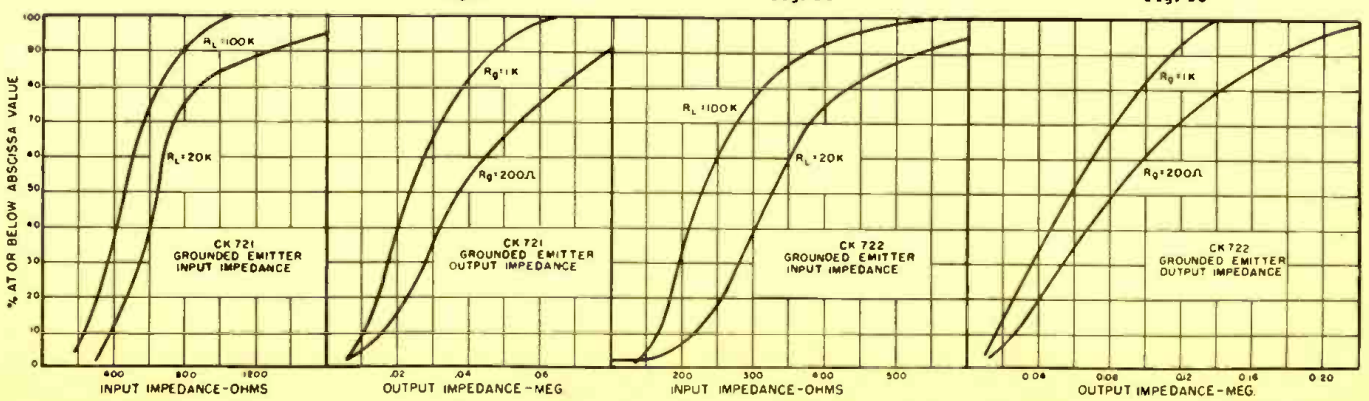
The capacitance of the emitter junction when operated with reverse voltage should be noted. In these diffused units, the area of the emitter junction is appreciably smaller than that of the collector, with the result that the emitter capacitance is about 25% of the collector capacitance.

Figure 7 shows the collector resistance, R_c. Improvements in I_{co} have also resulted in the elimination of most of the very low units that appear here. It should be realized that the values of certain of the parameters shown in Figs. 1 through 7 are functions of operating point. In Fig. 8, alpha is a function of collector current. Alpha holds up well down to about 200 μa., but below this point it falls off rapidly and may be subject to a large unit-to-unit variation. Figure 9 presents the variations in R_c and R_e as functions of collector current on typical units; if high R_e is desired, it can be obtained at lowered collector currents without loss in current amplification. Theoretically, R_e should be equal to $25.9 \times 10^{-3}/I_e$. The variation shown here with I_e approximates this relation quite closely. In Fig. 10, R_c and C_c are shown as functions of collector voltage V_c. R_c tends to maximize at various collector voltages, depending on the unit. C_c is theoretically proportional to $1/\sqrt{V_c}$.

Transistor parameters also depend on temperature. The variations in R_e, R_c, α, and R_b are given in Fig. 11. Alpha remains relatively constant with rising temperature, R_c decreases and R_e increases. R_b has a rather peculiar action as the temperature changes. Here it is shown as decreasing; however, examination of the low temperature range indicates that it also decreases in that region. Thus, R_b tends to be maximum at normal temperatures.

Before examining the circuit performance, it is essential to consider d.c. operating points. It is extremely important, from the standpoint of production use, that the external circuit and not the transistor itself govern the operating point. In the two-battery or tapped-battery circuit, the external circuit is in control—inasmuch as the resistance setting the emitter current is normally large compared to the d.c. emitter drop and, thus, primarily determines the emitter current. (It also

Fig. 12 Fig. 13 Fig. 14 Fig. 15



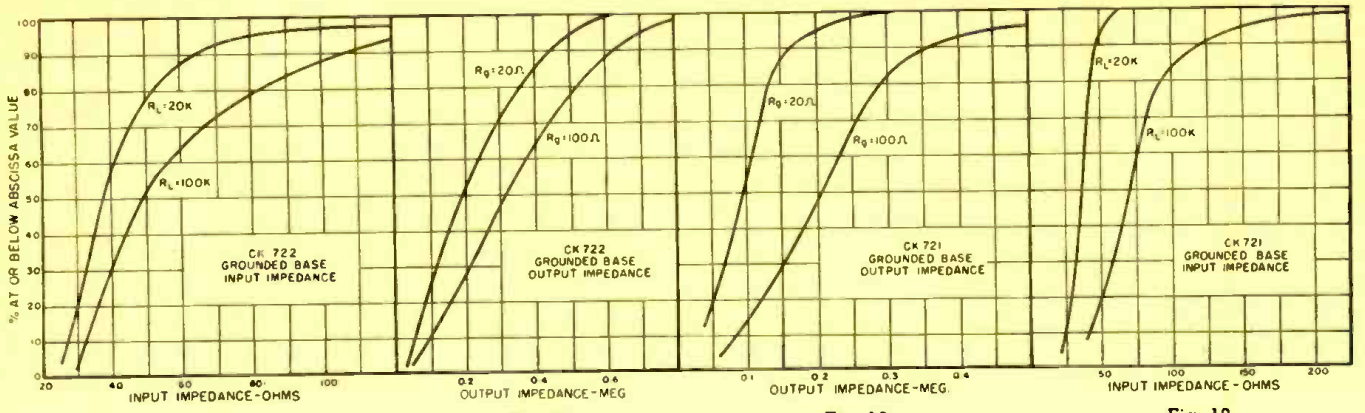


Fig. 16 Fig. 17 Fig. 18 Fig. 19

determines the collector current, for I_c and I_e are practically equal when I_e is large compared to cutoff current.)

On the other hand, single-battery operation is attractive, and one is first led to the simple circuit of Fig. 20A. In this circuit, the collector current is given approximately by:

$$I_c = \frac{I_b + I_{co}}{1 - \alpha}$$

The expression is approximate because α is a function of I_c. It will be evident that in this circuit I_c is subject to wide variations because I_{co} has rather wide limits and is comparable to I_b (the base current). In addition, $(1 - \alpha)$ may vary over 10:1 in the CK721. As Fig. 20A shows, the variation in the operating point is intolerable unless base resistances and transistors are matched, which constitutes an obviously undesirable process. Furthermore, if one wishes to hold collector current at, say, 500 μa., it is impossible to do so in the circuit of Fig. 20A with units of even moderately high alpha and very reasonable cutoff currents. Figure 20B is a d.c.-stabilized circuit using three resistors in the manner described by Shea[1]. The operating point is very nicely controlled at the expense of only a small amount of power being consumed by the stabilizing network. Networks of this sort also stabilize the operating point with temperature, which is of great advantage because of the sensitivity of cutoff current to temperature variations. For example, at low cutoff currents, I_{co} has a temperature coefficient of about 7% per °C at 25°C. Incidentally, because the transistor doesn't know how it is connected, the d.c. stabilization circuit is the same and produces the same results no matter how it may be connected from an a.c. standpoint. Of course, one doesn't ever get something for nothing, and a disadvantage of this stabilization is that—depending on the degree of stabilization—the voltage available at the collector is always smaller than that available when a single base resistor is used.

(*Continued on page* 24)

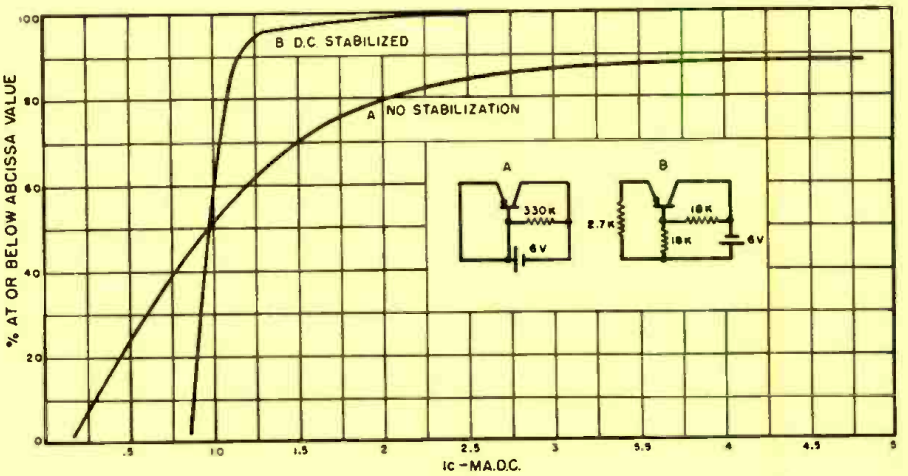


Fig. 20

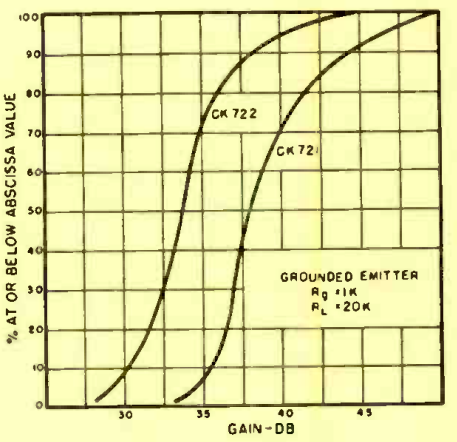
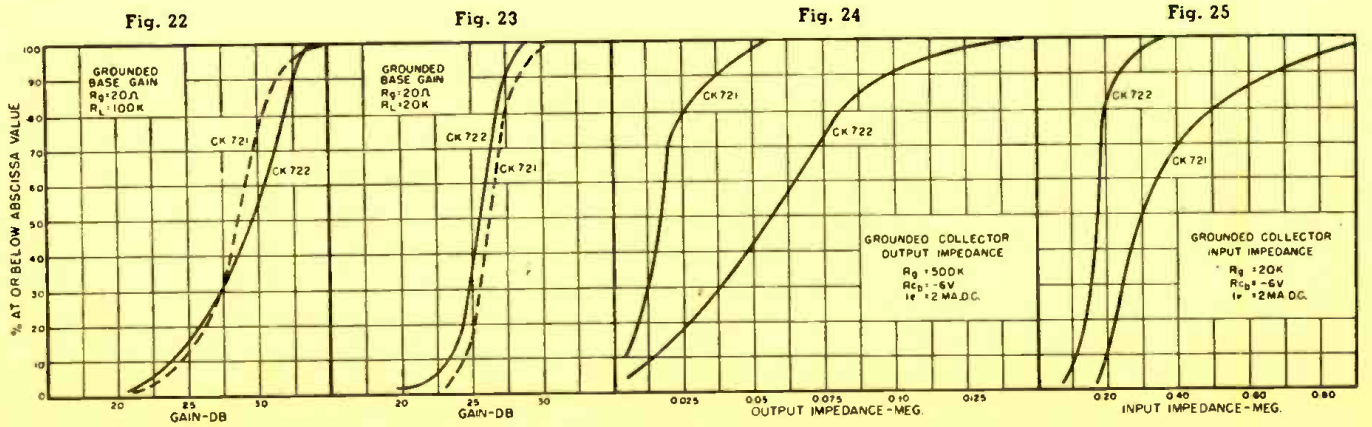


Fig. 21

Fig. 22 Fig. 23 Fig. 24 Fig. 25



BALANCED CRYSTAL-DIODE MODULATOR*

By

WILLIAM F. BYERS

General Radio Company

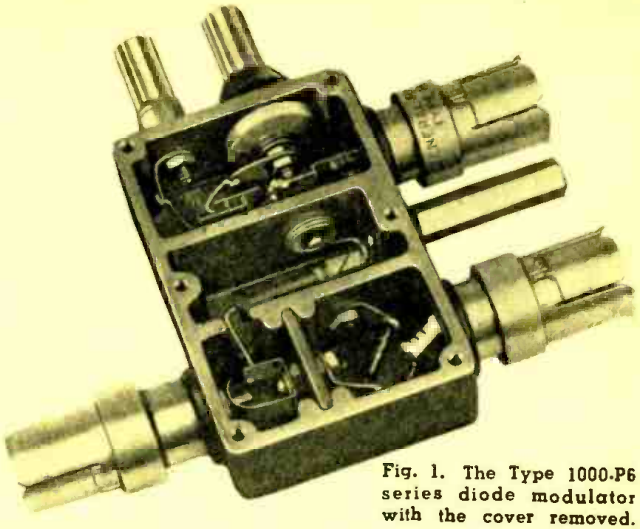


Fig. 1. The Type 1000-P6 series diode modulator with the cover removed.

Silicon diodes are used in a balanced modulator circuit to give up to 100% modulation of r.f. signals at 60 to 2500 mc.

IT IS well known that amplitude modulation can be accomplished by simultaneously applying radio and modulating frequencies to a nonlinear circuit element. Copper oxide rectifiers are commonly used as low-level modulators at audio and low radio frequencies, and silicon diodes are used at frequencies up to several thousand megacycles as modulators or mixers in receivers. This article will describe a balanced modulator utilizing silicon diodes which can be used to modulate the output of signal generators in the frequency range of 60 to 2500 mc.

The usual v.h.f. and u.h.f. signal generator consists of a carrier oscillator whose plate supply can be modulated. Such modulation inevitably results in considerable frequency modulation accompanying the desired amplitude modulation. For square-wave or pulse modulation, incidental FM is not usually a problem, but difficulty is encountered in obtaining fast rise time because of the time required for the oscillator to build up in amplitude to its maximum output.

Modulation of the output of an oscillator can be accomplished by a crystal diode if the signal level required is of the order of 10 mv. or less. This output level is sufficient for many applications. The use of a modulator at the output of an oscillator greatly reduces or eliminates incidental FM and simplifies the problem of pulse modulation.

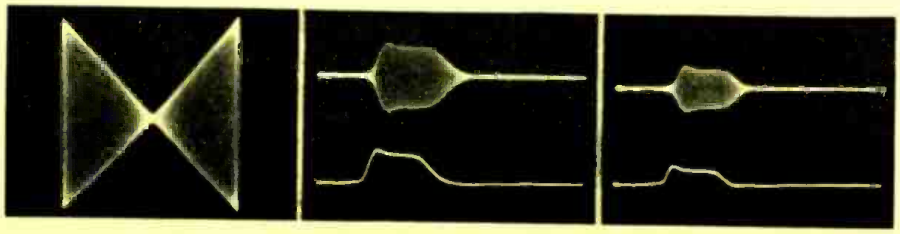
Figure 5 gives the volt-ampere characteristic of a typical 1N21-B crystal diode. As can be seen from this curve, the incremental resistance varies from about 5000 ohms with zero current to about 60 ohms at 1.2 ma. The small circles indicate the maximum spread of characteristics between ten 1N21-B units. With the range of resistance shown, it is evident that a reasonable degree of modulation can be obtained by inserting this crystal diode between a low impedance source and load as a series-modulated resistance. However, the high frequency impedance variation is less than that indicated by the d.c. volt-ampere characteristic, due principally to residual inductance and capacitance.

A crystal-diode modulator was developed a few years ago using a single diode as a series modulator. In the wiring diagram of this unit (Fig. 6), C_1 is a blocking capacitor which permits modulation and bias to be applied to the diode but has a low impedance at the signal frequency. L_1 is the modulation feed choke. L_2 and C_1 constitute a simple high-pass filter, passing the signal frequency and attenuating the modulating frequency. A mixing pad provides a means of applying d.c. bias and modulation simultaneously. The bias is usually made adjustable and is set to give the desired operating point on the modulation characteristic. D.C. insertion can be supplied at the modulation terminals with the modulating signal if desired.

Figure 1 is a photograph of this modulator with the cover removed, displaying the arrangement of components. The crystal diode is contained within the r.f. input connector at the lower left. The tip of this diode can be seen projecting into the lower compartment of the casting, contacting a spring supported by an insulating strip. The r.f. path is then through the small capacitor at the right side of the compartment to the r.f. output connector at the lower right. In the center compartment is the modulation feed choke. The modulation input is at the upper right connector. The mixing pad is in the top compartment, and the bias terminals are at the top.

Modulation characteristics of this unit at various carrier frequencies are such that the depth of modulation decreases with increasing carrier frequency. For many applications, such characteristics are satisfactory. However, inability to get high percentages of modulation and the nonlinearity of the modulation characteristics limit the

Fig. 2. (A, left) Modulation characteristic of the Type 1000-P7 modulator. (B, ctr.) An 0.2-μsec. r.f. pulse at a 60-mc. carrier frequency produced by Type 1000-P7 modulator. (C, rt.) Same as (B), but with a reduced amplitude.



*This article is based on a paper presented at the 1953 *Airborne Electronics Conference*, Dayton, Ohio, May 11-13.

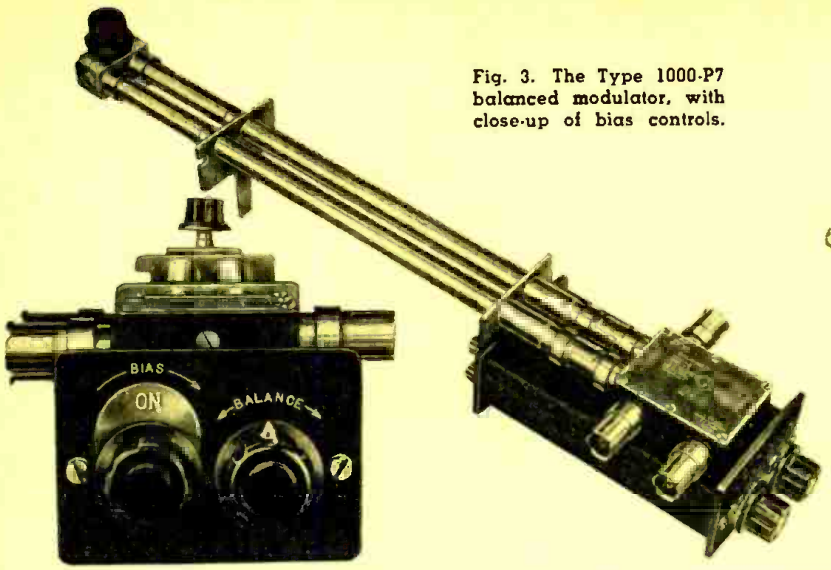


Fig. 3. The Type 1000-P7 balanced modulator, with close-up of bias controls.

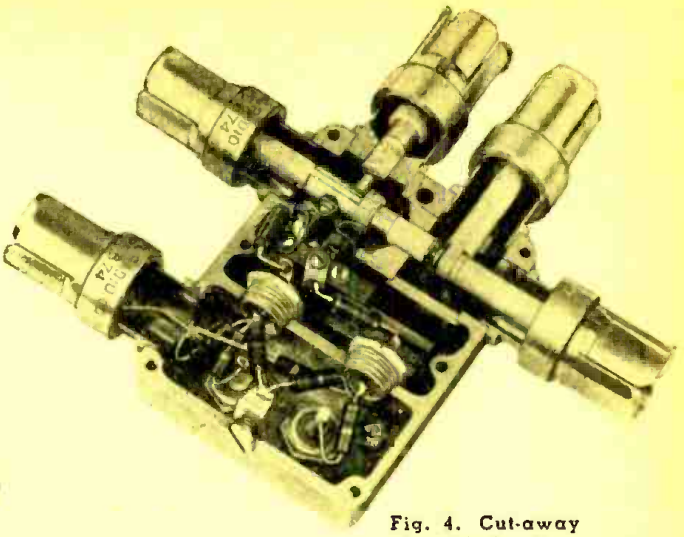


Fig. 4. Cut-away view of the Type 1000-P7 modulator.

application of a device of this kind. For most pulse work, the carrier level between pulses must be suppressed to a very small fraction of the pulsed level. Also, a higher degree of linearity and 100% modulation are often required. To overcome these limitations of the simple crystal-diode modulator, and to extend the operation to higher carrier frequencies, a balanced crystal-diode modulator has been devised.

Figure 7 is an elementary schematic diagram of the *General Radio* Type 1000-P7 balanced modulator. This is merely a combination of two crystal-diode modulators with an adjustable phasing line to supply two carrier signals which are 180° out of phase to the diodes. The outputs are connected in parallel. By adjusting the phasing line to an odd multiple of one-half wavelength and adjusting the relative bias of the two diodes, the combined output can be brought to essentially zero. The bias supply is arranged with a differential bias or balance control, and the phasing line is a "trombone" section of coaxial line. The two diodes are poled in such a manner that the application of a modulating signal increases the impedance of one and decreases the impedance of the other, permitting a single-ended or grounded modulation source to be used.

The balanced modulator, complete with the adjustable phasing line, is shown in Fig. 3. A bias battery, consisting of four standard flashlight cells, is contained within the base of the instrument. Also shown is a view of the bias supply controls which permit setting the magnitude and balance of bias applied to the two crystal diodes.

In the cutaway view of the balanced modulator (Fig. 4), a detailed arrangement of components is displayed. The r.f. input connector is on the right. At the top are the adjustable phasing line connectors. The output connector is at the top, left. One signal path is through the diode unit (top center), and through a built-in coupling capacitor to the output connector. The other signal path branches near this diode and the external phasing line brings it to the other diode unit at the left adjustable line connector. A built-in capacitor brings the signal to the common output connector. The modulation and bias feed chokes are in the center compartment, and the resistive networks in the lower compartment mix the modulation input from the lower left connector with bias voltage supplied through feedthrough capacitors in the back of the case.

The modulation characteristic at a carrier frequency of 900 mc. is illustrated in Fig. 2A. This characteristic is essentially the same at all carrier frequencies from 60 to 2500 mc. Above 2500 mc. the residual impedances begin to swamp the modulated portion of the diode impedance, the balance becomes difficult to make, and the insertion loss increases rapidly. The photograph shows the r.f. envelope vs. instantaneous modulation voltage (positive to the right, zero in the center, and negative to the left). This characteristic represents balanced-modulator operation, and when sine-wave modulation is applied, two sidebands are generated with the carrier suppressed.

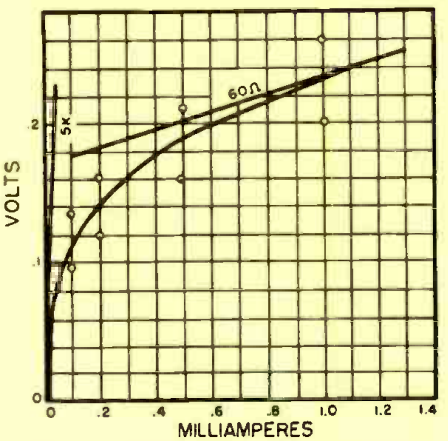


Fig. 5. Typical volt-ampere characteristic of a type 1N21-B crystal diode.

A balanced modulator has desirable characteristics for pulse modulation. Application of a pulse of either polarity will result in an r.f. pulse in the output. The balance can be adjusted without much difficulty to give a carrier suppression between pulses of 60 db below the pulsed level, at all carrier

(*Continued on page* 27)

Fig. 6. Circuit of the Type 1000-P6.

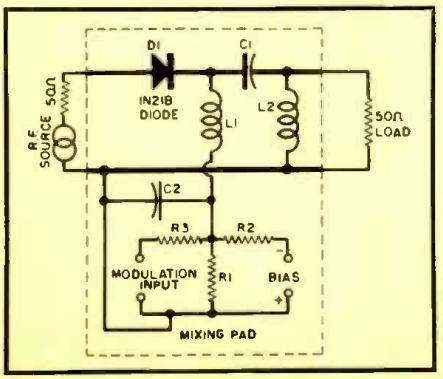
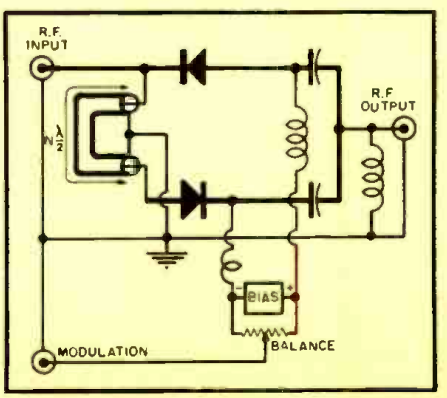
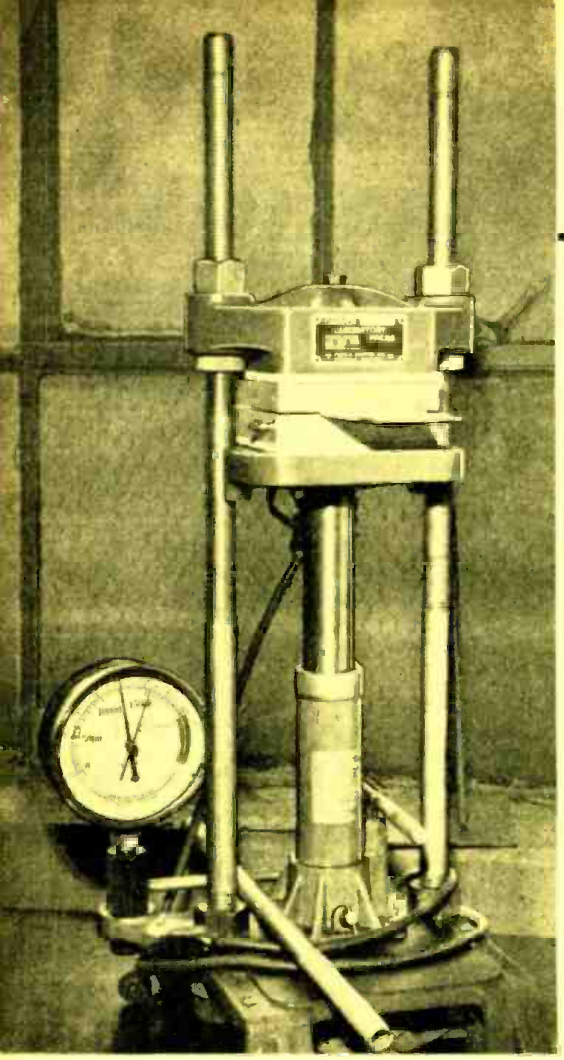


Fig. 7. Circuit of the Type 1000-P7.





Pressing the adhesive tape into contact with the copper plating and stop-off lacquer prior to the stripping operation.

A FLEXIBLE PLATED

This cloth-backed plated circuit, produced by a new technique, is a versatile tool for engineers.

By **E. R. BOWERMAN**

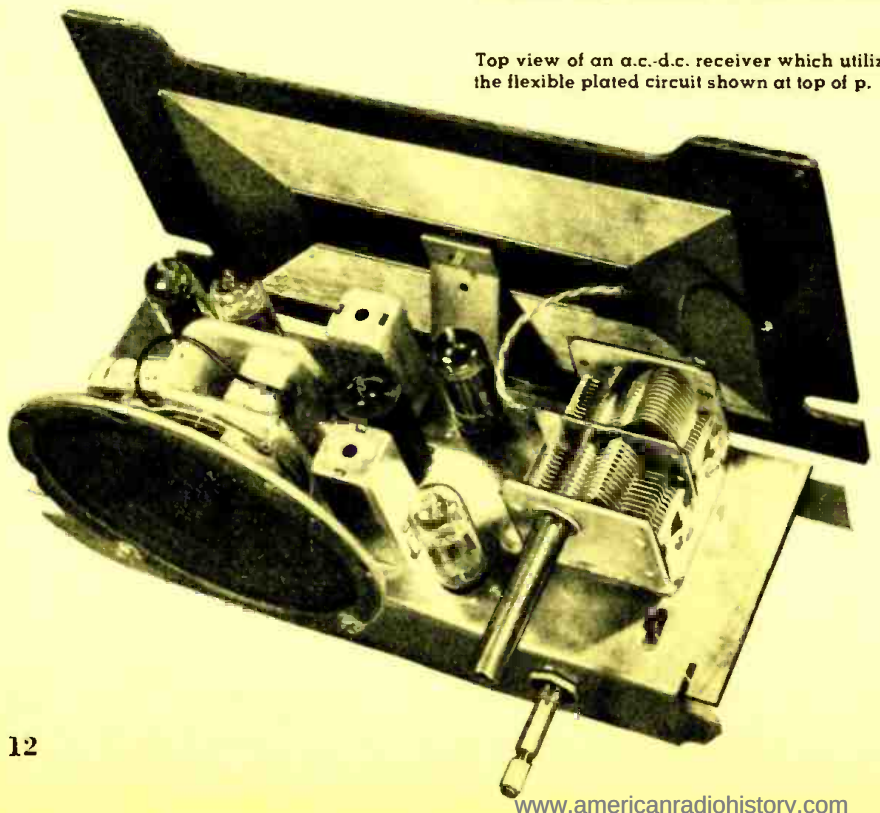
Physics Laboratories
Sylvania Electric Products Inc.

and **R. F. WALTON**

THE FLEXIBLE plated circuit appears to fit nicely into the general methodology of fabrication of electronic equipment. Some of the current forms of printed circuitry are rigid, and this rigidity is made use of in supporting small components. On the other hand, larger equipment is going to be chassis-bound for some time to come. Here, experience has shown that a state of fluctuation exists in individual terminal-to-terminal dimensions and elevations. Individual wires easily take this variation into account, as can pigtailed components. If the circuit is complex, it is not unusual for a number of small components to be subassembled on a terminal board where dip soldering can be used to advantage.

Production of a flexible plated circuit, simply stated, consists of silk screening a stop-off (i.e., an insulating lacquer) onto a stainless steel surface, copper plating the nonstopped-off area, and stripping the plating and stop-off from the stainless steel surface with an adhesive tape. This is illustrated in the flow diagram (Fig. 1), which will serve as an outline of the description to follow.

Type 316 or 347 stainless steel sheet, free from blemishes, flaws and fissures, is chosen because of its resistance to chemical attack in the copper plating solution and because it can be easily maintained in the passive condition necessary for stripping the copper plating. The surface is given a mirror finish by polishing and buffing, and care is exercised in handling to avoid scratches. Surface roughness has a tendency to cause adhesion of copper plating to the steel, possibly by mechanical bonding, since this difficulty is noticed even with properly passivated steel. Individual scratches will be faithfully reproduced in the plating and, if sharp, will have a tendency to cause local mechanical weakness in the copper—probably as the result of a notch effect. After polishing and buffing, the surface is cleaned and passivated by anodic treatment in a conventional hot alkaline steel electrocleaning solution. (A solution suitable for this purpose is *Oakite* #90, manufactured by *Oakite Products, Inc.*)



Top view of an a.c.-d.c. receiver which utilizes the flexible plated circuit shown at top of p. 13.

Silk Screening

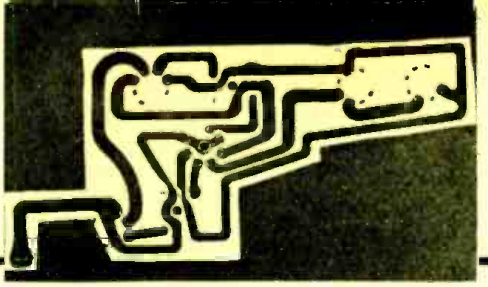
A reversed silk screen is prepared by conventional graphic arts procedure, using a fine mesh wire cloth (140 or 160 U.S. Standard) and a film which is resistant to the stop-off lacquer and thinner. The reversed screen is necessary because of the subsequent reversal when the circuit is stripped from the stainless steel.

The stop-off lacquer is a vinyl copolymer (Unichrome Quick Dry Stop Off Lacquer #324, manufactured by *United Chromium Inc.*). The original solvent is replaced with n-butyl acetate to give a lacquer with 16-20% solids and a viscosity of 200 poises. Care is taken in the screening to avoid holes or discontinuities in the lacquer film other than those of design. The evaporation rate of the solvent is adjusted in a compromise between rapid drying of the screened film and slow drying on the screen.

Electroforming

After the stop-off is dry, the wiring is formed by electroplating between 1 and 3 mils of copper onto the nonstopped-off stainless steel in an acid copper sulfate plating solution. A practical lower thickness limit exists in that deposits thinner than 0.7 mils have a tendency to tear when being stripped from the stainless steel. This is postulated to be due to a lower strength within the copper than in the weak bond between the copper and the stainless steel. An upper thickness limit is

CIRCUIT*



The complete plated circuit as it adheres to adhesive tape backing.

less easily defined, but as the thickness is increased, the flexibility of the copper decreases and the deposit tends to spread along the surface over the stop-off. If the wiring is closely spaced, bridging may occur between wires due to the spreading deposit.

For the circuitry investigated during the development of this process, loss in flexibility gave an upper limit at about 20 mils. The plating solution used for the investigative work contained 250 gms./liter $CuSO_4 \cdot 5H_2O$ and 75 gms./liter H_2SO_4 (sp. gr. 1.83). Before being used, the solution was filtered through activated carbon, and commercial electrolytic cathode copper was used as anode.

In this process, the stopped-off stainless steel is connected as cathode before immersion in the plating solution so that plating starts immediately on the passive surface. The cathode is agitated during plating and a cathode current density of 100 amperes per square foot is used. In 18 minutes, a 1.5-mil deposit is obtained which is suitable for 1/16"-wide wires in receivers having series string heater connections with 150-ma. currents. After plating, the cathode is water-rinsed to remove the plating solution and dried.

Stripping

An industrial cloth-backed adhesive tape is pressed against the copper plating and stop-off with sufficient pressure and time to obtain good contact to the adhesive. The tape and adhered circuit is then stripped from the steel sheet with a rapid, continuous, even pull. The stop-off also transfers and serves to cover the sticky areas of the tape not covered by the copper. (The particular tape used was Permacel EE3012, manufactured by *Industrial Tape Corporation*, compounded with a thermosetting adhesive which could be cured at 250° F before use or allowed to cure in equipment.) After stripping, the tape is trimmed and the required holes punched out. The stainless steel may be reused as long as the surface is maintained smooth, clean and passive.

Installation

The flexible circuit is forced over the fixed component and tie point lugs before the small components are installed. Flexibility of circuit harness speeds up the installation due to the give and take possible in cloth fabrics. Some attention to the design of the lugs will pay off in easing the assembly and reducing the necessity for hole punching to accommodate lugs. On the other hand, if highly detailed work is not being produced, it is also possible to use a loose woven fabric for the adhesive tape backing which will permit the lugs to pierce it easily.

Coding

Since the electroforming of the copper will faithfully reproduce the surface finish of the stainless steel, it is possible to transfer certain types of designs to the copper surface beyond the obvious capabilities of outline identification techniques. Localized texturing of the stainless steel by, for example, shot blasting, etching or engraving, will give a visual coding to the plating. Only rounded and relieved designs may be employed to permit parting after plating. In addition, the deposit may have to be made a little thicker to obtain good strength for the parting operation.

A flexible circuit such as that described above has many advantages over rigid plated circuits. It may be flexed, warped, twisted, or otherwise deformed to accommodate itself to various mechanical designs. With proper precautions, the circuit can even be rolled up in tubular form.

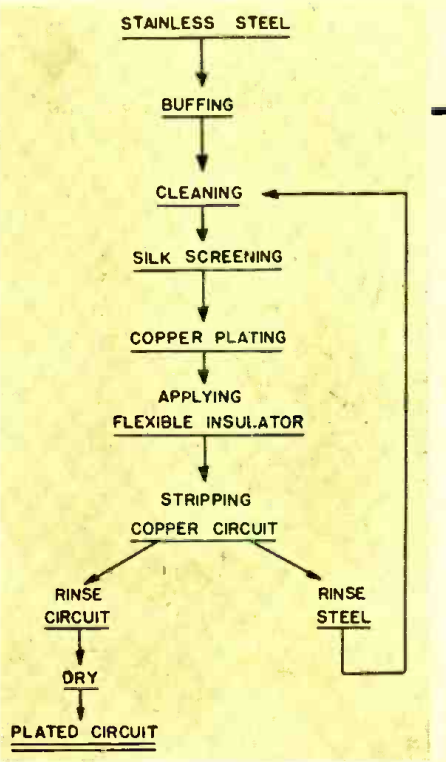
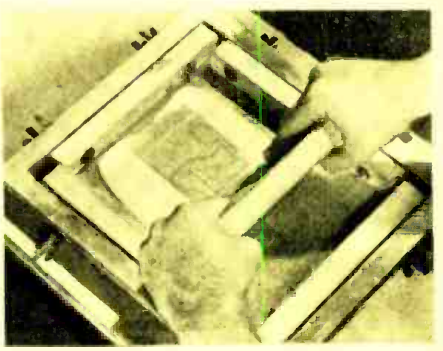
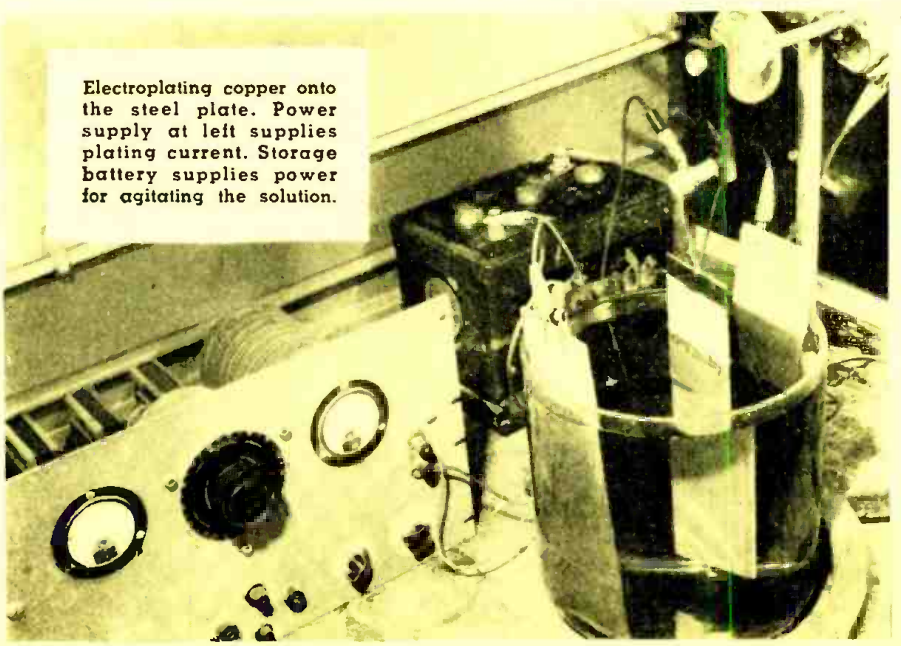


Fig. 1. Flow diagram of process.



Application of the stop-off lacquer through the silk screen stencil.



Electroplating copper onto the steel plate. Power supply at left supplies plating current. Storage battery supplies power for agitating the solution.

*This article is based on a paper which was presented at the 1953 *Airborne Electronics Conference, Dayton, Ohio, May* 11-13.

VISUAL PROOF OF PERFORMANCE MEASUREMENTS

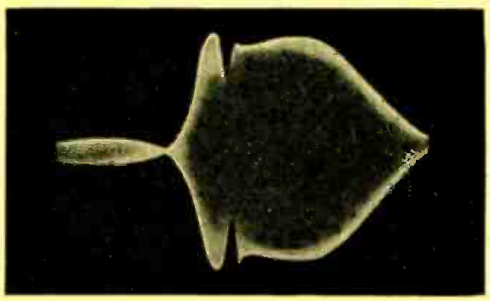


Fig. 1. Display from the Ruston wobbulator[4].

By

R. D. CHIPP, Director of Engineering
Du Mont Television Network

Equipment and techniques used in making visual transmitter measurements to check TV operation.*

SECTIONS 3.46 and 3.254 of the Rules of the Federal Communications Commission require that certain Proof of Performance measurements be made annually by standard AM and FM broadcasting stations. Although there are at present no such specific rules for television broadcasting stations, an initial Proof measurement is required in Form 302, the Application for New Broadcast Station License. Further, annual tests are implicit in Section II of Form 303, Application for Renewal of Broadcast Station License, which calls for the date on which equipment performance measurements have been made, and specifically asks, "Do these measurements show the transmitting system performance to be in accordance with the Standards of Good Engineering Practice?" The Standards of Good Engineering Practice Concerning Television Broadcasting Stations, formerly a separate document, is now a part of the Rules.

Subpart E of Part 3 of the Rules covers the television broadcast service. Section 3.686 of this Subpart describes the requirements for field strength measurements. Section 3.687 covers the measurements of transmitters and associated equipment, and Section 3.689 covers the determination of operating power. The measurements required by these three sections fall naturally into three major categories:

1. Field strength measurements
2. Performance of the aural transmission system
3. Performance of the visual transmission system

Fig. 2. Waveform monitor for measuring significant amplitude levels.

Field Strength Measurements

Field strength measurements may be made in two different ways. Mobile measurements, which involve continuous recording in a vehicle in motion, are preferred by the Commission. As an alternative, cluster or spot measurements may be submitted. Mobile measurements lend themselves readily to statistical analysis inasmuch as there are much more data available for study. However, it is often difficult to find highways that follow the radials used to show the topography in a station's service area. Cluster or spot measurements permit the use of higher receiving antennas, and provide better information for studies of diffraction.

Detailed information on the mobile method is available in the Proof of Performance measurements made by *Du Mont* for Station WTTG in Washington, D. C. Also, the mobile method as used at WEWS in Cleveland has been described by J. B. Epperson[1]. Detailed information on the spot or cluster method is available in the Proof of Performance measurements made by *Du Mont* for Stations WDTV in Pittsburgh and WABD in New York[2].

**This article is based on a paper presented at the 7th Annual NARTB Broadcast Engineering Conference, April 29, 1953, in Los Angeles, Calif.*

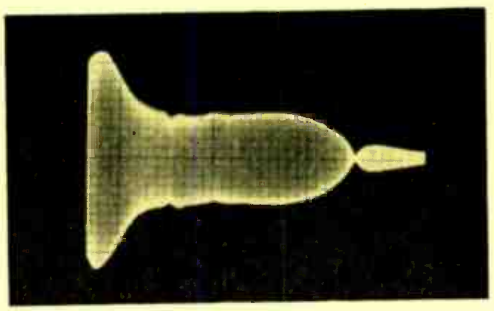


Fig. 3. Attenuation display with 4.5-mc. notch.

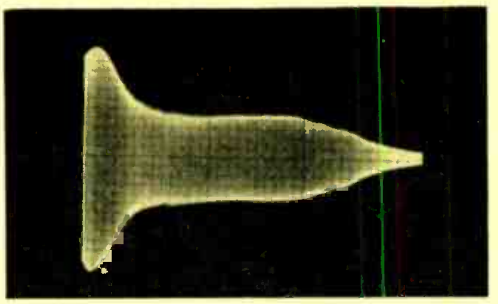


Fig. 4. Same as Fig. 3 without diplexer notch.

Aural Proof of Performance measurements for television stations are equivalent to the aural Proof of Performance measurements required for FM stations. A thorough and complete description of aural Proof of Performance measurements[3] was presented before the NARTB Engineering Conference on April 15, 1950, by George Adair. This has been reprinted and is available through NARTB.

Visual Measurements

This article will discuss techniques and equipment used in making the visual transmitter measurements required by Section 3.687 and the power output measurements required by Section 3.689.

The upper sideband attenuation characteristic may be measured in at least two ways, either of which conforms to the Commission's Rules. The first method utilizes a composite video signal consisting of standard sync and blanking, with sine-wave modulation at selected discrete frequencies occupying the interval between blanking pulses. A typical test setup for such a measurement is shown in Fig. 5A.

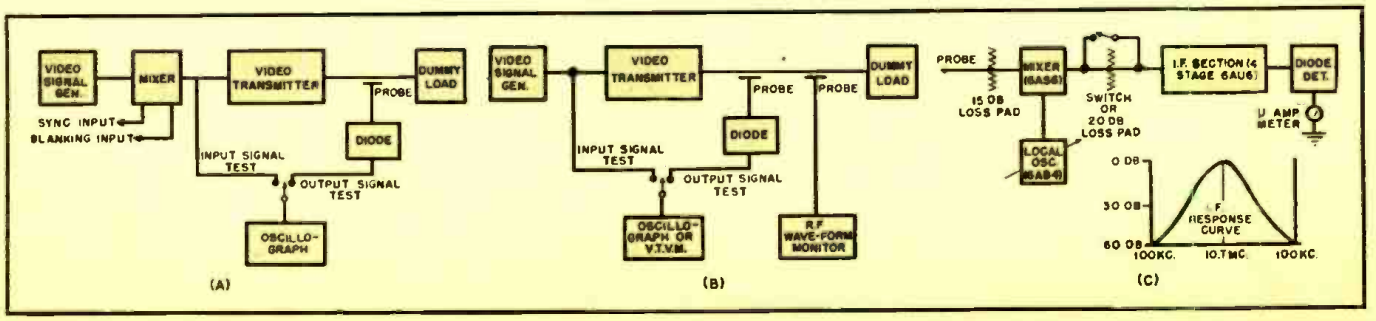
A standard black picture is fed to the dummy load, and the transmitter is adjusted for rated output. Sync and blanking levels are set to normal values with sync equal to 25% of the total modulation envelope. Proper setting may be determined by the r.f. waveform monitor that is usually a part of the station's monitoring equipment. Sine-wave modulation is generated in a video signal generator and is introduced into a line amplifier or stabilizing amplifier, usually included in the station's normal equipment. The axis of the sine-wave modulation is placed at a point equal to 50% of the sync peak amplitude, and video signal generator output at 100 kc. is then adjusted so that the maximum excursion of the sine wave reaches a point equal to 75% of the sync peak amplitude. Thus, in standard level measuring terminology, sine-wave modulation occupies the region between blanking level and 75% of reference white.

Blanking and sync level controls are not altered during the remainder of the test, and the amplitude of the sine wave is maintained within the limits specified. Video signal generator output voltage at 100 kc. is measured by a vacuum-tube voltmeter and recorded on a suitable form. The oscillograph is connected to the transmitter input and vertical gain adjusted to obtain suitable vertical trace deflection, of the order of 2" to 2½" on a 5" scope. Amount of deflection is recorded. The oscillograph is then switched from the transmitter input to the rectified transmitter output, and vertical trace deflection is recorded.

The measurement made at 100 kc. is the reference for the remainder of the test and is noted as 0 db. The oscillograph is now switched back to the transmitter input and the frequency of the signal generator is shifted to 500 kc. Output of the video signal generator is maintained at the value previously recorded, and vertical gain of the oscillograph is adjusted, if necessary, to maintain the deflection previously recorded. The oscillograph is then switched to the transmitter output, and vertical deflection is measured and entered in the appropriate column in the form. The ratio between the deflection at 100 kc. and at 500 kc. is entered in a differential column and converted to db. This test is then repeated at other frequencies; suggested values are 1.25, 1.5, 2, 2.5, 3, 3.5, and 4 mc.

The db differences are plotted on a rectangular coordinate display, similar to that shown in Fig. 7. This plot is the required attenuation characteristic. Figure 7 also shows the FCC ideal curve, as well as the upper and lower limits specified by the RTMA.

Fig. 5. (A) Setup for Proof of Performance measurement. (B) Alternate method. (C) Narrow-band receiver.



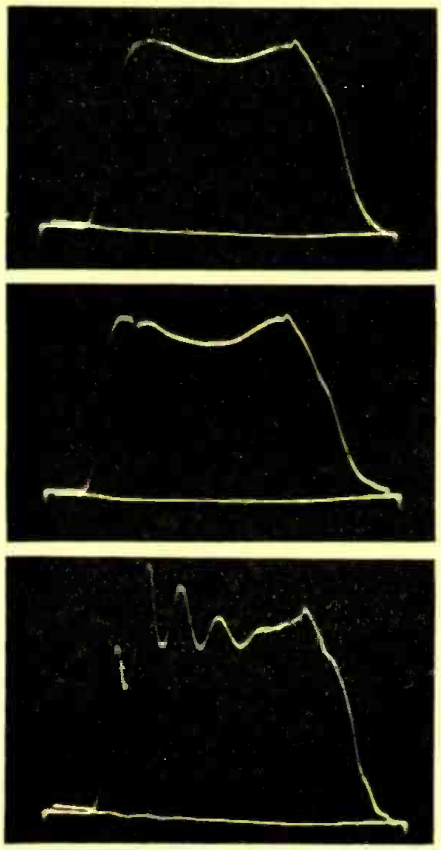


Fig. 6. Transmitter wobbulation curves. (A, top) Output into dummy load. (B, ctr.) Output into normal antenna system. (C, bottom) Output into defective antenna.

The alternate method for measuring the over-all attenuation characteristic involves use of a sine wave without sync and blanking. A typical equipment setup is shown in Fig. 5B. During this measurement, any transmitter clamping circuits must be disabled and the d.c. level set manually for mid-characteristic operation. With the video input at zero, the r.f. drive is adjusted to dissipate rated average power in the dummy load—3 kw. for a 5-kw. peak power. The r.f. waveform monitor is then set so that the peaks are at 77.5% —the average value of voltage equivalent to the rated peak power output. Bias on the modulated stage is adjusted, still with no video modulation, until the r.f. peaks are at 45%; this 45% value represents the operating point and is midway between black level of 75% and white level of 15%. Now the video signal generator is set for 100 kc., and its output is adjusted for modulation peaks of 75% and troughs of 15% on the r.f. waveform monitor. Either a vacuum-tube voltmeter or an oscillograph may be used to measure a rectified sample of the output voltage; this value is recorded and represents 0 db. Output at other modulating frequencies is measured, recorded, converted to db, and may be plotted to give the over-all attenuation characteristic.

Another similar alternate method, which may be used to show the complete spectral response, involves the use of a narrow-band receiver and requires an r.f. signal generator as a calibrating instrument. By means of the r.f. waveform monitor, the transmitter is adjusted in the manner just described and modulated with 100-kc. sine waves. The receiver is tuned to locate either the upper or lower 100-kc. sideband, and meter deflection is noted. The receiver is then switched to the r.f. signal generator, which is tuned to the frequency of the receiver. Output of the signal generator is adjusted so that the receiver meter has the deflection previously noted, and the signal generator ouput at that point is recorded. This process is repeated for other modulating frequencies, and readings are taken of both the upper and lower sidebands. Recorded values of r.f. signal generator output may be converted to db and plotted, using the 100-kc. value as a reference. The curve shown in Fig. 8 is a recent spectral measurement made at WABD, New York; it also indicates transmitter performance with respect to the FCC rule that the lower sideband be 20 db down from the 100-kc. reference at frequencies of 1.25 mc. and higher.

From this complete spectral response, it is possible to derive the ideal demodulated curve, assuming negligible phase shift. This may be done by adding the values plotted for the lower sideband to the values plotted for the upper sideband. Several checks of this method have shown good correlation with the other methods of determining the ideal curve.

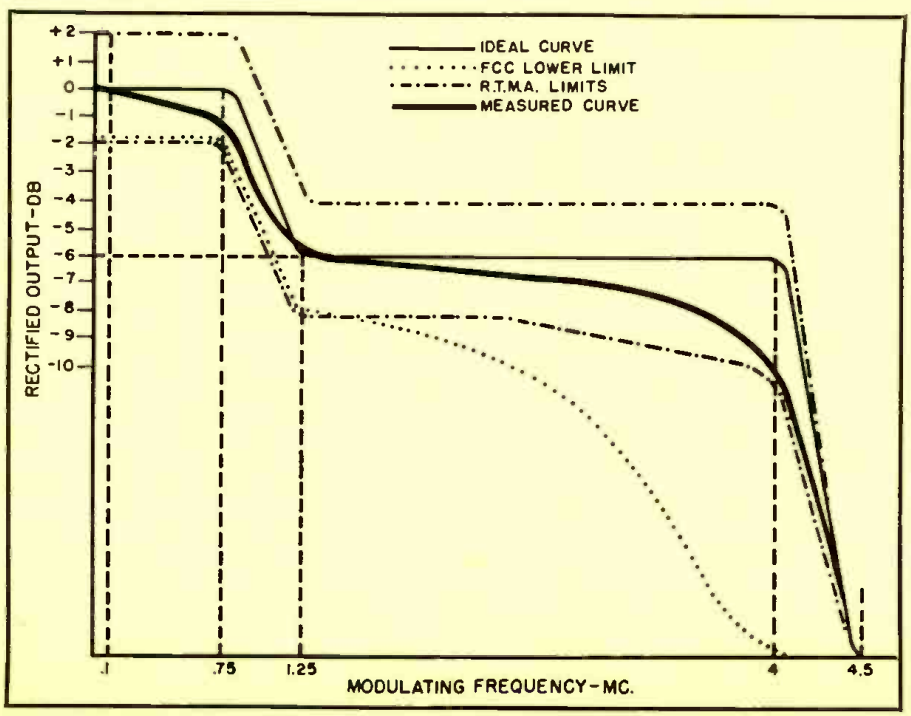
Throughout all of these measurements, it is necessary that power output be held constant. Transmitter power is generally measured by means of a dummy load, sometimes called a phantom antenna. There are two basic types of dummy load. The calorimeter type of load consists of a ceramic tube having a resistive coating which is cooled by a flow of water. The flow of water and its input and output temperatures are recorded. From these data, a simple calculation gives the average power dissipated in the resistor, and multiplication by 1.68 gives the peak power. It is important that sufficient time be allowed to permit temperatures to stabilize before taking readings with this type of load.

The other type of dummy load consists of a terminating resistor immersed in a tank of oil which is cooled by water. A portion of the voltage across the resistor is read by a meter, factory-calibrated by the calorimetric method to register watts. In general, dummy loads used at v.h.f. are accurate to within 5%. The same method of power determination is used at u.h.f., although in this range it is more difficult to be sure that the load does not present some reactive component to the transmission line.

Measuring equipment required for the foregoing tests is in most cases available commercially from several manufacturers and should be included in any station's regular test equipment complement. A vacuum-tube voltmeter, utilized for this type of measure-

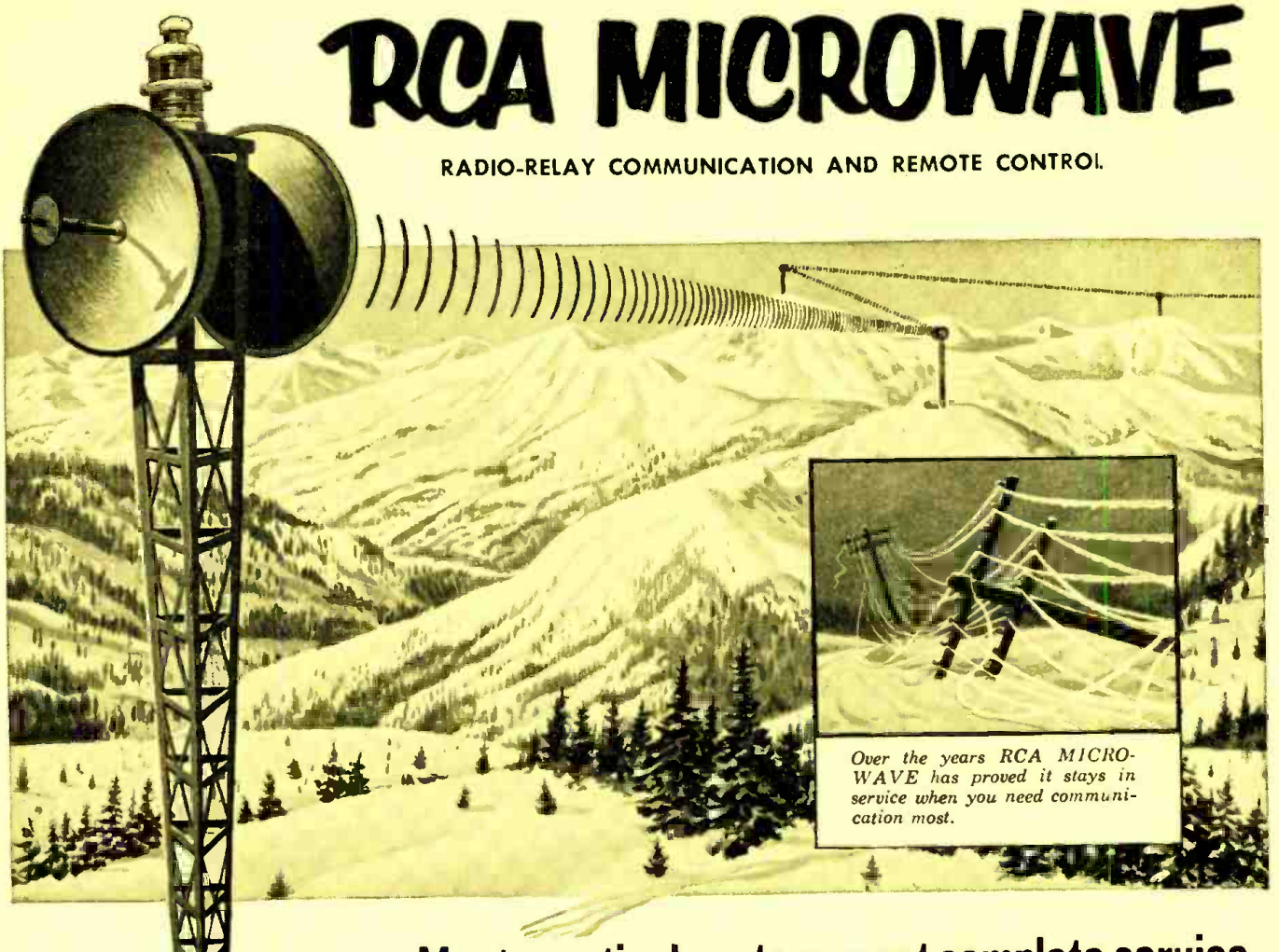
(*Continued on page* 30)

Fig. 7. Over-all attenuation characteristics of the visual transmitter.



RCA MICROWAVE

RADIO-RELAY COMMUNICATION AND REMOTE CONTROL



Over the years RCA MICROWAVE has proved it stays in service when you need communication most.

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NEWS BRIEFS

WIRE TWISTING DEVICE

Twisting the ends of stranded wire is speeded up with a device developed by the production department of the Brooklyn, N. Y., plant of *CBS-Columbia, Inc.*, television set manufacturing subsidiary

of the *Columbia Broadcasting System*. When the stranded wire ends are inserted in a "gripper" mounted on the shaft of a small motor, rotation of the motor shaft quickly twists the strands of wire.

RESEARCH CENTER

Plans for the construction of a functional two-story laboratory and headquarters in Kansas City, Mo., have been revealed by the Midwest Research Institute, technological and research center for middle western states. All operations of the Institute, which now occupies six scattered buildings, will be consolidated in the new structure. Actual construction on this 1¼-million dollar scientific center is expected to start some time in the fall.

ELECTRONICS DIVISION

An electronics division has been established by *Dade Brothers, Inc.* Known as the Engineering and Manufacturing Division, and located at Mineola, N. Y., it is currently engaged in design, development and production in connection with the military program. Elston H. Swanson, formerly on the engineering staff of *Airborne Instruments Laboratory*, is manager of the division.

BINAURAL TRANSMISSION

In an address before the American Institute of Electrical Engineers in June, Murray G. Crosby, President of *Crosby Laboratories*, Hicksville, N. Y., discussed a system of binaural sound transmission by FM multiplex which could result in third-dimension sound for FM and TV audiences.

Mr. Crosby presented a method of applying the two channels of the binaural system in which improved signal-to-noise ratio characteristics are obtained from the subcarrier channel which normally has a poorer signal-to-noise ratio than the main channel. His system also has advantages with respect to balancing the noise received on the main and subcarrier channels, and provides a "compatible" reception for listeners receiving on a monaural system.

RECORDING ANALYTICAL BALANCE

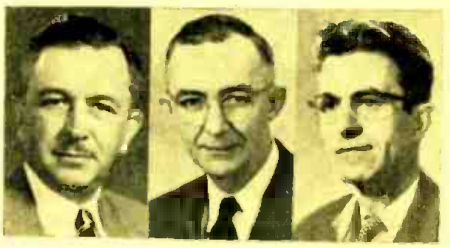
The recording analytical balance recently developed at the National Bureau of Standards automatically makes a continuous record of changes in weight. It is being used at the Bureau to record weight changes in samples of complex minerals during thermal decomposition, but is suitable for many other laboratory applications requiring a record of weight as a function of time.

Any weight change on the left side of the balance is promptly balanced by

automatic application of current to a solenoid that surrounds a permanent bar magnet suspended from the other side. A dual phototube (on top of balance case) senses unbalance in the illumination reflected from a mirror mounted on the balance beam; associated electronic circuitry consists essentially of a bridge circuit and two amplifiers. The current through the solenoid, which varies linearly as the weight being measured, actuates a strip-chart recorder (upper right).

G-E APPOINTMENTS

Three subdepartments have been created within the Commercial and Government Equipment Department of the *General Electric Company* at Syracuse, N. Y., and general managers have been appointed for each. This department is



one of four product units of the *G-E* Electronics Division.

William J. Morlock (shown at right) was named general manager of the Commercial Equipment Subdepartment; he will have responsibility for all engineering, manufacturing and sales activities relating to commercial products of the department. John J. Farrell (center) is the general manager of the Heavy Military Electronic Equipment Subdepartment, and Herman F. Konig (at left) is the general manager of the Light Military Electronic Equipment Subdepartment.

EXPANSION AT AEROVOX

Charged with basic research and engineering development for all divisions of *Aerovox Corporation*, this company's research laboratory continues to expand in facilities and personnel. Since moving into new quarters in *Aerovox* Plant 2 at New Bedford, Mass., the laboratory has increased its space by five times.

Miss Elise Harmon, an outstanding physicist and chemist, now heads the printed circuit development at *Aerovox;* this development has already attained the level of pilot runs in the research laboratory, with actual production items being shipped to radio-electronic manufacturers. Prior to joining *Aerovox*, Miss Harmon was with the Bureau of Standards and the Naval Research Bureau in Washington, D. C.

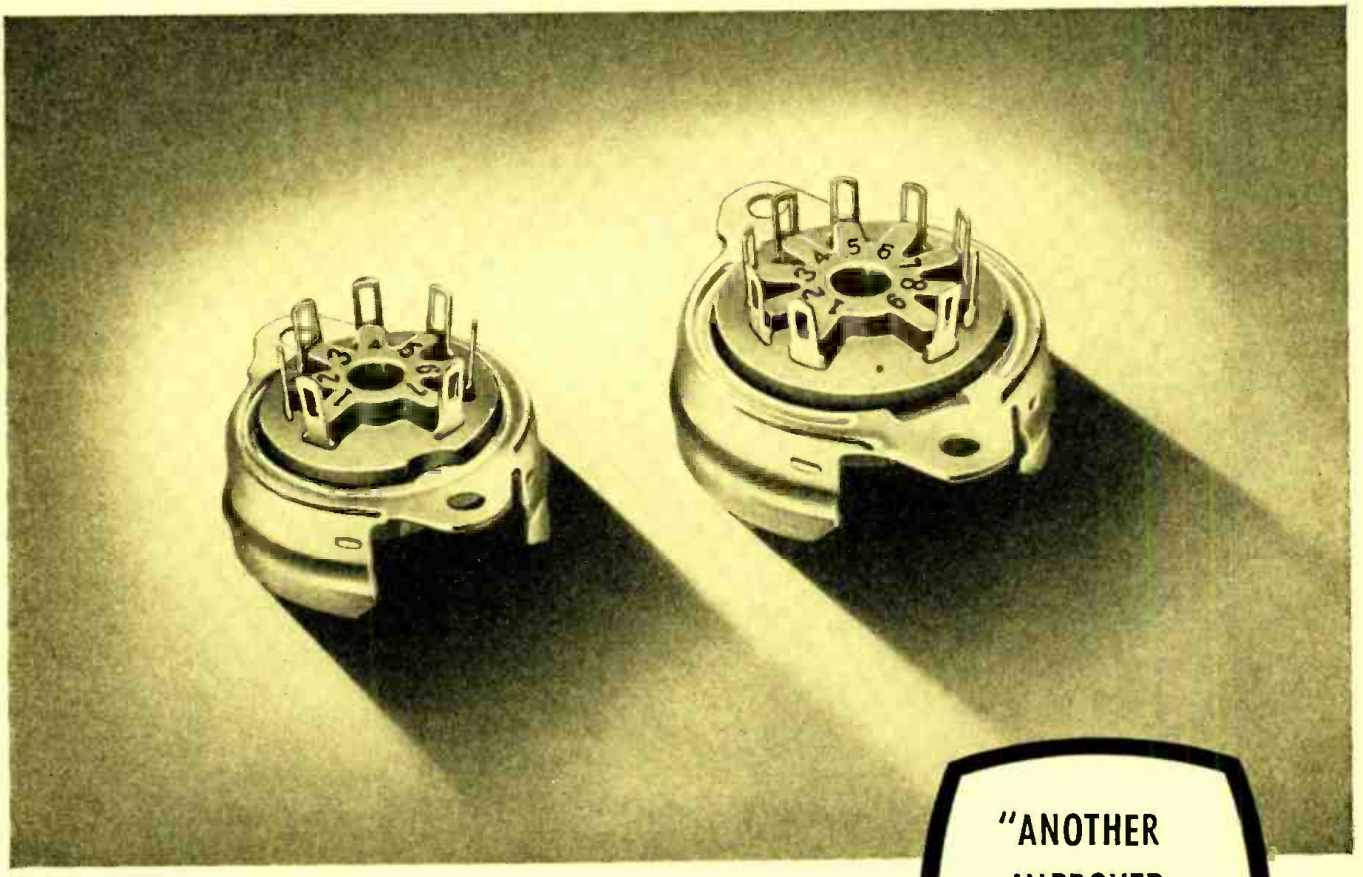
CAPACITOR MANUFACTURING

Cornell-Dubilier Electric Corporation's giant new capacitor manufacturing plant being built at Sanford, N. C., is nearing completion. Production has already begun on paper tubular and electrolytic type capacitors.

Situated on a 27-acre tract, the new plant will have 270,000 square feet of operating space, including a two-story administration building. Facilities are being provided for a potential of some 2900 employees.

Ultra High Quality Sockets

FOR UHF APPLICATIONS



Sylvania now offers you highest quality sockets especially designed for UHF applications. Precision engineered throughout to assure minimum inductance.

Shielded bases and contacts are cadmium plated. Low-loss phenolic castings completely inclose tube pins to prevent shunted circuits.

You'll find it pays to insist on Sylvania ultra high quality parts for all your ultra high frequency requirements. For additional information and specifications, write: Sylvania Electric Products Inc., Dept. 3A-3509, 1740 Broadway, N. Y. 19, N. Y.

SYLVANIA

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

LIGHTING • RADIO • ELECTRONICS • TELEVISION

NEW PRODUCTS

TRANSISTOR CURVE TRACER

Simple to operate, the automatic transistor curve tracer now being produced by *Magnetic Amplifiers Inc.* offers trouble-free circuitry and compact size. It tests NPN, PNP, junction and point-

contact transistors and features flexibility of design to accommodate new types of transistors. For complete specifications, write to *Magnetic Amplifiers Inc.*, 632 Tinton Avenue, New York 55, N. Y.

The curve tracer dynamically plots an entire family of curves simultaneously on a standard laboratory d.c. oscilloscope. A function switch selects the output and transfer curve in the grounded base or grounded emitter connection. Curves are displayed in any quadrant and the origin is always indicated.

POWER SUPPLY UNITS

Two high-voltage power supply units — Models LAB-40 and PN-60 — have been developed by the *Spellman Television Company, Inc.*, 3029 Webster Avenue, New York, N. Y. Detailed information on both of these units is available from the manufacturer.

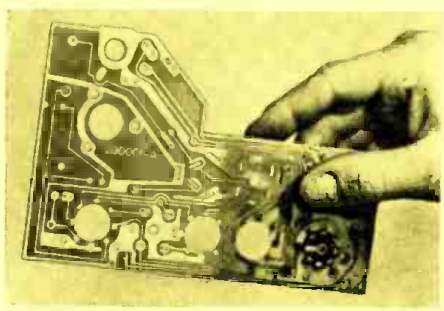
Model LAB-40, which features a continuously variable regulated 25-40 kv.

d.c. power supply, has a 4-6 kv. focus tap for use with flying-spot kinescope recording tubes. This unit has a regulation of 0.5% at 1 ma.

Model PN-60 (shown in the photograph) is ideal for electrostatic paint spraying, capacitor charging and testing. Its reversible polarity r.f. d.c. power supply is continuously variable from 0-60 kv. Current output is 1 ma. at 60 kv.

ACTIVATED ROSIN FLUX

Insulation characteristics comparable to those of polyethylene have been successfully combined with extremely fast "take" in a newly developed rosin flux. Known as Lonco insulating rosin flux, this material is devoid of any free acid and is completely noncorrosive, thus providing (1) the fast fluxing action and smooth, even coating necessary in the dip tinning of printed circuits (see photograph), and (2) elimination of



breakdown due to corrosion in the soldering of delicate u.h.f. components.

In addition, this flux is unusually resistant to high temperatures; its ability to withstand prolonged application of heat enables it to solder through badly oxidized copper surfaces and to solder hard-to-bond metals and alloys. For complete information, write to the *London Chemical Co., Inc.*, Dept. R5, 325 West 32nd Street, Chicago 16, Ill.

TRANSFORMER PANELS

Available in three models, the *SKL* Series 303 transformer panels are designed to be used with the *SKL* Series 300 variable electronic filters when a 600-ohm impedance is required. They can also be used when it is necessary to go from a 10,000-ohm impedance to a 600-ohm impedance. The transformers on each panel are arranged to provide either grounded, "floating," or balanced connections.

Model 303A supplies one 600-ohm output, Model 303B supplies two 600-ohm outputs, and Model 303C supplies two 600-ohm inputs and two 600-ohm outputs. For further information, write *Spencer-Kennedy Laboratories, Inc.*, 186 Massachusetts Avenue, Cambridge 39, Mass.

RADIATION MONITOR

Production of the Model 1310 "Remote Monitron," an area monitor developed at Oak Ridge National Labora-

tory, has been announced by the *Nuclear Instrument and Chemical Corporation*, 229 West Erie Street, Chicago 10, Ill. Consisting of an ion chamber and a main chassis, the system is used for measurement of relatively high gamma or neutron flux around reactors and accelerators.

The 4000-cc. ion chamber may be located either at the main chassis or up to 100 feet away, allowing its use in places of high radiation level without exposure of the operator. Visual indication of gamma or neutron radiation up to 125 mr/hr. is provided by a panel meter; a panel "alarm" light indicates any meter reading arbitrarily preset from 5 to 125 mr/hr.

RANDOM NOISE GENERATOR

The Type 811-A random noise generator announced by *Hermon Hosmer Scott, Inc.*, 385 Putnam Avenue, Cambridge 39, Mass., provides entirely random noise with very good normal or

Gaussian amplitude distribution. It is useful for tests in the design and production of sound apparatus and for calibrating acoustical instruments.

Random noise is generated by gaseous discharge in a 6D4 gas tube. Oscillation at high frequencies is eliminated by a magnetic field. Three noise ranges are provided, with a maximum open circuit output of 2 volts r.m.s. In the r.f. range, a constant spectrum level or

(*Continued on page* 27)

LOOKING at TUBES

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

Picture reproducing tubes for color television.

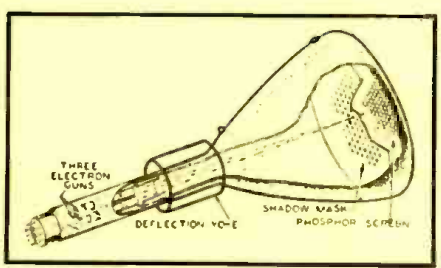
UNTIL quite recently, all devices for reproducing color television could be considered as expedients of one form or another. The assemblies of three picture tubes—using various optical combining methods—have been cumbersome and limited in viewing angle, with image registration quite difficult to obtain, while the use of rotating color discs and drums has somewhat limited the maximum size of the color picture.

Tricolor Requirements

For full color reproduction by electronic control, without the addition of mechanical techniques and complex optical systems, it is desirable to have a single device which—during scanning by preferably only one electron beam—can give any one or a combination of primary colors. With scene brightness controlled by voltage variations on one electrode, it should be possible to change the hue by a change in voltage on another electrode or group of electrodes. In the experimental three-picture tube assemblies described last month, changes in color were controlled by changing the three grid voltages of the three electron guns.

Also, if the light is to be released from a single surface, such as a multiphosphor screen at the face of a picture tube, and yet provide equal resolution in each primary color as well as in white, the electron beam diameter must be smaller than for conventional monochrome picture tubes. This is necessary for any arrangement of color phosphors, whether they are in strips or in clusters of dots.

Television broadcasting will always contain a large percentage of black-and-white programs due to the high percentage of monochrome newsreel and feature films. Therefore, it is important that the tricolor picture tube also give good black-and-white pictures. Some tricolor tubes have been developed which give moderately good color pictures, but reproduce black-and-white pictures with low resolution and with variegated tints over the surface.

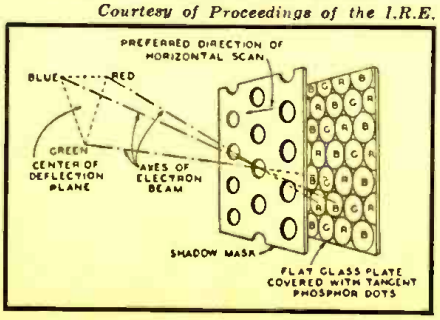


Courtesy of Proceedings of the I.R.E.

Fig. 1. Cut-away view of experimental shadow-mask color kinescope.

Fig. 2. Geometrical relations existing in the color tube shown in Fig. 1.

Courtesy of Proceedings of the I.R.E.



Early Color Tubes

Following his pioneer work in color television with rotating color discs, John L. Baird made possible the first electronic color reproduction by a relatively simple modification of a standard picture tube. The screen was divided into two sections, one half being settled with one color phosphor while the other was coated with a different color phosphor. The single electron gun could scan any portion of the whole surface.

The scanning system was so arranged that—in combination with the blanking signals on the electron gun—it gave two picture rasters side by side. By correct orientation of the yoke, each image was presented in a single color. Then two optical lenses were positioned in front of the images to project and combine the light on a single viewing surface.

This method of multiarea phosphor color reproduction has been tried many times since, usually with three color areas, but it presents several basic problems. First, the images on the picture tube are reduced in area by the square of the number of adjacent pictures; thus reducing the inherent resolution of each image. Then, it is quite difficult to obtain separate images with accurately similar horizontal and vertical dimensions and scanning linearities. Combining the color images by the necessary optical systems requires critical adjustment for registration. Also, the total light on the final surface is low, due to the loss of light in such types of optical systems.

Multielectron Gun Tubes

Much of the development in tricolor picture tubes has been influenced by the interest of certain laboratories in "simultaneous" or parallel color systems; many engineers thought that the reproducing device should be capable of supplying light in each of the three primary colors at the same time.

Various proposals were made which endeavoured to combine the properties of three separate picture tubes into one envelope. John L. Baird demonstrated a three-gun tube in which two electron beams scanned the front surface of a thin corrugated translucent structure while the third beam scanned the opposite side. The alternate faces of the ridged surface were coated with green and blue phosphor. Thus, one electron beam scanned the green section, the second excited the blue section, and the third beam—on the opposite side—produced light in the red region.

The next proposal was to use a screen made of a great number of small pyramid-shaped pieces. These three-sided pyramids were all oriented in the same direction, with the corresponding face of each coated with one color phosphor. The tube assembly had three electron guns displaced in three necks at approximately 120°, so that each electron beam would scan as closely as possible the same face of each pyramid.

Both of the latter types presented fundamental operating problems. Since the electron beams arrived at the same picture element from different angles, each deflection yoke required special waveforms for both the horizontal and vertical scans. Registration of three images formed on three similar picture tubes is sufficiently difficult; here the waveforms had to be different and yet be very precisely maintained. Also, it was difficult to avoid interaction between the fields of the three yokes.

As a further step in using three electron guns, yet avoiding three separate deflection yokes with the many associated waveforms, a "mask" type tube was developed as shown in Fig. 1. The three electron guns were equispaced around a common axis. Each of the three guns had a similar small tilt angle so that, with no extraneous field present, the three electron beams would coincide as closely as possible near the center of the tube face.

Toward the face of the tube there was a thin sheet of metal having a very large number of small holes. Parallel to this aperture mask was a glass sheet covered with clusters of three phosphor dots, one each for red, green and blue. As may be seen in Fig. 2, it was necessary that there be as many groups of phosphor dots as there were holes in the mask, and that they be accurately positioned to conform with the increasing scanning angle toward the edges of the screen. In this method of reproduction each electron beam passed through an aperture in the mask at a different angle from each of the other two beams, and could therefore excite the correct one of the three phosphor dots.

Since the electron guns were closely spaced, only electrostatic focusing could be used, requiring very careful electrode design. The large gun assembly required correspondingly larger neck and yoke diameters and increased power for deflection. Also, several fundamental problems existed. Since the three beams were displaced in volume at the entrance to the deflection yoke, they would disperse as the scanning angle was increased from the center of the tube. Hence, special deflection yokes, together with auxiliary convergence and "color purification" coils and small correction magnets, were necessary around the neck of the tube in order to provide some compensation. Any variation in second anode voltage required corresponding corrections in the currents through these various coils.

Setting up such a three-gun mask tube required quite critical adjustment of convergence voltages and coil currents, and alignment of the small magnets. This may be clearly realized when the small change in magnetic field necessary to shift one electron beam by one hole spacing is considered. Since the maximum field at the top or bottom of the vertical scan of the picture was only a few hundred gauss, an error in adjustment of one-fifth gauss could cause misregistration of the three electron beams. It might be noted that this field change is much less than that of the earth's magnetic field.

Despite the use of three electron guns, the light output was limited. The small apertures allowed only 10 to 15 % of the electrons to be useful in producing light, the remainder being collected by the mask. Also, there was a practical limit to the maximum scanning angle; if this limit were exceeded, color control would be lost at the edges of the picture. The scanning angle limit caused this type of tricolor tube to be about 1.8 times the length of a typical monochrome picture tube having the same useful picture area.

Personals

RODNEY D. CHIPP, director of engineering for the *Du Mont Television Network*, has been elected president of the Technical Societies Council of New York, Inc.; he served as director and treasurer during the past year. Associated with broadcasting since 1933, Mr. Chipp has been with *Du Mont* in his present capacity since 1948. He was the 1950-1951 chairman of the New York Section of the IRE and is a member of many other technical societies.

DR. WILLARD GEER, who invented one of the three recognized tubes in color television and is a patent holder of several other developments in the field, has been appointed a consultant on color in TV and military applications at the *Hoffman Radio Corporation* and *Hoffman Laboratories, Inc.*, Los Angeles, Calif. Dr. Geer is currently associate professor of physics at the University of Southern California and has been a faculty member there since 1943.

LEO G. KILLIAN has been appointed director of technical publications for *The Cook Research Laboratories*, a division of *Cook Electric Company*, Chicago, Ill.; he has been in charge of the preparation of technical reports, over-all project liaison and contract coordination since 1947. Holder of an M.S. degree in electrical engineering, Mr. Killian's past experience includes design, research and development work in the fields of radio, sound and electronics.

GORDON C. KNIGHT is the new manager of the Lodi, N. J., Television Transmitter Division of *Federal Telecommunication Laboratories, Inc.*, research associate of *IT&T*. Assistant to the president of *IT&T* since last August, Mr. Knight will now be responsible for the development and production of the Division's complete television line. He was formerly associated with the *Capehart-Farnsworth Corporation* in various capacities.

JOHN M. PEARCE, former president of *Phebco, Inc.*, has joined the Electronics Division of *American Machine & Foundry Company* in Boston, Mass., as director of engineering. Active in radio and electronics since 1925, Mr. Pearce received the Presidential Citation of Merit for his contribution to the proximity fuse program at Johns Hopkins University during World War II. He was engaged in the development of guided missiles for many years.

W. WALTER WATTS has been elected a director of *Hydrocap Eastern Inc.*, Philadelphia, Pa., a subsidiary of *Industrial Research Inc.* of Miami, which specializes in newly developed catalyst storage battery caps. Col. Watts (U. S. Army Signal Corps) just recently was made vice-president in charge of technical products of the *RCA Victor Division*; his earlier associations were with *Montgomery Ward, Inc.*, and *Zenith Radio Corporation*.

Transistor Characteristics

(*Continued from page* 9)

Figures 12 through 26 (except Fig. 20) are distributions of performance for the CK721 and CK722 in the three amplifier connections. Units below the tentative limits shown on previous curves have been eliminated.

The input impedance of the CK721 in the grounded emitter circuit for two values of load is given in Fig. 12; Fig. 13 is the output impedance for two values of R_g. It may be seen that increasing the load resistance lowers the input resistance. Similarly, raising the generator resistance lowers the output resistance. In the grounded base circuit, the opposite is true. Figures 14 and 15 show the same data for CK722.

Relative gain distribution of the CK721 and CK722 in the grounded emitter circuit for one load and generator condition is given in Fig. 21. Gain as used here is defined as the output power delivered to the indicated load divided by the available power from the generator. In the grounded emitter connection, because gain is strongly dependent on $1/(1-\alpha)$, the CK721 is appreciably better than the CK722. Of course, the generator and load conditions favor the CK721, but it takes almost a 3:1 mismatch to cause a 1-db loss in power; so, to a certain extent, the mismatch is not serious.

Presented in Figs. 16 and 17 are the grounded base input and output resistances (CK722) for two values of R_L and R_g. 100K has been used as a load resistance—although the matched condition indicates a higher value—in deference to the fact that 100K is a more practical limiting value for the small transformers used in transistor circuits. Figures 18 and 19 show the same data for the CK721 and Figs. 22 and 23 compare the grounded base gain of the two types for two values of R_L. Note that the gain of the CK721 and CK722 under these conditions is quite comparable, and although the gain is less than that of the grounded emitter connection, the variation in gain is markedly reduced. (The average gain of the CK721 in the grounded emitter connection was about 38 db with a variation of 16 db while in Fig. 23, where $R_L = 20K$, it centers at about 26 db with only a 7-db variation.) The reduction in variability when the grounded base circuit is used is, of course, due to the fact that the alpha variation is small and that the gain, particularly under conditions of mismatch, tends to be more a function of R_g and R_L than of the transistor parameters.

Figure 24 is for the grounded collector circuit and shows output impedance of the CK721 and CK722 for

a generator resistance of 500K, while Fig. 25 shows input impedance for a load of 20K. In the interest of high input resistance, it is desirable to use a very high load resistance; unfortunately, the opposite is true if optimum gain is to be realized. A 20K load has been used here to hold up the gain, and it is, of course, more typical of what can be done with small transformers. Ordinarily, the grounded collector connection is preferred because it can provide high input resistance in an amplifier without the use of transformers. As the input resistance is a function of R_e and $1/(1-\alpha)$, it is desirable to operate with very high R_e —which, as has already been demonstrated, can be obtained at lower collector currents than 2 ma. without appreciable loss of alpha level.

Gain distributions for the grounded collector connection of the CK722 and CK721 are given in Fig. 26. The CK722 is obviously not recommended for this connection. Gain variability in this circuit is similar to that in the grounded emitter circuit.

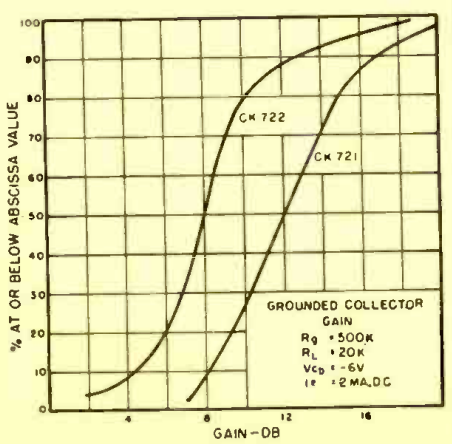
The foregoing analysis may be summarized as follows:

1. Presently available transistors are quite variable in characteristics, and although more is being learned daily about control, units must still be selected after manufacture.
2. Some form of d.c. compensation is almost mandatory to control operating points.
3. Although the highest gains are available using the grounded emitter amplifier connection, the spread of gain in the grounded base amplifier is less.
4. Designers of transistor amplifiers for production purposes would do well to sacrifice appreciable stage gain by suitable feedback in order to reduce unit-to-unit variability.

REFERENCE:

1. *Shea, R. F., "Transistor Operation—Stabilization of Operating Points," Proceedings of the IRE, November, 1952.*

Fig. 26



NEW LITERATURE

RESISTORS AND VARISTORS

Comprehensive data on two *IRC* products have been offered by the *International Resistance Company*, 401 N. Broad Street, Philadelphia 8, Pa.

Tubular and flat power wire-wound resistors are discussed in Catalog Bulletin C-1, a 12-page bulletin with photographs, detailed charts and graphs. Topics covered are adjustable features, brackets, characteristics, coating, dimensions, derating, insulation, specifications, tolerances and windings.

Catalog Bulletin SR-3 (available from the Special Products Division) is a six-page bulletin on varistors. Data on these nonlinear resistors include voltage-current characteristics, current ratings, temperature characteristics, typical applications and dimensions.

CAPACITORS

Bulletin AB-20A contains complete performance characteristics and test specifications on the new "Blue-Point" molded plastic capacitors (patent pending.) It is available from *Astron Corporation*, 255 Grant Avenue, East Newark, N. J.

These capacitors are housed in molded plastic cases and are permanently sealed against heat and moisture by means of a solid, glass-like, thermosetting bond which also locks in the leads so that they cannot be pulled out. Neither lead, bond nor case is affected by flame or soldering iron heat, regardless of how closely they may be applied.

HIGH VACUUM PUMPS

F. J. Stokes Machine Company has issued an extensively revised edition of the 36-page catalog entitled "Stokes Microvac Pumps for High Vacuum." Known as Catalog No. 750, it includes: valuable tables of formulas, constants, and conversions frequently used in vacuum processing; solutions to problems of pump selection for typical vacuum systems; and useful information on continuous oil purification and other maintenance procedures for high vacuum pumps.

Copies of Catalog No. 750 may be obtained free on request to *F. J. Stokes Machine Company*, 5500 Tabor Road, Philadelphia 20, Pa.

CAPACITY MICROPHONE

In a four-page brochure, *International Research Associates*, 222 Warwick Avenue, Santa Monica, Calif., describes and illustrates the Model D-42 capacity type microphone. Small, sensitive and extremely linear, yet rugged enough to withstand shocks up to 200*G*, the Model D-42 is suitable for such applications as aircraft vibration detection, naval and medical research, and seismographic surveys. It reproduces acoustic levels in excess of 170 dbm and has a flat response from d.c. to 12.5 kc.

MODIFIED POLYSTYRENES

Characteristics and applications of *Koppers* modified polystyrenes are discussed in a 14-page technical bulletin which has been published by the Chemical Division of *Koppers Company, Inc.* Of the seven types of this thermoplastic material covered, four provide high elongation and high impact resistance while three provide medium elongation and medium impact resistance.

Information on parts manufacture, injection molding, compression molding, extrusion and finishing is presented in Technical Bulletin C-3-161, which may be obtained on request from *Koppers Company, Inc.*, Chemical Division, Koppers Building, Pittsburgh 19, Pa.

MICROWAVE EQUIPMENT

A new line of microwave instruments and components is set forth in a four-page bulletin now available from Narda, *Nassau Research & Development Associates, Inc.*, 66 Main Street, Mineola, N. Y. Frequency meters, mixers, impedance meters, attenuators and other microwave equipment are listed.

SHOCK MACHINE

The Type 150-400 VD shock machine is designed to perform calibrated shock tests up to 77*G* peak acceleration, simulate the types of shock required for Government acceptance tests of airborne equipment, and carry out uniformly reproducible qualification tests for development engineering and quality control.

Barry Product Bulletin 533 gives detailed dimensions and construction features of this machine, operation and installation instructions, and calibrated performance data covering range of operation. It is available on request from *The Barry Corporation*, 870 Pleasant Street, Watertown 72, Mass.

CONTROL CENTERS

Federal Electric Products Company, 50 Paris Street, Newark 5, N. J., has issued a booklet on its "Noark" control centers. Each control assembly consists of a standardized, prefabricated steel enclosure, 20" x 20" x 94", in which are mounted *Federal* "Noark" motor starters of any required NEMA size, together with circuit breaker disconnect.

Besides listing specifications and enclosure sizes, the 16-page leaflet emphasizes the advantages of centralized control in a plant, describes exclusive features of these control centers, and shows photographic examples of typical installations.

FLEXIBLE DELAY LINES

A single-page bulletin has been released by *Richard D. Brew & Company, Inc.*, 106 Concord Avenue, Belmont 78, Mass., which describes and gives specifications for two types of flexible delay lines.

Type "A" lines are short lines in hermetically sealed stick form, with delays ranging from .1 μsec. minimum to 3 μsec. maximum; Type "B" lines are longer, in hermetically sealed cans, with delays ranging from 2 to 10 μsec. Both are guaranteed to conform to delay specifications within ± .05 μsec.

New Products

(*Continued from page* 20)

flat frequency response exists to 1 mc., with the response sloping off thereafter at approximately 12 db per octave.

VARIABLE INDUCTOR

Improved stability is made possible through the use of a permanent-magnet bias in the Model PA-63 *Vari-L* variable inductor. In many FM and sweep applications, this feature eliminates the problem of assuring a well-regulated supply of d.c. to the control winding. The entire unit operates at a lower temperature, at high frequencies and high *Q*, without the constant presence of high saturating currents. Its sensitivity is shown by the fact that control-current changes of the

order of 0—10 ma. will accomplish inductance changes of several hundred per cent.

Described as a manually variable, high frequency, saturable-core reactor, the Model PA-63 also features provision for manual tuning—when desired—by movement of a metal slug to shunt the magnet bias. Complete details may be obtained from *The Vari-L Company, Inc.*, P. O. Box 1433, Stamford, Conn.

PHASE MONITOR

The *Andrew* Type 40-C phase monitor is a direct-reading phase-measuring instrument designed to facilitate adjustment and maintenance of broadcast directional antenna arrays. Phase angles are indicated directly in degrees on a single meter, permitting immediate observation of the effects of small antenna system adjustments. Relative amplitude of antenna currents can be quickly and accurately determined, the ratio appearing on a special current ratio scale on the indicating meter.

Available from the *Andrew Corporation*, 363 East 75th Street, Chicago 19, Ill., the Type 40-C contains no calibrated phase-shifting circuits which might become misadjusted. Six individual input circuits accommodate directional systems utilizing as many as six towers; front panel switching permits rapid selection of any two input signals for comparison.

Balanced Modulator

(*Continued from page* 11)

frequencies within the range of 60 to 2500 mc. For ordinary amplitude modulation, the bias balance can be offset to insert the desired amount of carrier, and 100% linear modulation obtained.

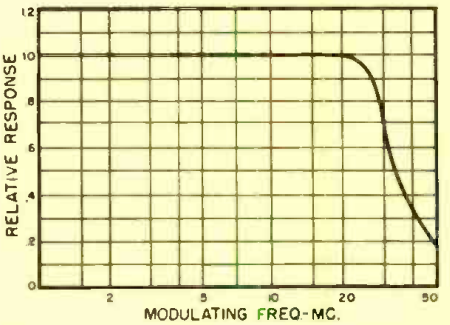
Response vs. modulation frequency of the Type 1000-P7 is given in Fig. 8. The simplicity of the circuit makes it relatively easy to achieve a response flat to 20 mc.

Figure 2B is a photograph of an r.f. output pulse at a 60-mc. carrier frequency. The applied pulse also shown was 0.2 μsec. long and had a 50-millimicrosecond rise time and about a 100-millimicrosecond fall time; it was faithfully reproduced in the r.f. envelope. The balanced modulator itself has a rise time of better than 20 millimicroseconds.

The setup that produced the pulse shown in Fig. 2B consists of a v.h.f. signal generator supplying the 60-mc. carrier, the balanced modulator, and a pulser with its own power supply. A flexible cable provides an extension of the phasing line. The trombone section alone is suitable for 400 to 2500 mc., and flexible cable extensions are used at the lower carrier frequencies where the adjustable line alone has insufficient range.

Modulation characteristics of the balanced modulator are independent of signal level below 50-mv. input. Higher signal levels shift the operating points of the diodes and offset the balance. Operation at higher levels is possible if balance is set for each level. The Type 1000-P7 modulator is made to work with a generator of 50-ohms output impedance and into a 50-ohm load. Under these conditions and with a generator voltage of 50 mv., 10-mv. output on modulation peaks for linear amplitude or pulse modulation can be obtained.

Fig. 8. Modulating frequency characteristic of the Type 1000-P7 modulator.



NEW TUBES

DECADE COUNTER TUBE

The "Vidicount-E1T" is a specially designed decade counter tube, based on cathode-ray tube principles, which has the dimensions of a radio receiving tube. Just announced by *Amperex Electronic Corporation*, 230 Duffy Avenue, Hicksville, L. I., N. Y., it makes possible the elimination of a number of tubes and components in decade circuits as well as a considerable reduction in power requirements.

According to the number of counting pulses applied, the ribbon-shaped electron beam of the tube passes through ten apertures of a cylindrical anode,

thus impinging on a fluorescent screen lining the envelope. Rectangular, luminescent spots corresponding to the number of pulses are read on the outside of the tube envelope opposite the figures from 0 to 9. As the last position is passed, the beam automatically resets to its zero position and a counting pulse is simultaneously applied to the following tube. With several such tubes in cascade, any number can be read directly.

SMALL-AREA JUNCTION DIODES

A line of small-area junction diodes has been announced by the Transistor Division of the *National Union Radio Corporation*, Hatboro, Pa. The three types currently available include: 1N106—a high back-voltage diode, 1N107—a high forward-current diode, and 1N108—a general-purpose unit.

Of extremely small size, the "Union" diodes have relatively high dissipation ratings and ratios of back-to-forward resistance an order of magnitude greater than those obtainable in conventional point-contact diodes. Use of the small-area junction results in rapid switching action and good high-frequency characteristics. In addition, these diodes are capable of withstanding high temperature-humidity ambient conditions.

TEMPERATURE-LIMITED DIODES

Complete specifications for six temperature-limited diodes having a stable emission characteristic are given in a four-page folder published by *Thermosen, Inc.* Three of the tubes incorporate a safety feature by which filament failure closes an external high-impedance circuit.

Copies of the folder, which includes illustrations of all the tubes, electrical and mechanical specifications, basing diagrams and basing designations, may be obtained by writing directly to *Thermosen, Inc.*, 361 West Main Street, Stamford, Conn.

SUBMINIATURE RECEIVING TUBES

Particularly suitable for military use, Types GL-6111 and GL-6112 subminiature receiving tubes are the latest additions to the *G-E* "Five-Star" line of high reliability tubes. Complete details on these tubes, both of which are designated for service under severe mechanical shock and vibration conditions and high ambient temperature, are available from the *General Electric* Tube Department, Schenectady 5, N. Y.

The GL-6111 is a medium-mu twin triode designed for use in general-purpose amplifier applications. Each section has an individual cathode and is electrically independent. This tube may also be used as a combined oscillator and mixer in high-frequency circuits.

The GL-6112 is a high-mu twin triode suitable for use as an a.f. voltage amplifier or phase inverter. As a result of its low microphonic characteristics, the GL-6112 can be employed at relatively low signal levels.

SILICON DIODES

Eleven silicon diodes for microwave and video use are described in a four-page brochure available from *Microwave Associates, Inc.*, 22 Cummington Street, Boston, Mass. Designated as Catalog 53S, the brochure contains distribution charts and tables on diodes for use from 10 cm. to less than 1 cm. Special mention is made of new low-noise, uniform-impedance characteristic detectors for radar and the microwave relay frequencies.

R.F. Power Measurements

(*Continued from page 6*)

to its proper length by first determining the exact frequency of the power source being used and then adjusting the length of the transformer accordingly.

The insulated quarter-wave transformer is thermally calibrated, and a test made of the effectiveness of the insulation, by using the braid of a coaxial cable or the metallic surface of other components as a reference. The braid temperature of a cable, the surface temperature of a connector, or any reference temperature other than the center conductor temperature is directly proportional to the center conductor temperature at any given power level after steady state conditions have been attained. Therefore, if this reference temperature in the vicinity of the quarter-wave transformer remains constant before and after the transformer insertion, the center conductor temperature also remains constant, and the insertion of the insulated transformer does not affect the true center conductor temperature.

A series of tests, in which the center conductor temperature of polyethylene and Teflon dielectric coaxial cables was measured, confirmed the above analysis.

Measurements were made at various power input levels and the reference temperatures measured. The insulated quarter-wave transformer was then inserted into the cable between the reference thermocouples, and the measurements of the reference temperatures were repeated at the various input power levels. Results of measurements made with an RG-9/U (polyethylene dielectric) and RG-87A/U coaxial cable (Teflon dielectric) are presented in Fig. 6. The reference temperatures before and after insertion at the same power level remained constant, indicating that the center conductor temperature also remained constant. The insulated transformer, therefore, did not affect the heat flow characteristics of the component into which it was inserted.

Since the quarter-wave transformer measures center conductor or—more generally—internal temperatures of r.f. components, it may also be calibrated as an input or through power meter by means of the calorimeter. The center conductor temperature rise at various power levels may be calibrated as a function of input power. A quarter-wave transformer, similar to Type B of Fig. 4, may be readily utilized with an air dielectric and rigid outer tube for use as a power indicator.

Applications

The calorimetric water load and the quarter-wave temperature indicator were successfully utilized in power rating tests of high temperature Teflon and liquid dielectric coaxial cables recently developed for use in airborne installations at elevated temperatures. Although in the measurement of the power-handling capacities of coaxial cables it is necessary to measure surface and environment temperatures accurately in addition to input power, output power, (if attenuation data is required), and center conductor temperatures, this discussion is primarily concerned with the power and center conductor measurements.

Briefly, the cable to be power-rated was connected to a high power source (a *General Electric* magnetron heater capable of delivering up to 5000 watts at a frequency of 915 mc.) and terminated by the calibrated calorimeter. A quarter-wave transformer was inserted into the cable at the point of maximum center conductor temperature (determined by preliminary surface temperature measurements) to give maximum center conductor temperatures at the various input power levels.

The quarter-wave transformer, the magnetron output meter, a high power slotted line with susceptance stub, or an r.f. wattmeter can be utilized to measure input power when accurately calibrated with the calorimetric water load. Obviously, the most easily adapted procedure for this investigation was the use of the magnetron output meter, the sensitivity of which was increased by means of a resistor network. It was conveniently calibrated by attaching the calorimetric water load directly to the magnetron heater output. The calibration curves are shown in Fig. 7; the output meter indications for various power levels and sensitivities are obtained as a function of the cooling water temperature difference. These curves may then be combined with the calorimeter calibration curves of Fig. 5 to obtain the final working curve of the magnetron meter indication vs. the true r.f. power values shown in Fig 8. Thus, the power input may be obtained by inserting the coaxial cable between the calorimeter and the magnetron, and reading the values directly. Use of the calorimeter for measuring output power may be eliminated by calibration of the r.f. wattmeter, which may be attached to the calorimeter and used in the same way as the output meter of the magnetron heater.

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TECHNICAL BOOKS

"ELECTRON OPTICS" by O. Klemperer, Ph. D. Second Edition. Published by *Cambridge University Press;* American Branch, 32 East 57th Street, New York 22, N. Y. 471 pages. $9.50.

One of the Cambridge Monographs on Physics, this book gives a concise account of the most important principles, methods and applications of geometrical electron optics. Expanded to six times its original size, the present edition is intended to introduce the student to a specialized subject and to present the research worker or the designer of electron optical gear with essential information on the subject. An extensive bibliography is included as a guide to the literature; it lists some 500 papers.

The first five chapters give an outline of principles and facts about electron lenses. Lens errors are then discussed from an essentially experimental point of view. Following chapters discuss space charge and electron optics, emission systems, electron lenses and emission systems with line focus, and deflecting fields. Finally, a short survey is made of important applications of electron optics in both industry and research.

"DESIGN FOR A BRAIN" by W. Ross Ashby. Published by *John Wiley & Sons, Inc.*, 440 Fourth Avenue, New York 16, N. Y. 260 pages. $6.00.

How does the brain produce adaptive behavior? "Design for a Brain" attempts to solve the origin of the nervous system's unique ability to do this, yet be mechanistic in nature.

Starting with first principles, requiring no specialized knowledge on the part of the reader, the book clarifies and relates various physical and psychological concepts, and shows how the problem can be stated with both generality and precision. It then develops the solution—the principle of ultrastability—which is defined and described in Chapter 8. The next two chapters apply this principle to the nervous system and show how it explains the organism's basic power of adaptation. The remainder of the book studies its developments.

Nonmathematical and complete in itself, the main account is given in Chapters 1-18. The appendix, in Chapters 19-24, contains the definitive theory in mathematical form. So far as was possible, the main account and the appendix were written in parallel to facilitate cross-reference.

Visual Proof

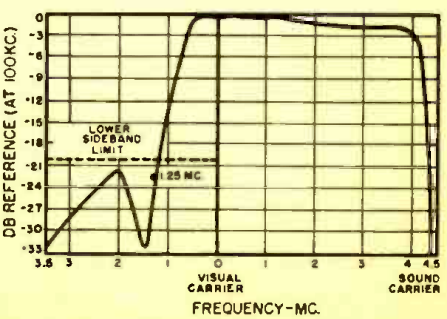
(*Continued from page* 16)

ment, should have good frequency response up to 5 mc. and should have low input capacity with high input impedance; cost is of the order of $300. Oscillographs for video work vary in price from $300 to $900; it is assumed that most television stations will probably have at least one high quality oscillograph, equivalent to the *Du Mont* 303, for test purposes. The cost of the r.f. waveform monitor (shown in Fig. 2), which should also be part of a station's normal video monitoring equipment, is of the order of $1000; this instrument is used during normal operation to measure significant amplitude levels—such as blanking, black peak, and white peak—and to assure maintenance of the proper percentage of sync. The video signal generator should have a frequency range of at least 100 kc. to 5 mc.; cost varies from $600 to $1000. Also available commercially are video sweep generators, sometimes known as wobbulators, which may be set to fixed frequencies and used as video signal generators. Provision for calibrating markers is highly desirable; these devices are regularly used in the maintenance of a station's video equipment. Mixing amplifiers, dummy loads, and diode detectors are also—in most cases—a part of a station's regular equipment.

Narrow-band receivers with extreme selectivity are not generally available commercially. Figure 5C shows a block diagram of a receiver that was constructed by *Du Mont* for making spectral measurements. Cost is of the order of $700. The response of this receiver is such that good resolution is obtained at 100 kc. off carrier. Similar receivers without as much selectivity can be used if 200 kc. is the reference point. Actually, it makes little difference whether 100 or 200 kc. is the reference inasmuch as the transmitter characteristic is flat at both points. R.F. signal generators are commercially available, at costs of $600 to $1000.

Certain precautions are always necessary in making measurements: (1) test equipment must be properly termi-

Fig. 8. Spectral analysis of the output of the visual transmitter.



nated with noninductive loads of the correct value; (2) equipment should be shielded to avoid the effect of stray r.f. fields; (3) diode detectors must be linear over the frequencies being measured, or known correction factors must be applied; (4) overmodulation or undermodulation of receivers used for measuring purposes must be avoided; (5) probes must receive sufficient energy to operate diode detectors or receivers in the linear region; (6) the transmitter should be set to operate at the proper modulation level; (7) test input levels and power output should be held constant during all measurements. Other points to remember include the following: video sweepers may not have constant output, and may generate some harmonics—for precise measuring, a low pass filter in the output may be necessary; vacuum-tube voltmeters are generally peak-reading devices calibrated in r.m.s. values, and correct readings are obtained only with sine waves having unity form factor; where notching diplexers are used, 4.5-mc. sine-wave modulation should not be applied, as the load resistor in the diplexer will overheat.

Although complete Proof of Performance measurements are made infrequently, it is believed essential that a television station make spot checks at least monthly. At the *Du Mont* stations, it is standard practice each week to wobbulate the transmitter into the dummy load and the antenna. Each transmitter has a built-in wobbulator, essentially a low power r.f. generator which sweeps ± 5 mc. from the carrier. An oscillograph display shows qualitatively the bandpass of various tuned stages as well as the final transmitter output. Crystal markers provide calibration points, and markers can be introduced at other frequencies to permit relatively accurate determination of the over-all characteristic. Three photographs of a typical wobbulation pattern are shown in Fig. 6. Figure 6A shows the transmitter wobbulated into a dummy load; note the carrier frequency marker and the marker at 3.5 mc. Figure 6B shows the transmitter wobbulated into the antenna; there is substantially no difference between antenna and dummy load. Figure 6C shows the wobbulation pattern taken at a time when, as it was later determined, two feed straps on a five-element antenna had broken off; the picture quality under these conditions was only slightly deteriorated, but the wobbulation test showed immediately that there was trouble.

A more recent type of built-in wobbulator has been described by John Ruston[4]. This unit provides variable video input and has the advantage that the transmitter can operate under normal conditions of r.f. excitation and video modulation during its use. The output is a 15-kc. signal, the amplitude of which is proportional to the amplitude-frequency characteristic of the transmitter, and may be displayed on any general-purpose oscillograph. Figure 1 shows such a display.

Another type of spot check utilizes an external video sweep generator for modulating the transmitter. Output is detected and shown as a video signal on a wide-band oscillograph. Typical output with and without the use of a notch diplexer is shown in Figs. 3 and 4.

It is evident that visual transmitter Proof of Performance measurements, exclusive of field strength, can be made with readily available equipment. It is recommended that stations make frequent spot checks to assure continued compliance and to detect potential trouble or failure. These spot checks can be made with relative ease.

CALENDAR of Coming Events

SEPTEMBER 1-3—International Sight and Sound Exposition, Palmer House, Chicago, Ill.

SEPTEMBER 14-16—Fourth Annual Convention and Manufacturer's Conference, NEDA, St. Louis, Mo.

SEPTEMBER 21-25—Eighth National Instrument Exhibit, Hotel Sherman, Chicago, Ill.

SEPTEMBER 28-30—National Electronics Conference, Hotel Sherman, Chicago, Ill.

OCTOBER 5-8—Fall Technical Meeting of USA and Canadian National Committees of URSI and the IRE Professional Group on Antennas and Propagation, National Research Council, Ottawa, Canada.

OCTOBER 26-28—IRE-RTMA Radio Fall Meeting, Toronto, Ontario.

NOVEMBER 13-14—Annual Electronics Conference, Kansas City Section, IRE, Hotel President, Kansas City, Mo.

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

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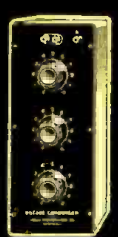

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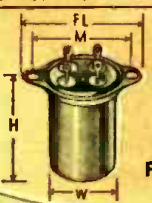
PMA 1	Line or microphone to single or push-pull grids	50/ 200/ 500	60,000 C.T.	+8	1:11	0	0	±2.0 DB 30-20000	DM-12
PMA 2	Dynamic microphone or speaker voice coil to single or P.P. grid	4/8	60,000 C.T.	+8	1:86.6	0	0	±2.0 DB 30-20000	DM-12
PMA 3	Line or microphone to single or push-pull grids. Magnetically shielded.	50/ 200/ 500	60,000 C.T.	+8	1:11	0	0	±2.0 DB 30-20000	DM-12
PMA 4	Single triode plate to single or push-pull grids	15,000	60,000 C.T.	+8	1:2	0	0	±2 DB 30-10000	DM-12
PMA 5	Single triode plate to push-pull grids	15,000	60,000 C.T.	+8	1:2	2	2	±2 DB 200-10000	DM-12
PMA 6	Single triode plate to multiple line	15,000	50/200/500	+8	5.48:1	0	0	±2 DB 30-20000	DM-12
PMA 7	Single triode plate to multiple line	15,000	50/200/500	+8	5.48:1	2	2	±1 DB 200-10000	DM-12
PMA 8	Push-pull triode plates to multiple line	30,000 C.T.	50/200/500	+8	7.75:1	2	0.25	±2 DB 30-20000	DM-12
PMA 9	Crystal mike or pickup to multiple line	60,000	50/200/500	+8	11:1	0	0	±2 DB 30-20000	DM-12
PMA 10	Mixing or matching	50/200	50/200/500	+8	1:1.50	0	0	±2 DB 30-20000	DM-12
PMA 11	Parallel Feed Reactor * 1 mw. reference level.	40 hy.	3 ma dc,	3500 ohms D.C. resistance					DM-12



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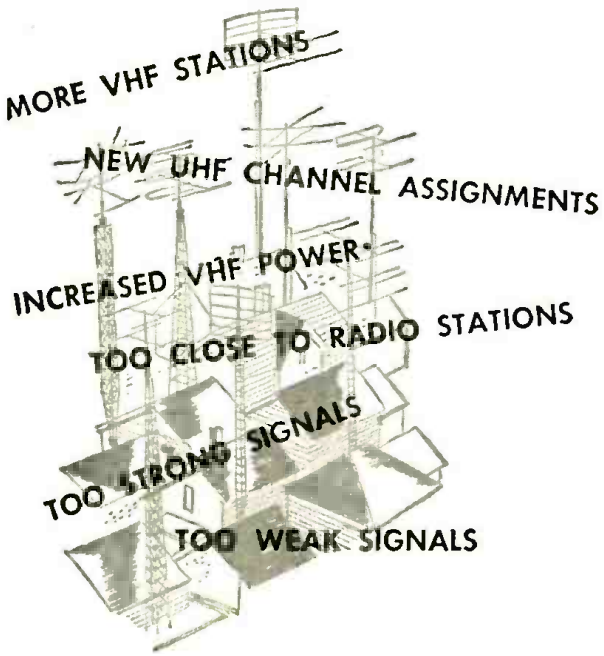
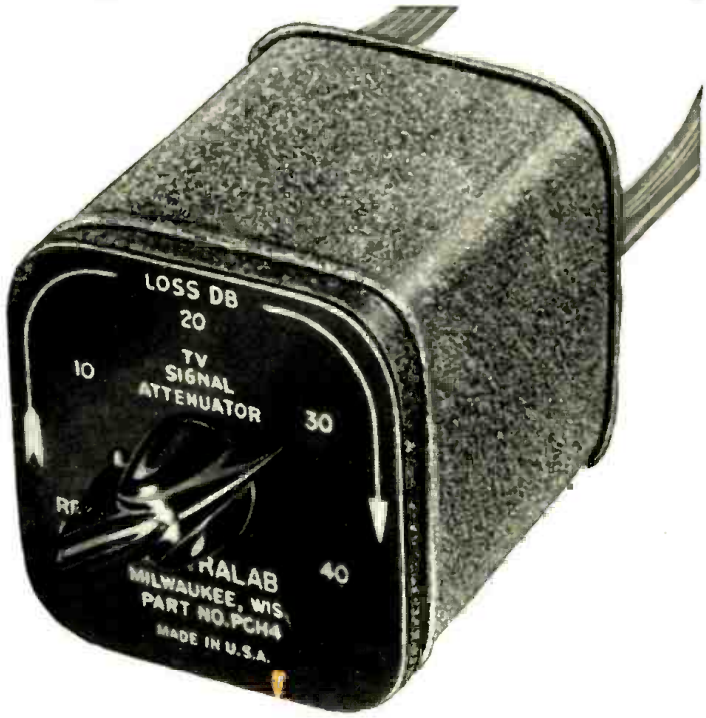
NOW...more important than ever!

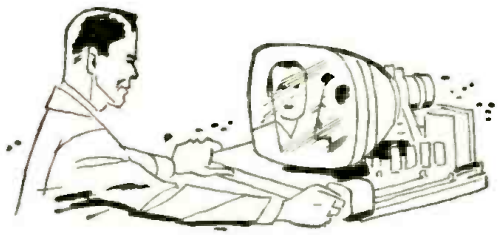




New service tool...PCH-4 TV ATTENUATOR assures best reception in multi-station areas

IF you're in the thick of all the new channel assignments, both VHF and UHF, you know what a job it is to install H-pads for proper attenuation. Ordinary "cut-and-try" methods take too much time and there's always danger of overloading.

Even if you don't have attenuation problems now — *you will later on!* That's why it's smart to get the low-down on this brand-new Centralab TV Attenuator.



The switching arrangement makes it possible to attenuate each station as much or as little as necessary depending on daily conditions such as weather or existing interference, and allows for proper attenuation to balance two or more stations. It shows you the proper attenuation merely by turning a switch. You instantly match signal strength to requirements of receiver. Four different H-pads are mounted permanently to the attractive metal case. All you do is hook up to the 300-ohm antenna twin lead and turn dial to the H-pad that gives you the proper attenuation. Then unhook leads and install the proper H-pad. Checking and installation takes only a few minutes.

If customers want permanent selective attenuation installation, this handy unit makes the job easier. And it's another sale for you!

Your Centralab distributor has these TV Attenuator Switches in stock for immediate delivery. Also ask him for a demonstration and complete data on dependable Centralab H-pads.

Always use Centralab H-pads —you'll prevent overloading, eliminate tearing of image . . . improve both audio and video results. Available in 10, 20, 30 and 40 db. Install in series with 300-ohm antenna.

Centralab

A Division of Globe-Union Inc.

910-I East Keefe Ave. • Milwaukee 1, Wisconsin

In Canada, Box 208, Ajax, Ontario

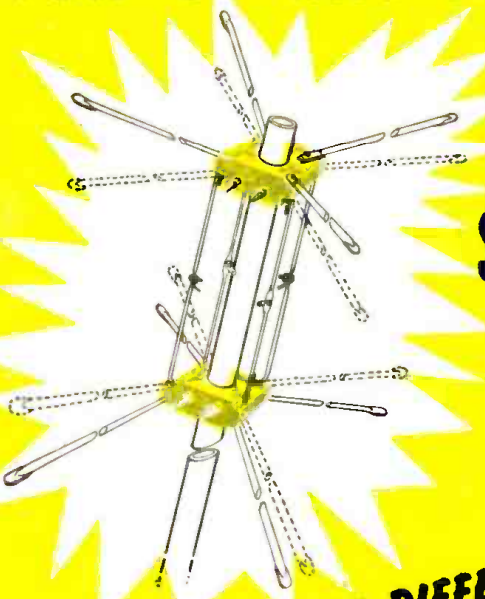
MONEY BACK GUARANTEED

TO RECEIVE *All* UHF and *All* VHF STATIONS IN *All* DIRECTIONS FOR 60 MILES

WITHOUT A ROTORMOTOR OF ANY KIND!!

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.



MODEL SUPER 60

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

ONE INSTALLATION ONE ANTENNA
ONE TRANSMISSION LINE

SO NEW! SO DIFFERENT! IT'S PATENTED!

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

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 • 3 - 7½" stand offs • Individually boxed in mailable carton

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.

BE READY NOW — FOR THE FUTURE

ALL CHANNEL ANTENNA CORP., 70-07 QUEENS BLVD. WOODSIDE 77, NEW YORK

Servicemen!

CHECK THESE PHILCO TEST EQUIPMENT FEATURES

Field Strength Meter

Model M-8104. More new features than any other unit at this popular price. Reads signal strength directly from the dial from 10 to 100,000 microvolts. A serviceman's time saver to measure actual TV picture signal strength.

- ✓ New Low Prices
- ✓ New Circuitry
- ✓ New Styling
- ✓ New Ruggedness
- ✓ New Versatility
- ✓ New Accuracy

Cross Dot Linearity Pattern

Model G-8004. Philco's new unit for the finest possible linearity adjustments when a station pattern is not available. It provides extreme versatility of performance and design at amazing economy of operation. Light, rugged and portable it's the new leader in test equipment.

NOW YOURS ON NEW EASY PAYMENT PLAN

VHF to UHF Signal Generator Adapter

Model G-8000. The most economical system yet designed to produce UHF signals for TV receiver tests. Through a conversion process using any VHF meter this unit produces from an input VHF signal, UHF signals having the same characteristics as the VHF signal.

Mutual Conductance Tube Checker

Model 7052. Tests more different type tubes than any unit on the market, from subminiature to acorn low power transmitting tubes. Shorts on tube elements can be easily determined, employs roll chart instead of cards, for use as a portable or counter top unit.

Dynamic Signal Tracer

Model 7031. An extremely versatile instrument . . . this unit is designed for fast diagnosis of radio trouble by audibly monitoring RF and AF circuits. Can be used to accurately check P.A. systems, microphones and phonograph pick-up circuits, also localizes distortion.

5-inch High Gain Oscilloscope

Model S-8202. This outstanding scope is built to the very highest standards of test instruments . . . It features the highest gain 10 millivolts/inch, and widest frequency range at its popular price. Wide sweep ranges allow extreme flexibility in sweep circuit trouble shooting.

3-inch TV Oscilloscope

Model S-8200. The most practical portable unit available for bench or field servicing. Preset horizontal and vertical sweep rates take the guesswork out of trouble shooting, aligning and measuring. Ideal for television because of its high sensitivity and wide response.

Philco Circuit Tester

Model 8102. A general purpose volt-ohmeter that challenges comparison. Utilizes 1% resistors throughout to insure maximum accuracy. Tests AC voltage ranges of audio and high impedance AC circuits where a vacuum type voltmeter would normally be required.

Philco Circuit Master

Model 8100. Designed to the most rigid of engineering specifications, this rugged metal-cased vacuum tube voltmeter is by far the finest in its price class. Provides unmatched accuracy for measuring and aligning where plus and minus indications are required.

UHF Auto-Level Sweep Generator

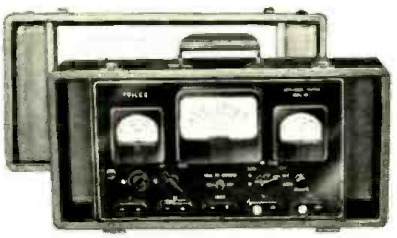
Model G-8002. The most modern, most inexpensive UHF sweep generator on the market. Checks sweep alignment with *any* test oscilloscope. Its output is controllable and leakage is negligible . . . makes possible over-all trouble shooting and testing of low level units.

Cathode Ray Tube Checker

Model 7053. Will accurately test *all* picture tubes used in home TV receivers. Special cathode-ray tubes are easily checked by using plug-in adapters. Eliminates trouble shooting guesswork. Neon lamp indicates shorts and open elements in the electrodes of the gun.

Visual Alignment Generator

Model 7008. Combines in *one* economical instrument functions that can be approached only in a cumbersome collection of costly devices. No special scope connections are required for the most accurate visual alignment and calibration that is possible to achieve.



Appliance Tester

Model 5007. The ultimate in versatility. A one package, all purpose, portable appliance service unit. Permits over-all analysis of refrigerators, ranges, air conditioners and household appliances. With "pick-up" elements to determine temperature and built-in voltmeter.

MAIL THIS COUPON FOR NEW FREE BOOKLET
or see your Philco Distributor

PHILCO CORPORATION
Accessory Division
Allegheny Ave. & "A" St., Phila. 34, Pa.

☐ I am interested in the Philco Test Equipment shown here. Please send me details of your SPECIAL PURCHASE PLAN for obtaining these units.

☐ Please send FREE copy of your new booklet on Philco Test Equipment.

NAME .....

ADDRESS .....

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

Within the INDUSTRY

GLEN McDANIEL, who served as the first paid president of the Radio-Television Manufacturers Association in 1951-52, has been elected temporary president of the organization pending the selection of another full-time paid president. He will also continue as general counsel of the Association.

The board of directors also elected Robert C. Sprague as chairman of the RTMA board for the next fiscal year. Mr. Sprague, who succeeds A. D. Plamondon, Jr. of Chicago, is past president of the Association and served as its chairman for two years in 1950-52.

Leslie F. Muter of Chicago was re-elected treasurer and Dr. W. R. G. Baker of *General Electric Company*, was re-elected director of the Engineering Dept.

* * *

NEDA has announced that the services of Donn Mason, widely known as "Minute Man of sales training," have been secured for its 1953 Convention and Manufacturers' Conference to be held in St. Louis, Sept. 14-16.

In view of the current shortage not only of trained help but of suitable people who can be trained, distributors report having to comb unlikely sources for prospective sales personnel.

Mr. Mason will provide new suggestions for getting, training, and keeping a fully-staffed operation, with emphasis on sales personnel.

* * *

EUGENE M. KEYS has been elevated to the post of president by the board of directors of *Edwin I. Guthman Co.* of Chicago, largest independent coil manufacturer in the country.

He was formerly executive vice-president of the firm and succeeds the late Edwin I. Guthman, president and founder who died last April.

Mr. Keys joined the company in 1942 as a member of the purchasing department. In 1945 he was named assistant sales manager and in 1947 he was promoted to the position of sales manager. In 1951 he was named vice-president in charge of sales and a year later was made executive vice-president of the firm.

* * *

MARTIN BETTAN, director of sales and engineering for *Radio Merchandise Sales, Inc.*, has been elected president of the Antenna Manufacturers Association.

Ben Snyder, of *Snyder Manufacturing Company* was named vice-president and Edward Finkel of *JFD* will serve as secretary-treasurer of the trade group.

* * *

W. WALTER WATTS has been elected to the post of vice-president in charge of technical products for the *RCA Victor Division* of *Radio Corporation of America.*

He was previously vice-president in charge of engineering and is assuming the position formerly held by L. W. Teegarden who became executive vice-president of *RCA* last February. In his new assignment Mr. Watts will supervise the activities of both the Engineering Products Department and the company's Tube Department.

He joined *RCA Victor* after wartime service as a Colonel and Commanding Officer of the Signal Corps Distribution Agency and as a Signal Corps Procurement Director for which he was awarded the Legion of Merit.

* * *

SPRAGUE ELECTRIC COMPANY of North Adams, Massachusetts is building a new plant about seven miles from West Jefferson, North Carolina. About 250 workers will be employed when the plant reaches full production. It will be the company's seventh plant . . . **TRACERLAB, INC.** is constructing a new $100,000 plant in Richmond, California to house its Western Division. The building will contain approximately 15,400 square feet and will replace quarters the company has occupied in Berkeley since 1948. The building is scheduled for November completion . . . **I. E. MANUFACTURING COMPANY** is undertaking an extensive expansion and modernization program designed to double its plant area. Completion is scheduled for next May . . . **OAK MFG. CO.** has opened a new factory in Elkhorn, Wisconsin to serve as a feeder for its Chicago and Crystal Lake, Illinois plants. James L. von Harz will be in charge of the new facility . . . **LOUIS M. HERMAN COMPANY** has opened a new branch store in Norwood, Massachusetts to service the Norwood, Framingham, Brockton, Taunton areas. The company handles a complete line of radio and television parts . . . **AEROCOIL, INC.** has moved into larger quarters at 24 Cliff Street in Jersey City, N. J. . . . The **RCA VICTOR DIVISION** has purchased land in Findlay, Ohio and will build a plant for the manufacture of electronic component parts for radio and TV home receivers. The first unit will be in op-

No matter where you live or what you are doing now . . .

I WILL TRAIN YOU FOR A HIGH PAY JOB IN TELEVISION

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

VETERANS! CIVILIANS!

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 industry . . . enjoy the success and happiness you always wanted out of life! Now . . . prepare for a life-time career as a trained TV TECHNICIAN, often within months . . . using the same successful "learn-by-doing" home study methods that have helped hundreds of men with NO PREVIOUS TRAINING!

NO EXPERIENCE NECESSARY

LEARN TELEVISION AT HOME IN YOUR SPARE TIME!

Giant Screen TV Receiver

GET MORE! LEARN MORE! EARN MORE!

I give you ALL the equipment and training you need to prepare for the BETTER PAY jobs in TV. While training, many of my students make $25.00 a week repairing Radio-TV sets in their spare time . . . start their own profitable service business.

MORE EQUIPMENT!

You build and keep this professional GIANT SCREEN TV RECEIVER complete with big picture tube (designed and engineered to take any size up to 21-inch). Also all units illustrated, plus additional equipment! Everything supplied complete with all tubes.

Super-Het Radio Receiver

AC-DC Power Supply

FREE FCC COACHING COURSE!

Prepares you at home for your FCC License. The best jobs in TV and radio require an FCC License. My FCC Coaching Course is given to you at NO EXTRA COST after TV Theory and Practice is completed.

Combination Voltmeter-Ammeter-Ohmmeter

BECOME A TV CAMERAMAN!

TV CAMERAMAN & STUDIO COURSE

(Advanced training for men who have had radio & TV training or experience). I train you for an exciting, high pay job as the man behind the TV camera. Work with TV stars in TV studios or "on location" at remote pick-ups.

FM-TV TECHNICIAN TRAINING!

My FM-TV Technician Course will save you months of training, if you have previous Armed Forces or civilian radio experience. Complete with kits, BIG SCREEN TV RECEIVER, and FREE FCC Coaching Course.

C-W Telephone Receiver

NEW YORK ROUND TRIP!

Exclusive! Only RTTA gives you a ROUND TRIP TO NEW YORK CITY at NO EXTRA COST! Yes, from anywhere in the continental U.S. or Canada, I'll pay your way to New York and return after you finish your complete Radio-TV course. Get 2 FREE weeks, 50 hours of advanced study at our affiliated PIERCE SCHOOL OF RADIO & TV. Operate modern TV studio and camera equipment, go behind the scenes of New York's big Radio-TV centers! (Available only to students enrolled for complete Radio-TV Technician Course.)

RF Signal Generator

VETERANS!

MY SCHOOLS FULLY APPROVED TO TRAIN VETERANS UNDER *NEW* G.I. BILL! If discharged after June 27, 1950 — CHECK COUPON BELOW! Also approved for RESIDENT TRAINING in New York City . . . qualifies you for full subsistence allowance up to $160 per month.

MAIL COUPON TODAY!

MY 4 FREE AIDS SHOW YOU HOW AND WHERE TO GET A BETTER PAY JOB IN TELEVISION! See for yourself how my simple, practical methods make success easy.

NO SALESMAN WILL CALL!

Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSOCIATION
1629 Broadway, New York 19, N. Y. Dept. T-9A

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

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

RADIO-TELEVISION TRAINING ASSOCIATION
1629 Broadway, Radio City Station, New York City 19, N. Y.
LICENSED BY THE STATE OF NEW YORK

eration next Spring . . . The addition of a new 18,000 square foot warehouse has been announced by **RADIO MERCHANDISE SALES, INC.** The building is located at 945 Cortlandt Avenue in New York City . . . **MANNFRED ELECTRONICS CORP.** has moved to new and larger quarters at 21-38 36th Avenue, Long Island City 6, New York. The new facility offers off-the-street parking for the company's wholesale customers.

* * *

RALPH R. STUBBE has been named assistant chief engineer of *General Instrument Corporation* in line with the company's growing emphasis on u.h.f. television devices.

He will make his headquarters at the firm's home plant in Elizabeth, New Jersey. Mr. Stubbe has been connected with such firms as *Westinghouse, Hazeltine, NBC,* and *Hoffman* and will play a key role in *GI's* expanding production of u.h.f. tuners, converters, and other components it supplies to manufacturers and the government.

* * *

HAROLD B. RHODES of Paterson was re-elected president of the Radio and Television Servicemen of New Jersey, Inc. at the fourth annual meeting of the association.

Serving with Mr. Rhodes are: Fred E. Berdy, vice-president; J. Palmer Murphy, executive secretary-treasurer; and Jerome J. Gelman, counsel. All are from Paterson, N. J.

Mr. Rhodes pledged the Association's continued cooperation with the Greater Paterson Chamber of Commerce and the Paterson Better Business Committee during the coming year.

* * *

NATESA will hold its annual Fall convention October 9, 10, and 11 at the Morrison Hotel in Chicago. TISA-Illinois will be the host.

Present plans call for display booths, seminars, discussions, banquets, and entertainment. John Cecich, vice-president of TISA-Illinois is the convention chairman.

Further information on this meet is available from NATESA president, Frank J. Moch, 5908 Troy Street, Chicago 29, Illinois.

* * *

STANDARD TRANSFORMER CORPORATION of Chicago and the **CHICAGO TRANSFORMER DIVISION** of *Essex Wire Corporation* have been consolidated and will operate under the name of **CHICAGO STANDARD TRANSFORMER CORPORATION.** The new firm will retain and operate all present locations and facilities without any contemplated changes in personnel . . . Martin Corn has acquired the assets of **INTERNATIONAL CONNECTOR CORPORATION** of Paterson, New Jersey and will operate the new firm as **CORN ELEC-**

(*Continued on page* 120)

ADVANCE! Raise your earning power—learn RADIO-TELEVISION-ELECTRONICS by SHOP-METHOD HOME TRAINING

GOOD JOBS AWAIT THE TRAINED RADIO-TV TECHNICIAN

There is a place for *you* in the great Radio-Television-Electronics industry when you are trained as National Schools will train you at home!

Trained technicians are in growing demand at good pay—in manufacturing, broadcasting, television, communications, radar, research laboratories, home Radio-TV service, and other branches of the field. National Schools Master Shop-Method Home Training, with newly added lessons and equipment, trains you in your spare time, right in your own home, for these fascinating opportunities. OUR METHOD IS PROVED BY THE SUCCESS OF NATIONAL SCHOOLS TRAINED MEN, ALL OVER THE WORLD, SINCE 1905.

EARN WHILE YOU LEARN

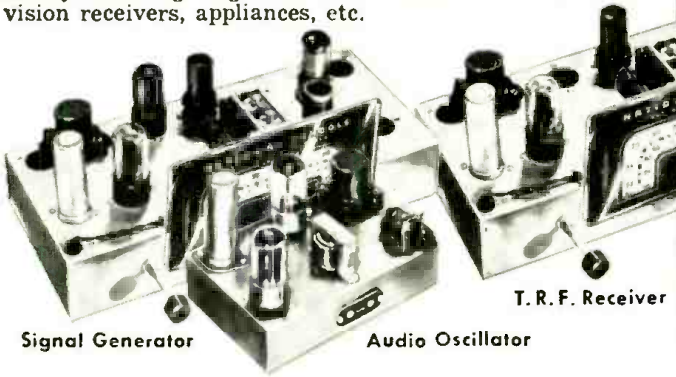
Many National students pay for all or part of their training with spare time earnings. We'll show you how you can do the same! Early in your training, you receive "Spare-time Work" Lessons which will enable you to earn extra money servicing neighbors' and friends' Radio and Television receivers, appliances, etc.

MASTER ALL PHASES!

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

We Bring National Schools To You!

Superheterodyne Receiver



T.R.F. Receiver

Signal Generator

Audio Oscillator

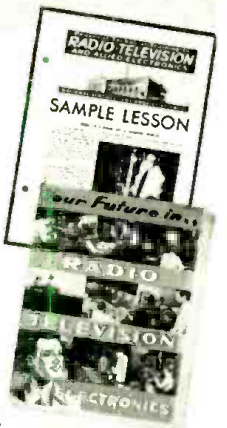
LEARN BY DOING

You receive and keep all the modern equipment shown above, including tubes and valuable, professional quality Multitester. *No extra charges.*

FREE! RADIO-TV BOOK AND SAMPLE LESSON!

Send *today* for National Schools' new, illustrated Book of Opportunity in Radio-Television-Electronics, and an actual Sample Lesson. No cost—no obligation. Use the coupon now—we'll answer by return airmail.

This course also offered in Spanish and Portuguese



National Schools Training is All-Embracing

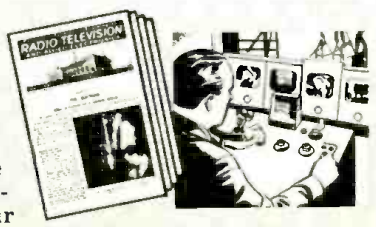
National Schools prepares you for your choice of many job opportunities. Thousands of home, portable, and auto radios are being sold daily—more than ever before. Television is sweeping the country, too. Co-axial cables are now bringing Television to more cities, towns, and farms every day! National Schools' *complete* training program qualifies you in all fields. Read this partial list of opportunities for trained technicians:

Business of Your Own • Broadcasting
Radio Manufacturing, Sales, Service • Telecasting
Television Manufacturing, Sales, Service
Laboratories: Installation, Maintenance of Electronic Equipment
Electrolysis, Call Systems
Garages: Auto Radio Sales, Service
Sound Systems and Telephone Companies, Engineering Firms
Theatre Sound Systems, Police Radio
And scores of other good jobs in many related fields.

APPROVED FOR VETERANS AND NON-VETERANS
Check coupon below

Both Resident and Home Study Courses Offered!

TELEVISION TRAINING



You get a complete series of up-to-the-minute lessons covering all phases of repairing, servicing and construction. The same lesson texts used by resident students in our modern and complete Television broadcast studios, laboratories and classrooms!

NATIONAL SCHOOLS

LOS ANGELES 37, CALIFORNIA • ESTABLISHED 1905
IN CANADA: 193 E. HASTINGS STREET, VANCOUVER, B.C.

FIND OUT NOW—MAIL COUPON TODAY!

Mail in envelope or paste on postal card.

NATIONAL SCHOOLS, Dept. RH-93
4000 South Figueroa Street
Los Angeles 37, California

Send FREE Radio-TV Electronics book and FREE sample lesson. I understand no salesman will call on me.

NAME _____ AGE ____

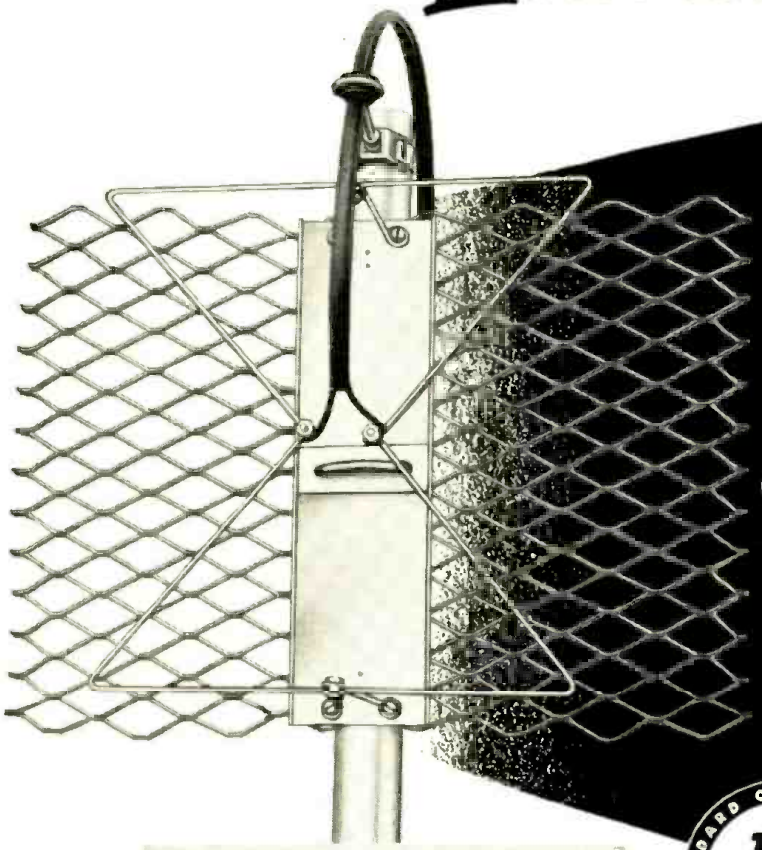
ADDRESS _____

CITY _____ ZONE ____ STATE _____

☐ Check here if released from service less than 4 years ago.
☐ Check here if interested in Resident Training at Los Angeles.

another original!

Entirely New!



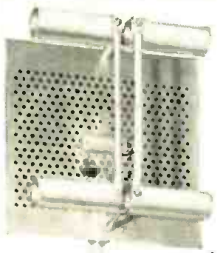
The last word in UHF TV Antennas the UW-2

STANDARD OF COMPARISON — RADIART

Here is another ORIGINAL . . . entirely NEW UHF TV antenna that far excels anything yet seen! It is a completely balanced broad band antenna covering ALL channels from 14 to 82 and terminating in 300 ohms with a very low voltage standing wave ratio! Same of the features include:

- Minimum wind resistance, (a double stacked UW-2 offers less wind resistance than many single bay antennas).
- The UW-2 assumes NO potential difference between itself and the mast, allowing MAXIMUM lightning protection when the mast is grounded.
- COMPLETELY FREE of insulators and their offending results.
- Excellent directivity, single lobe horizontal field pattern, 470 to 850 M.C.

Here's The One They've All Copied!



...NOW AT NEW LOW PRICES

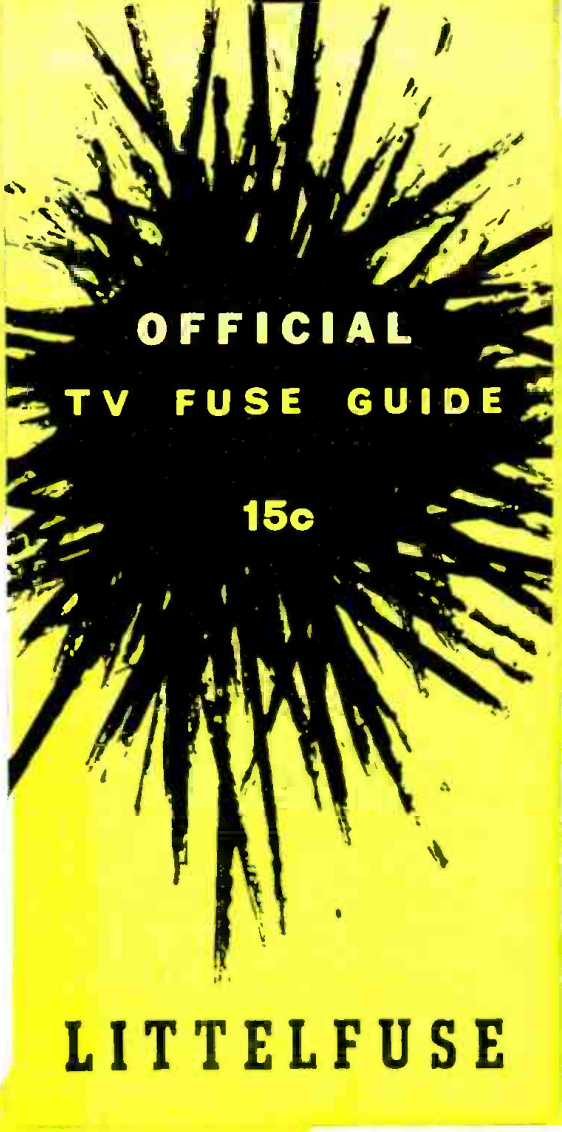
UHF TV Antennas MODEL U-4

A superb quality UHF antenna featuring uniform gain with low vertical radiation (no ghosts). 300 ohm terminal impedance... measures 12x12x15 inches.

STANDARD OF COMPARISON — RADIART

SUBSIDIARY OF THE RADIART CORPORATION CLEVELAND 13, OHIO

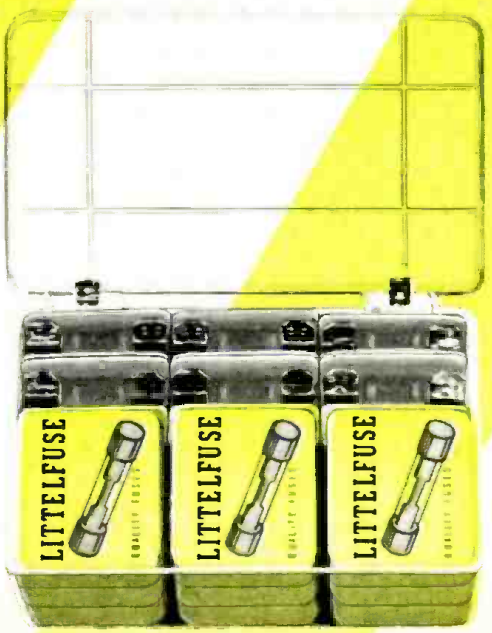
VIBRATORS • AUTO AERIALS • TV ANTENNAS • ROTORS • POWER SUPPLIES



Littelfuse 1953 TV Fuse Guide enlarged to include latest models

Both New—Both Needed

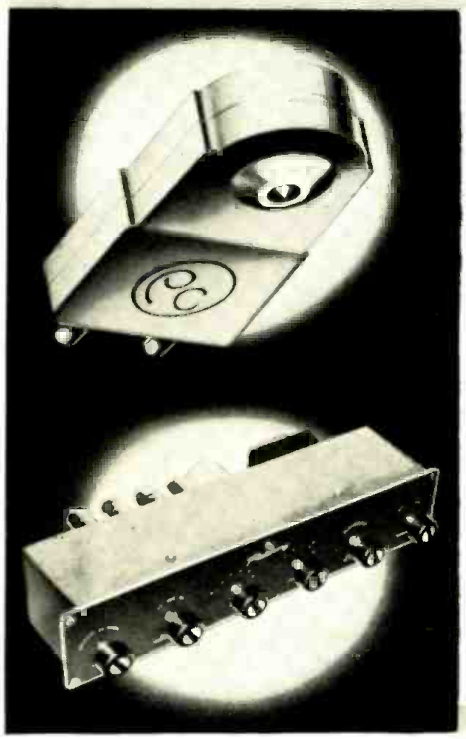
Littelfuse new One Call Kit adapted to include fuses being used in latest models—94 out of 100 times one call is all. Littelfuse Inc., Des Plaines, Ill.



PICKERING

PROFESSIONAL AUDIO EQUIPMENT

BALANCED COMPONENTS / MAXIMIZE PLAYBACK PERFORMANCE



PICKERING CARTRIDGES . . .

are the choice of audio engineers throughout the world. They are universally acclaimed because of their high output, wide range performance and low distortion. They are used wherever a fine cartridge is required in radio stations, recording studios and for purposes of quality control by leading record manufacturers.

MODEL 410 AUDIO INPUT SYSTEM . . .

is designed to provide a complete audio control center. Model 410 may be used in any high quality playback system. Three input channels are provided—one for magnetic cartridges and 2 "flat" channels for other audio circuits. A 3-position equalizer network is built into the magnetic cartridge channel and provides accurate equalization for LP, AES and 78 rpm recording characteristics. Separate bass and treble controls are also provided. These are of the step-type and permit boss and treble adjustments in 2 db increments. The tone contral circuits are intended to compensate for record characteristics and for listener-environment acoustical conditions. *They are not intended to compensate for amplifier and/or loudspeaker deficiencies.* Model 410 is intended for use with the highest quality professional type playback equipment. The output of the Model 410 is fed from a cathode-follower circuit and will work into any high quality audio or line amplifier having a high impedance input. It may also be used with a transformer for the purpose of feeding a 500 ohm line. Because of its flexibility, low noise and low distortion level, it is ideally suited for bridging and monitoring purposes and for critical listening applications.

THE MODEL 190 ARM . . .

Is designed primarily for use with microgroove records. Its design has been recognized by leading audio engineers as that which incorporates all of the desirable tracking characteristics. Analysis has shown that for maximum performance with LP records the vertical mass of the moving arm element must be held to a minimum and further, that the arm must be counterbalanced about the vertical axis. This permits minimum stylus or tracking force and provides maximum record life. The Model 190 Arm embodies these all important features necessary for proper microgroove record playback.

MODEL 230H EQUALIZER-PREAMPLIFIER . .

is unique in its accuracy of equalization and frequency response. The intermodulation distortion is .2 per cent at normal output level. It is intended for use with high quality amplifiers having gain and tone controls. When used with the Pickering Model 132E Record Compensator the 230H is ideal for radio station and recording studio use and for applications requiring accurate low noise and distortion free playback.

MODEL 132E RECORD COMPENSATOR . . .

is designed to be used in conjunction with a magnetic cartridge preamplifier such as the Pickering 230H or any preamplifier which provides 6 db per octave bass boost. Six playback positions are incorporated:

1—European 78 rpm Records
2—Victor 45 rpm and Decca 78 rpm Records
3—No high frequency roll-off, 500 cycle turnover
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Precision elements are used in its construction to give accurate compensation. The 132E is inherently a low distortion R-C device.

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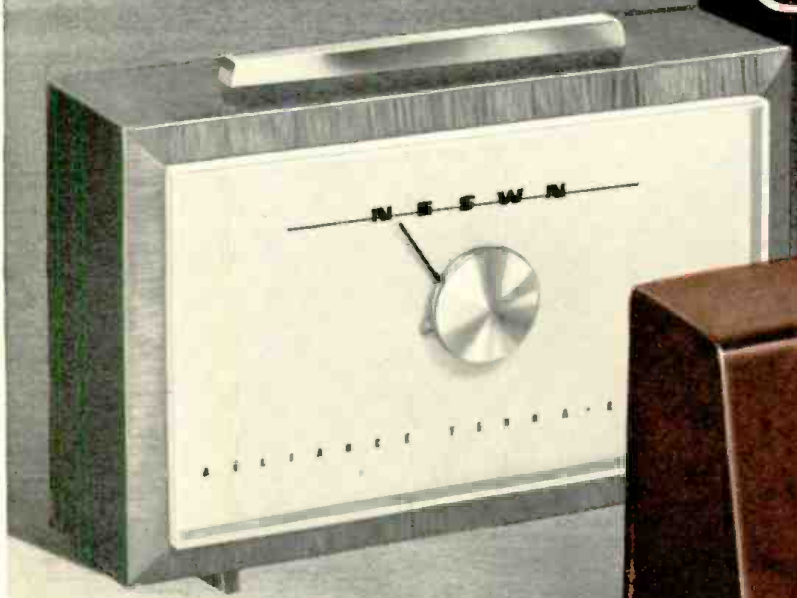
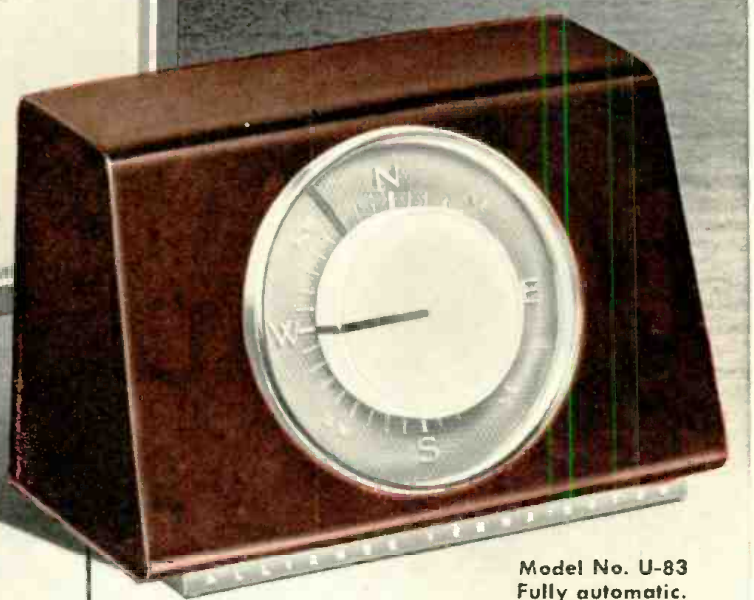


Model No. T-10
Manual control.
Shows antenna direction.



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WALSCO Imperial	10.0	9.5	9.5	15.0	15.5	16.0
Converter A	6.0	5.4	3.5	18.5	20.0	21.0
Converter B	7.0	6.5	5.0	18.0	18.5	20.0

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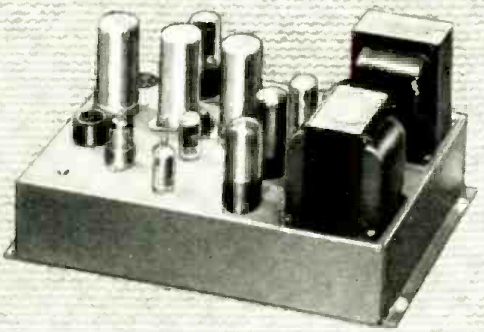

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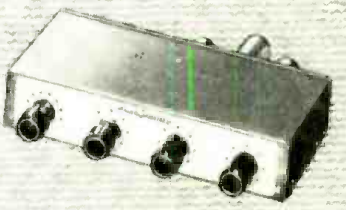

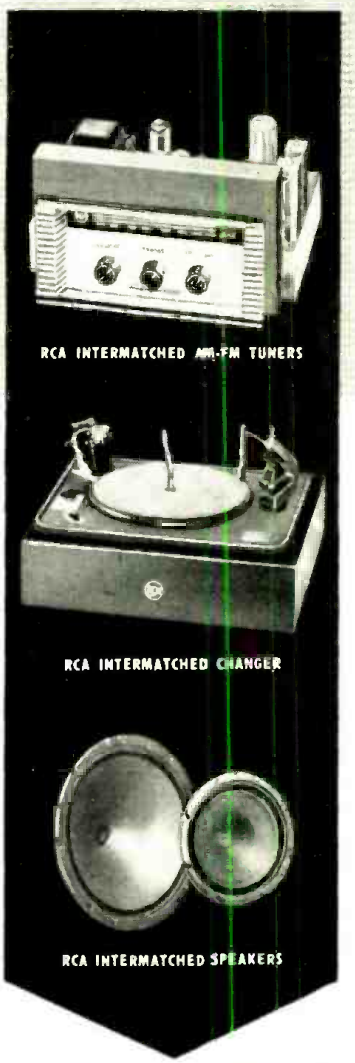

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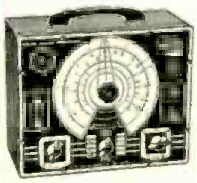

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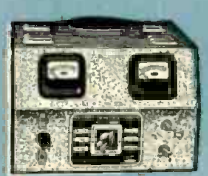

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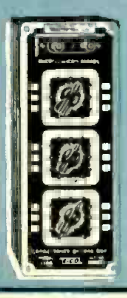

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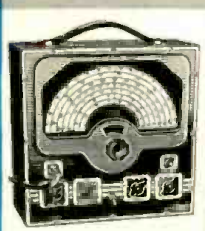

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THE STANDARD COIL 82-CHANNEL TUNER

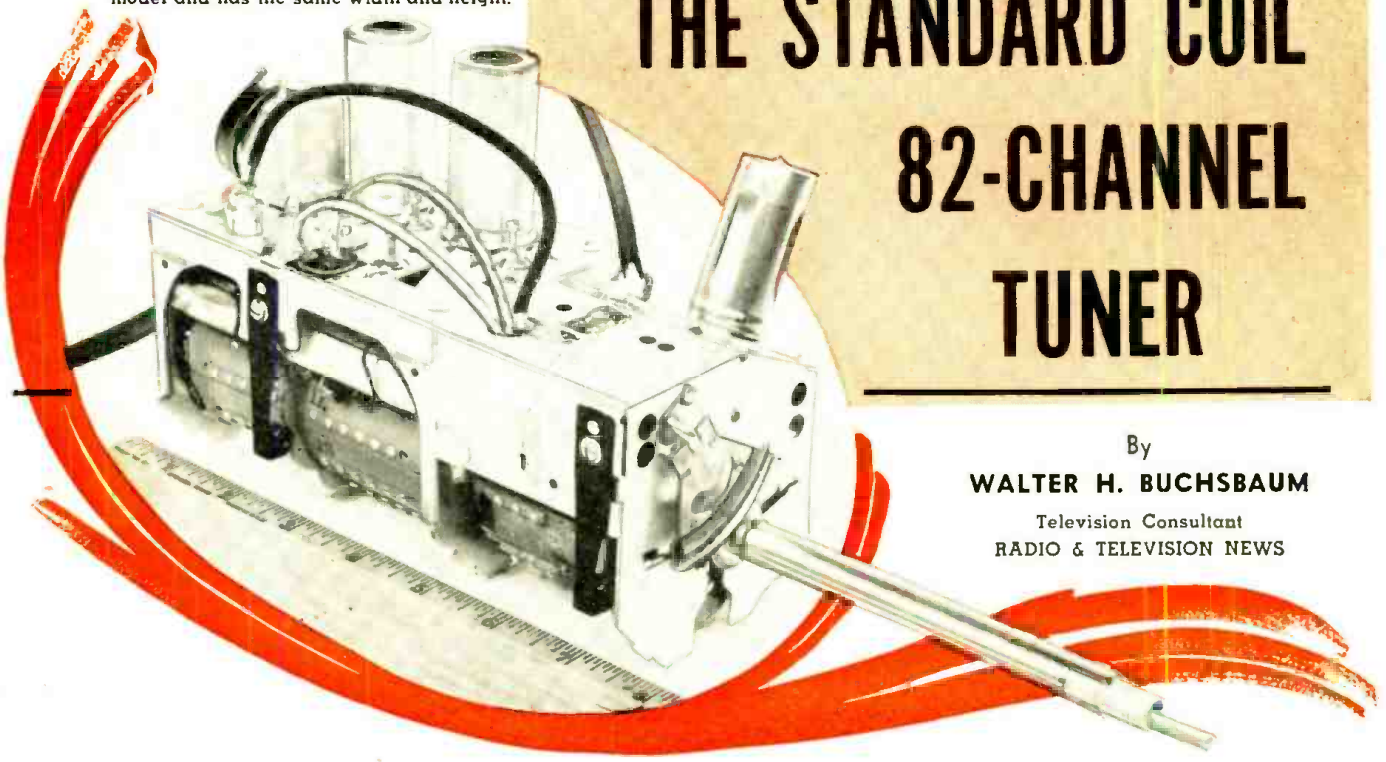


Fig. 1. The new Standard Coil 82-channel tuner. The front subchassis contains the u.h.f. coil strips. The tuner is about two inches longer than the 13-channel model and has the same width and height.

By
WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS

Complete description of the new turret tuner for both u.h.f. and v.h.f. reception, including service data.

WITH the rapid spread of u.h.f. television a large variety of converters, plug-in strips, and similar devices have appeared on the market, all designed to allow v.h.f. receivers to operate on the new channels. Some of the manufacturers have even built various types of u.h.f. converters into their receivers and a few are using a combination u.h.f.-v.h.f. tuner, consisting of continuously-tuned u.h.f. and switch-tuned v.h.f.

The latest development in tuners is actually the first true 82-channel step tuner, allowing the viewer to switch u.h.f. and v.h.f. channels with the same facility and accuracy.

The new *Standard Coil Products Co.* 82-channel tuner is the result of an extensive development program and contains many unique features. Using three tubes and a mixer crystal, this unit provides as much sensitivity on u.h.f. as on v.h.f., with excellent noise factors on both bands. Only slightly larger than the company's v.h.f. tuner, both u.h.f. and v.h.f. coil strips can be removed simply, and the entire drum assembly can be taken out for servicing without unsoldering or unscrewing anything.

As can be seen from Fig. 1, the tuner consists essentially of the v.h.f. chassis and drum with the u.h.f. section in front of it. The v.h.f. portion uses a 6BZ7 in a cascode r.f. amplifier and a 6U8 as a triode oscillator and pentode mixer. Twelve sets of coil strips tune in the v.h.f. channels and produce the i.f. signal. An improved cascode circuit permits better a.g.c. control over that stage and thus reduces the danger of overloading in strong signal areas. The u.h.f. portion uses a 6AF4 or 6T4 oscillator. The u.h.f. input is obtained through a built-in high-pass filter and then a double-tuned r.f. bandpass network. A 1N82 crystal mixer, mounted in a special socket at the top, provides the i.f. output signal from the u.h.f. tuner section. This i.f. signal is coupled to the v.h.f. section through a short shielded cable and plug. The r.f. bandpass network and oscillator tank circuit is switched through a set of eight coil strips, each containing the circuits for ten channels. Individual u.h.f. channels are tuned in through a 3-section concentric ceramic rotor which changes bandpass and oscillator frequencies as required. A fine tuning adjustment is provided for both v.h.f. and u.h.f., mounted on the same shaft but consisting of two different condensers. The u.h.f. oscillator tube is mounted on a slanted portion of the u.h.f. subchassis to help shorten leads.

The v.h.f. and u.h.f. antenna leadins are brought to different terminals in the model shown in Fig. 1, but a coupling transformer will probably be used in later versions. All power connections are made to the v.h.f. chassis, and a simple plug and two wires bring heater and "B+" over to the u.h.f. chassis. This permits separate alignment and assembly.

As can be seen from Fig. 1, two different detent springs control the motion of the u.h.f. and v.h.f. drums. When the v.h.f. drum turns, the u.h.f. drum stands still, but the ceramic rotor inside the u.h.f. chassis turns on the same shaft as the v.h.f. drum. Together with an ingenious internal cam arrangement, this permits very simple knob presentation. In effect, the customer simply turns the inner knob to tune the digits and v.h.f. Channels 2 to 13. When a u.h.f. station is selected, the outer knob is turned to show the tens. Thus, when Channel 24 is desired, the outer knob is set to 2 and then the inner knob is turned to 4. The numbers on the knob are so arranged that Channels 2 to 10 appear in one window while Channels 11, 12, and 13 appear both in the v.h.f. and u.h.f. window. Channel 14 appears only in the u.h.f. window. Tuning from Channel 13 to 14, or from Channel 83 to Channel 2, requires only a single turn, the internal changes being made automatically by the special cam. This mechanism is described in more detail later, but as far as the customer is concerned it really simplifies tuning tremendously.

When the u.h.f. channels are tuned in, the v.h.f. oscillator is disconnected and a special i.f. coil strip is switched into the v.h.f. circuit. This changes the 6BZ7 into a 41-mc. or 21-mc. amplifier and the pentode portion of the 6U8 operates as an i.f. stage. Because

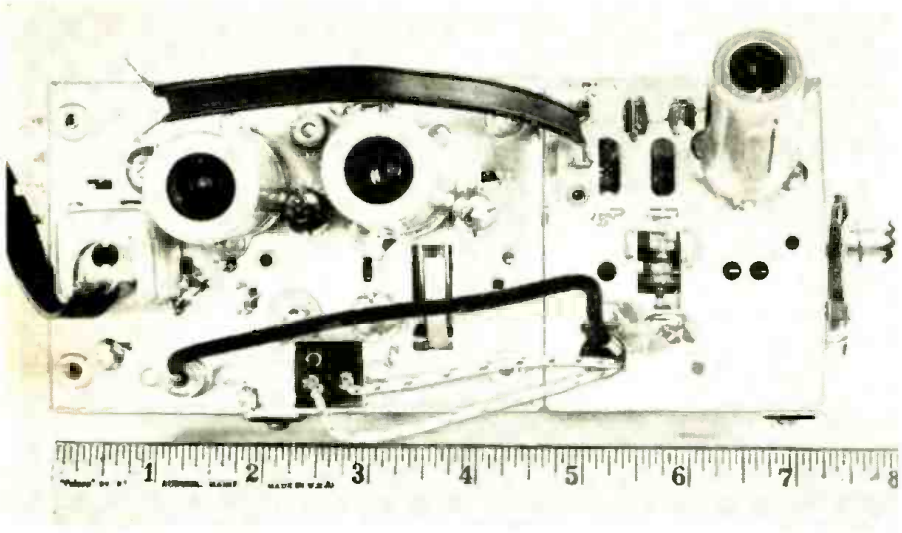
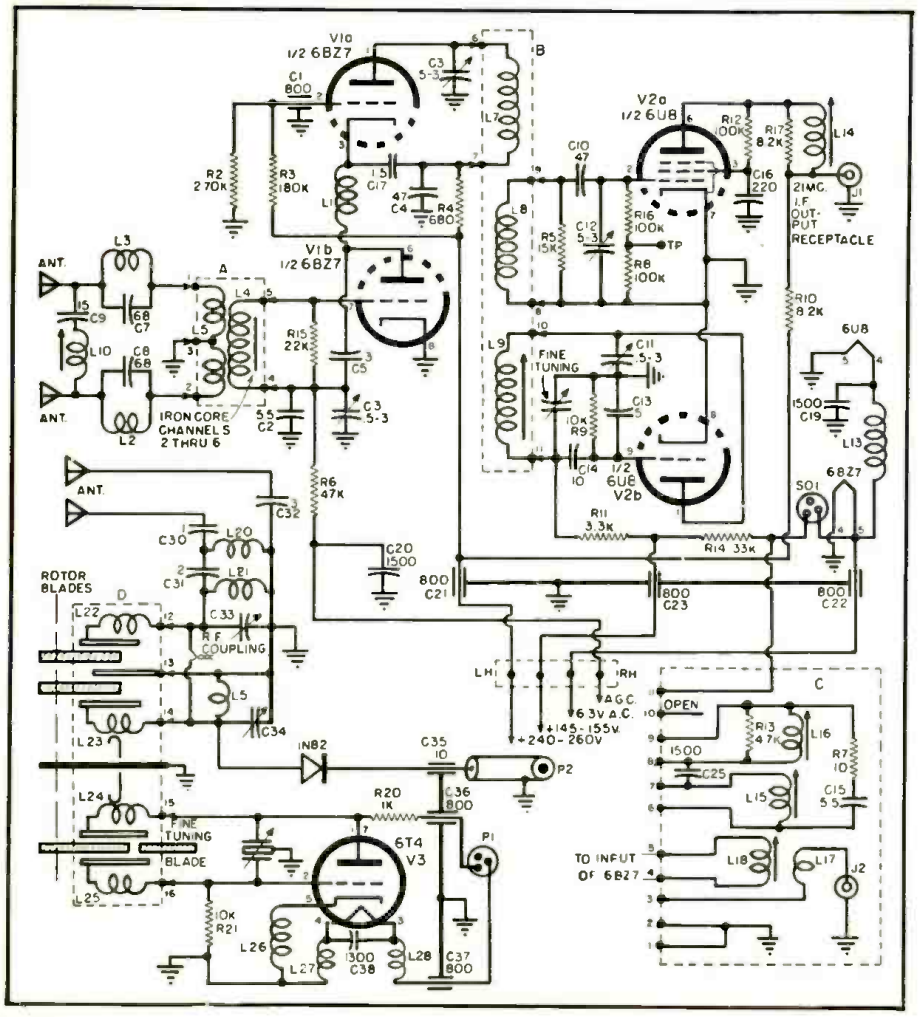


Fig. 2. Top view of the tuner showing the various adjustment points. See text.

of this unique arrangement, the u.h.f. sensitivity of this tuner is practically the same as for v.h.f.

The outermost shaft serves as fine tuning adjustment just as in present *Standard Coil* tuners. In Fig. 1, the friction drive for the fine tuning control can be seen together with its "off-center" shaft. Both the u.h.f. and v.h.f. fine tuning rotors are mounted on this shaft. Both consist of a dielectric which moves between two stator plates. In the v.h.f. chassis the fine tuning stator plates are part of the local oscillator and mounted directly on that chassis. For u.h.f., the fine tuning uses a portion of the oscillator condenser plates which protrude outside the u.h.f. coil plates. In effect, the fine tuning is then in parallel with the ceramic rotor inside the drum.

Fig. 3. Complete schematic diagram of the 82-channel Standard Coil tuner. At the lower left is the u.h.f. oscillator; lower right, the i.f. coil section.



Circuit Analysis

The complete circuit diagram of the tuner is shown in Fig. 3. The upper portion consists of the v.h.f. section which features balanced 300-ohm input with a tunable i.f. filter. This filter is contained in the small shield can at the left in Fig. 2. The 6BZ7 is connected in a series-type cascode circuit requiring 240 to 260 volts "B+". Current drain from this "B+" varies from 20 to 30 ma., depending on channels used. As in previous *Standard Coil* tuners, the antenna input coil is switched, permitting good bandwith and impedance match for each channel. To avoid overload under excessively strong signals, the first cascode stage is controlled by a.g.c. bias.

The 6U8 mixer and oscillator represent some improvement over the older dual triode (6J6) in that the pentode mixer gives considerably more conversion gain while the triode section acts as a conventional oscillator. The pentode operates at the higher "B+" (240-260 v.) while the oscillator uses 145 to 155 volts. The current required from this "B+" varies between 12 and 17 ma. As in previous *Standard Coil* tuners, the r.f., mixer, and oscillator coils are mounted on a single coil plate, and the oscillator coil is slug-tuned. The oscillator tuning slug can be adjusted from the front of the tuner just as in the v.h.f. models, but this time a longer tool must be used since it has to pass through the u.h.f. chassis. Power connections to the tuner are made through a set of terminal lugs at the rear of the v.h.f. section.

The tuner described here is designed for 21-mc. i.f. The same tuner is also available for 41-mc. and is identical in all respects except for the i.f. and oscillator coils.

At the lower left of Fig. 3 is the u.h.f. circuit. The 300-ohm input goes through a high-pass filter which attenuates all frequencies below 470 mc. Coils L_{20} and L_{21} are small diameter air core coils and condensers C_{30} and C_{31} are part of an assembly of silver-plated metal and dielectric strips riveted together.

The u.h.f. r.f. bandpass network consists of an input coil L_{22}, and the coupling condenser formed by three plates and the ceramic rotor blades. The center plate of this condenser is grounded, keeping the total capacity quite low. L_{23} and L_5 form a tapped coil arrangement tuned to match the impedance of the 1N82 crystal mixer to the r.f. bandpass network. The oscillator signal is coupled to L_{23} through a small piece of wire.

The u.h.f. oscillator uses a series-resonant circuit between plate and grid of the 6T4 (or 6AF4) tube. The center of this series circuit is a condenser whose plates are part of the u.h.f. coil strip and which is tuned by the ceramic rotor and the fine tuning control. The dotted section marked

"D" represents all the components which are part of each u.h.f. decade coil strip which is switched for every ten u.h.f. channels.

Stationary adjustments which are tuned for all u.h.f. channels include the r.f. bandpass condensers C_{3a} and C_{3b} and a split-stator oscillator trimmer condenser. The twisted wires marked "R.F. Coupling" form a small condenser which is adjusted at the factory.

The dotted box marked "C" on the diagram of Fig. 3, represents the 21- or 41-mc. i.f. coil section, which is switched in during u.h.f. operation. The contact numbers on section "C" correspond to the spring contacts made by the v.h.f. coil plates "A" and "B." When a u.h.f. channel is switched in, coil section "C" is depressed and connects to the stationary v.h.f. springs. At the same time these springs are bent away from the v.h.f. coil plates, so that only the components mounted on "C" are in the circuit.

Coils L_{5a} and L_{5b} form a transformer, coupling the output of the u.h.f. crystal mixer to the grid of the cascode amplifier. The network consisting of L_{7a}, L_{7b} and associated condensers and resistors is a double-tuned broadband circuit between the output of the cascode and the input of the 6U8 pentode which acts as a regular i.f. amplifier. Contacts 10 and 11 take the place of the v.h.f. oscillator coil. By leaving 10 open, no plate voltage can reach the v.h.f. oscillator. At the same time, contact 11 shorts out the 33,000-ohm resistor, R_{11}, and places the 145-volt "B+", through R_{10}, on the plate of the u.h.f. oscillator. All "B+" and heater leads are isolated by means of r.f. chokes and special ceramic 800-$\mu\mu$fd. feedthrough condensers.

Mechanical Features

Height and width of the new tuner are approximately the same as for previous v.h.f. models, but the length has been increased about 2 inches. Shaft dimensions will depend on the cabinet and chassis designs of individual manufacturers.

The top view of the tuner (Fig. 2), shows the location of all adjustments, except for oscillator tuning for each channel which is done from the front. Starting at the left is the tunable i.f. interference trap, housed in a small shield can with two solder lugs for connection to the v.h.f. antenna. The tube next to it is the 6BZ7 with the input and output trimmer condensers on either side of it. At the lower edge is the connector plug and cable which brings the output of the crystal mixer to the v.h.f. section. The u.h.f. power plug with its heater and "B+" leads is to the right of this plug. Shown also is the cutout through which the v.h.f. fine tuning condenser protrudes. The remaining two trimmer condensers adjust the v.h.f. oscillator and the pentode mixer input tuned circuits. Between the two tubes, towards the upper edge of the chassis is the connection for the i.f. output to the TV chassis and, next to it hidden by the u.h.f. antenna line, is the slug-tuned i.f. output coil.

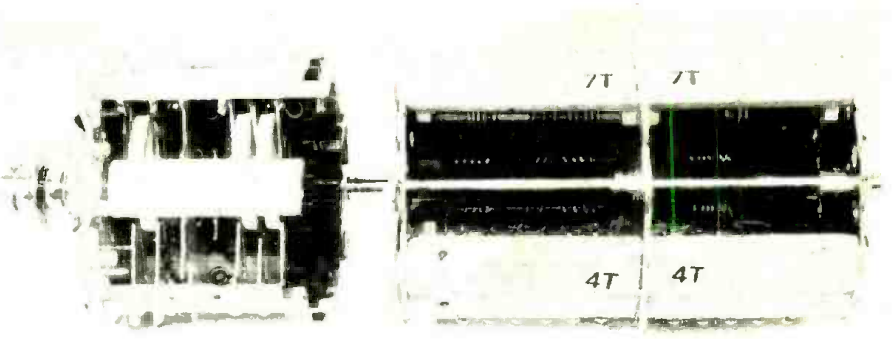


Fig. 4. The tuner drum. Section at left contains u.h.f. components, v.h.f. at right.

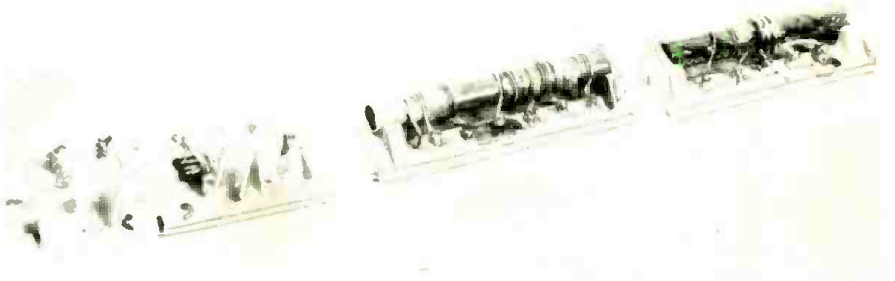


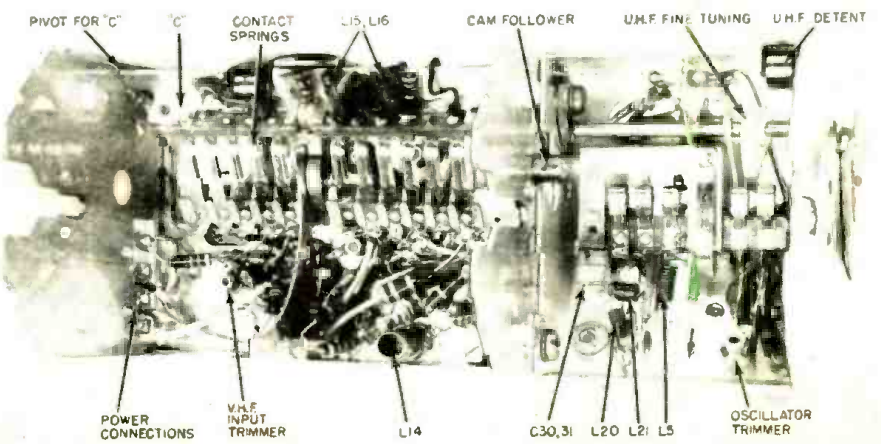
Fig. 5. Three strips from tuner. On left is u.h.f. strip, with v.h.f. strips at right.

The smaller chassis in Fig. 2 contains all u.h.f. circuits. As can be seen from Fig. 1, the u.h.f. oscillator tube is mounted on a sloping portion of the chassis. Two slots in the chassis to the right of the u.h.f. antenna terminals permit adjustment of C_{3a} and C_{3b} (see Fig. 3), the tuning condensers for the u.h.f. bandpass network. Particularly interesting is the rectangular cutout which contains a special socket to hold the 1N82 crystal mixer. Because the lead length is so critical at u.h.f., and because it is sometimes necessary to change crystals during the production testing process, *Standard Coil* designed this crystal socket right into the tuner. The crystal can be removed by pulling the exposed end upwards and then withdrawing the other end from its round socket. Each coil strip has an oscillator adjustment accessible from the front, located near the tuning shaft. This adjustment consists simply of a silver-plated screw which approaches the stator of the main tuning condenser. Fig. 4 shows these screws quite clearly, mounted on the metal detent plate on the front of the drum and reaching towards the stators.

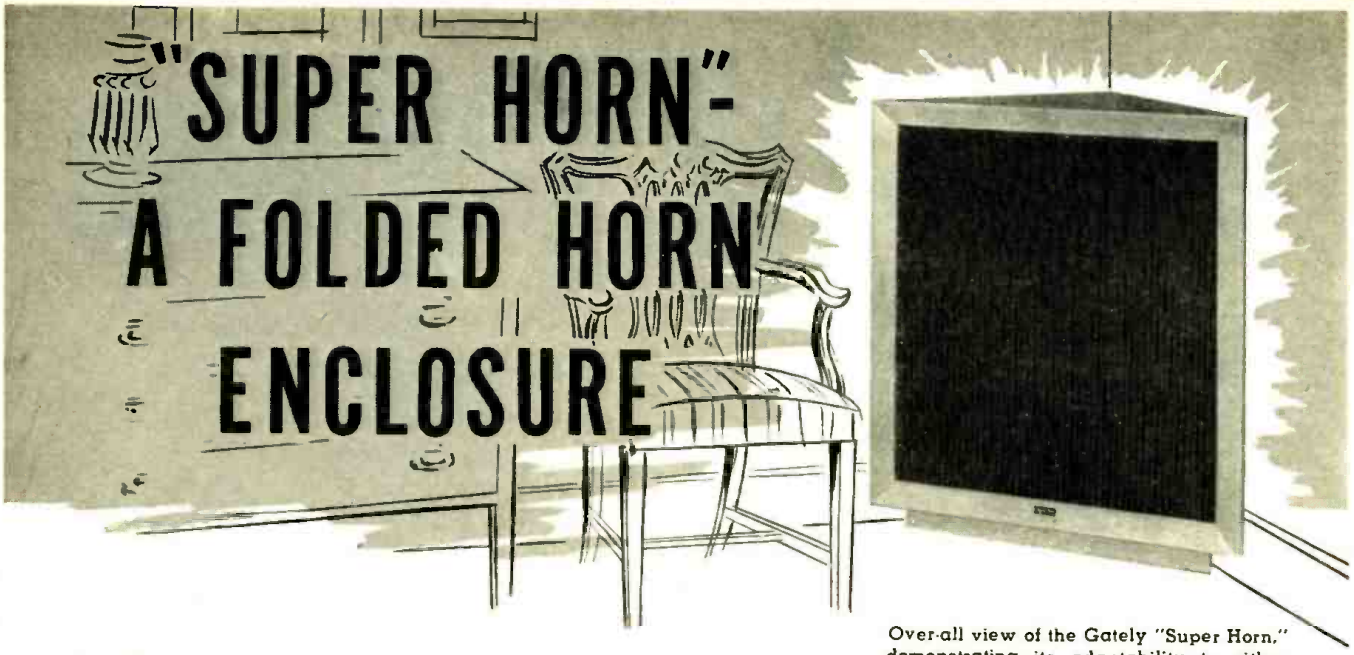
In Fig. 4 is shown the entire u.h.f. and v.h.f. drum arrangement, with some of the coil plates removed to show the inside. The entire drum assembly can be removed from the tuner by removing three shaft locking springs. The smaller drum at the left is the u.h.f. portion. Notice the stator plates mounted in each coil section, and the three ceramic rotors which tune them to individual u.h.f. channels. Between the u.h.f. and v.h.f. drums, and forming one end of the u.h.f. drum, is a black plastic molding which contains the key to the unique

(*Continued on page* 180)

Fig. 6. Under chassis view of the tuner with drum removed to show the switch springs.



"SUPER HORN"- A FOLDED HORN ENCLOSURE



Over-all view of the Gately "Super Horn," demonstrating its adaptability to either modern or traditional decorative schemes.

By **EDWARD J. GATELY, JR.** and **THOMAS A. BENHAM**
Gately Development Laboratory

Construction details on a reasonably-priced enclosure which is designed to accommodate either 12-inch or 15-inch speakers.

GOOD MUSIC reproduction requires that the product of the low and high frequency cut-off points must be approximately 600,000; that is, 40 x 15,000 cps. Some modern source materials cover this range. Electronic components have been developed to handle this range with low harmonic and intermodulation distortion. However, a satisfactory loudspeaker and enclosure that will do justice to the available material is the most expensive part of the phonograph reproducing system. A satisfactory, reasonably-priced enclosure, designated as the *"Super Horn,"* has been developed to be used in conjunction with many of the better speaker systems to obtain good bass reproduction.

Attaining reproduction down to 40 cycles must not be accomplished with increase in distortion or at the expense of power handling ability of the system or transient response. Power handling of the extremely low bass tones can be accomplished only by moving large masses of air. A single 12-inch or 15-inch cone can not move the large masses of air required at low frequencies, unless the impedance of the air is properly matched to that of the mechanical vibrating system. Of course, a large number of 12-inch speaker elements, each operating at very low amplitude can equal the performance of a single speaker, properly loaded, but the resulting cost of multiple high-quality speakers and a cabinet to house them is prohibitively high. One means of properly loading a single speaker is to place it in an exponential horn. If the horn is correctly designed, it serves as a transformer to match the impedance of the air which is to be moved to the vibrating system. However, a horn which is designed to reproduce low frequencies satisfactorily must have a low rate of flare and a large mouth area. The basic horn equation is

$$A = A_o e^{mx}$$

where: A = area at any point along horn axis
A_o = area of throat of horn
x = distance along axis of horn
$m = 4\pi f_c/c$ constant denoting taper rate of horn
f_c = cut-off frequency of horn
c = velocity of sound in air

The mouth area of the horn should equal approximately the area of a circle whose diameter is $1/\pi$ times the wavelength of the lowest frequency to be reproduced. For a horn having a theoretical cut-off at 40 cycles the area of the horn should double every 18 inches and the mouth should have an area of approximately 8400 square inches. If the horn is to be used with a 12-inch speaker which has an effective cone area of 75-square inches the horn would be approximately 10½ feet long.

The physical length of a horn may be reduced by folding it. However, this folding process must be done in such a way as to prevent the production of standing waves within the horn. These standing waves impair the transient response of the system and introduce peaks and valleys in the response curve. The length of the horn can be reduced by designing it so that it may be placed in the corner of a room so as to use the walls and floor as extensions of the horn. Fig. 1 shows a *"Super Horn"* with front grille assembly removed, mounted in a corner of a room, and illustrates how images of the horn mouth are formed by the floor and walls of the room. Images I_1, I_3, and I_5 are real images, while I_2 and I_4 are virtual images. 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 the horn mouth would normally occupy will quickly illustrate the manner in which the acoustic images are formed.

The *"Super Horn"* (Patents Pending) was designed to include all the previously mentioned criteria, and yet be small enough to fit into the corner of the average living room. The total fold of the horn is only 90°. The fold is accomplished by use of panel 1 (see Fig. 1) which is arranged at 45° to the original path of sound from the throat. Since the angle of incidence is equal to the angle of reflection, any acoustic reflections must pass out the horn. This 45° arrangement of baffle 1 materially reduces the possibility of standing waves.

The enclosure greatly increases the air loading on the cone of the speaker at low frequencies. This may be proved as follows. Reduction of bass resonance of a speaker can be accomplished in one or both of the following ways. (1) Increasing the compliance of the cone suspension and/or (2) adding mass to the cone either in the form of cone material or increased air loading. The reduction of resonance by addition of mass as a function of the mass is expressed by the following relation:

$$M_c = \frac{F_{rm}^2}{F_r^2 - F_{rm}^2} M_a$$

where: F_{rm} = effective resonance of

the cone with mass added (cps)
M_c = mass of cone (grams)
M_a = mass added
F_r = free-cone resonance of speaker

A typical 12-inch speaker having a free-cone resonance of 54 cps and a cone mass of 50 grams will have its resonance reduced to 38 cps when used in this enclosure. The air load on a 12-inch, infinitely-baffled speaker is 12.5 grams. In accordance with the relation given previously the increase in air loading is approximately 36 grams. This increased air loading reduces the necessary motion of the speaker for a given power output and thus reduces distortion due to non-linear suspension and non-linear air gap flux. Placing the same speaker in an infinite baffle of the same cubic content as the *"Super Horn"* raises the resonance to 61 cps due to the stiffness of the cavity behind the speaker. Since a speaker can radiate power only down to its resonant frequency, it is indicated that the *"Super Horn"* increases the range of the speaker system by nearly an octave over that obtainable in the same cubic content totally-enclosed box (from 61 to 38 cps). No tuning, porting, or other tricks are used to extend the apparent range of the *"Super Horn,"* as this would tend to spoil the transient response of the enclosure. Acoustic damping on the speaker cone is greatly increased by the improved air loading. This is illustrated by Figs. 3 and 4. Fig. 3 shows the impedance vs frequency curve of a 12-inch speaker in a *"Super Horn,"* while the "impedance curve" for the same speaker in a well padded infinite baffle of the same cubic content is shown in Fig. 4. The reduction in amplitude of the resonant peak is evident. The suppression of this peak indicates clearly the increased acoustic damping afforded by proper impedance matching between the air of the room and the cone of the speaker.

The ultimate test of any reproducer is the listening test. AB comparisons with vented enclosure and infinite baffles of the same cubic content clearly show the advantages of this design and its effects on damping and the resultant increased bass range. The increased power handling ability of the speaker system, considered as an integrated whole, is immediately noticeable on high-level organ pedal tones. Bass transients such as plucked strings or tympani are cleaned up and move up and down the scale as intended. This is due to the increased damping and non-resonant character of the baffle.

The dimensions of *"Super Horns"* designed for 12- and 15-inch speakers are shown in Fig. 5. Home constructors are cautioned to use ¾-inch wood and to securely screw and glue all joints. This can best be done by fastening glue strips to the top so that screws can be run into them from each side. Speakers can be best fastened by installing anchor nuts on the front panel, and running screws through the mounting holes in the speaker into the anchor nuts. This eliminates the danger of rupturing expensive loudspeakers which can result when using a stud system of mounting. A finished 15-inch *"Super Horn"* is shown in Fig. 2 with top and grille cloth frame assembly removed. This indicates the relative positions of the internal baffles. A photograph of a *"Super Horn"* in a typical home installation demonstrates (see facing page) how, although the cabinet itself has the clean lines which characterize modern furniture design, it fits in with period-type furniture and decor.

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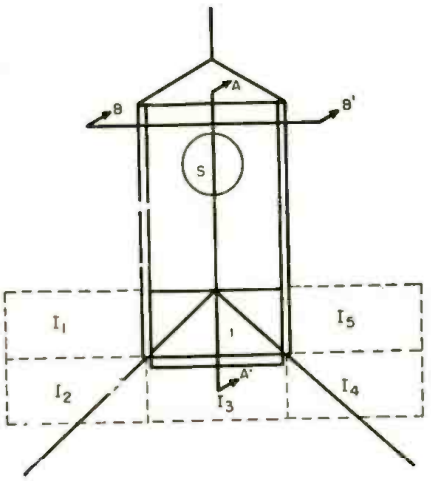


Fig. 1. Manner in which the walls and floor form images of the horn mouth.

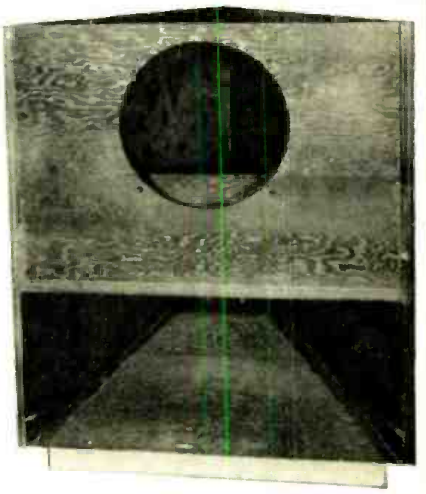


Fig. 2. Grille cloth frame assembly and top removed to show internal baffles.

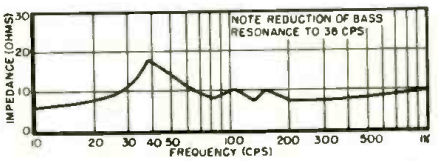


Fig. 3. Impedance vs frequency curve of 12" speaker in "Super Horn" enclosure.

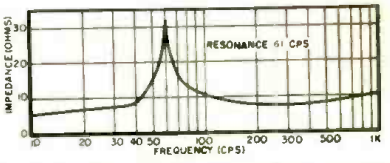
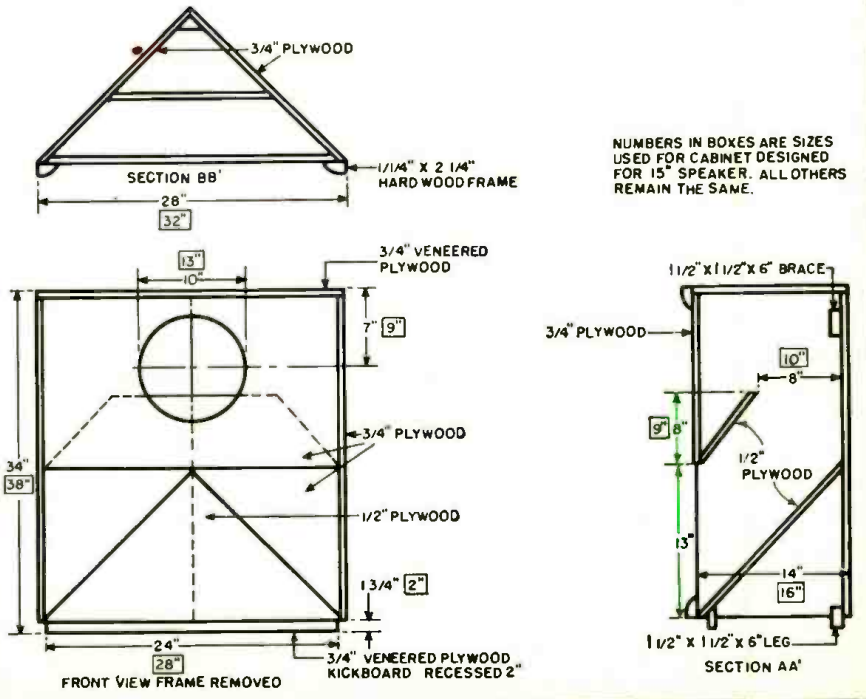


Fig. 4. Same speaker as Fig. 3 in enclosed box of same cubic content as "Super Horn".

Fig. 5. Dimensions for "Super Horn" enclosures to house 12- and 15-inch speakers.



EXTENDED CLASS A AMPLIFIER

Over-all view of amplifier chassis. Parts placement is deliberately roomy in order to eliminate overheating and hum pickup.

The power supply chassis measures 10" x 12" x 3" and is separate from amplifier.

By **LLOYD B. HUST**

Triodes versus pentodes? Here's one answer. This 50-watt amplifier uses four beam power tubes—two connected as triodes, two as tetrodes—in push-pull parallel circuit.

THE range of development in the field of audio frequency amplification is of such tremendous scope that sometimes various methods of amplification and various systems with the claims made for them, tend to be rather confusing to the lay person. In fact, the proponents of different audio systems themselves often cannot agree as to the value of the various features of their systems. Perhaps the longest and most bitter feud has been between the advocates of triodes for power amplifiers *versus* the clique which claims that pentodes or tetrodes are superior. It is not intended in this article to add fuel to the flames of contention, but rather to acknowledge that both sides have some good points in their favor. The "*RCA Receiving Tube Manual*" states:

> "Power tubes of the triode type in class A service are characterized by low power sensitivity, low plate-power efficiency, and low distortion. Power tubes of the pentode type are characterized by high power sensitivity, high plate-power efficiency, and relatively high distortion. Beam power tubes such as the 6L6 have a still higher power sensitivity and efficiency and have a higher power output capability than triode or conventional pentode tubes."

These facts have limited the use of triodes generally to amplifiers of relatively low power, but low distortion, while pentodes, including beam power tubes, have been used in public address work and other applications where the highest fidelity is not of the greatest importance. This seems to substantiate the claims of the triode supporters that if one desires an amplifier of really "high quality" he must use triodes. The other faction points out that in order to have realism in the reproduction of music, certain passages call for surges of power in a range beyond that which can be economically supplied by triodes. In all probability the feud will never be settled, but there are some compromises which may give satisfaction to the advocates of each type. One such compromise is a system which uses *both* types of tubes, but in such a way that the advantages of each type can be realized, without the attendant disadvantages.

This system is called "extended class A" and is discussed by Howard T. Sterling in his article "Tube Applications in Amplifier Design" which appeared in the May, 1951 issue of the RADIO-ELECTRONIC ENGINEERING edition of RADIO & TELEVISION NEWS. In this type of operation, four beam power tubes—two connected as triodes and two as tetrodes—in a push-pull parallel arrangement are used. The bias voltage is such that under conditions of low power the tetrodes are cut off and the effect is the same as if a straight triode amplifier were being used. However, when the signal voltage reaches such a level that high peaks of power are required, the pentodes conduct and satisfy the high power requirements of the amplifier. The tubes are operated under such conditions that at no time does their operation take them off the straight portion of the characteristic curve. Voltage and current requirements for 807's connected in such a system are as follows: plate voltage, 450; grid voltage, —45; screen voltage, 300; zero signal plate current, 110 ma. (triodes only conducting); maximum signal plate current, 256 ma. (all tubes conducting); power output, 47.5 watts.

The amplifier to be described in this article uses this mode of operation, and the extended class A feature does not introduce any problems which cannot be solved by the careful worker. It is necessary, for best results, to match the tubes, but that is the case with every high-quality amplifier. Tube types are not critical, and although the author used 807's as output tubes, many other types are suitable, including 6AR6's and 5881's.

The amplifier and power supply are built upon separate chassis, each 10" x 12" x 3". This method of construction eliminates many problems and makes testing very convenient. Of course, it would be possible to build the power supply on the same chassis as the amplifier, but precautions would have to be taken to guard against hum. The separate power supply method also has the advantage that the power supply can be used for experimental purposes with other equipment if desired.

It will be seen from the schematic diagram of the amplifier, Fig. 2, that it is actually a modified Williamson-type circuit. Some rather important changes have been made from the

original Williamson circuit, however. First, it will be noticed that the coupling between the first stage and the inverter is not direct coupling as in the Williamson circuit. This change was made in the interest of stability, particularly to obviate any unbalance developing in the circuit due to aging of the tube.

The phase-inverter circuit as used here can be thought to consist of three resistive elements in series, as is illustrated in Fig. 1. The first element consists of the 22,000 ohm plate-load resistor; the second consists of the plate resistance of the tube plus the bias resistance; and the third consists of the 22,000 ohm cathode-load resistor. This arrangement allows the biasing circuit to act as part of the tube resistance, and the only two elements which affect signal balance will then be the two 22,000 ohm resistors. Once these resistors are matched, the circuit will remain in balance, despite tube aging. The bias resistor, R_7 in Fig. 2, is shown as 3900 ohms. This value is not critical, but it does have some bearing on the signal balance as it will be seen that R_7 and R_8 act as a voltage divider as far as the signal voltage is concerned. If it is found that the signal voltage across R_8 is not the same as that across R_9, then the value of R_7 can be changed until the two signal voltages are equal. R_7 may range anywhere between 2000 ohms and 5000 ohms.

As in any high-quality, push-pull amplifier, it is necessary to match the load resistors on each side of the circuit. This means that R_8 and R_9 should be matched as should R_{15} and R_{16}. Two watt resistors were used as load resistors to minimize changes due to heating. The ones used by the author are *Ohmite* 10% resistors, pairs of which were carefully matched from a number of resistors. If the builder does not have equipment for matching resistors, it is suggested that he use 1% precision units for R_8, R_9, R_{15}, and R_{16}.

Although we often hear of the importance of matching load resistors in a push-pull circuit, little, if anything is said of the importance of matching coupling condensers. Although this may not be as important as the matching of resistors, it does have importance if good *over-all* balance is to be achieved in the amplifier. Condensers may differ in capacitance over a fairly wide range without too much effect at high frequencies, but at low frequencies, considerable unbalance may occur. Let us take the case of the condensers C_8 and C_9, each of which is in one side of the push-pull circuit. Let us assume that these two condensers have a tolerance of ± 20% which is common. Let us also assume that C_8 varies 20% in the positive direction and C_9 in the negative direction the same amount. The actual capacitance for C_8 would then be .3 μfd., and C_9 would be .2 μfd. The reactance unbalance at high frequencies would not be important because at high frequencies the capacitive reactance is low. However, a few simple calculations show us that at a frequency of 20 cycles, the reactance of C_9 would be about 26,500 ohms while

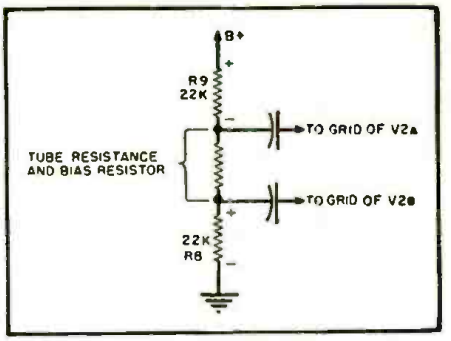
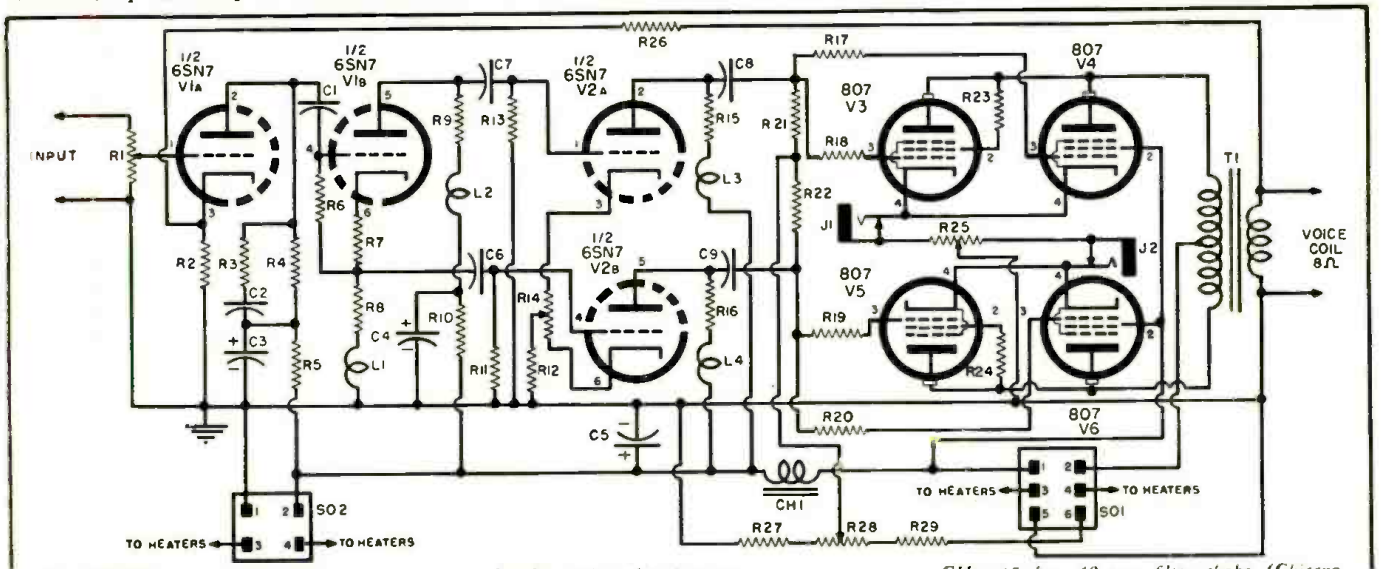


Fig. 1. How the inverter tube operates.

that of C_8 would be approximately 39,800 ohms. This difference of over 13,000 ohms would cause considerable signal unbalance at 20 cycles. Although it is unlikely that this extreme difference would exist with condensers chosen at random, it is entirely possible, and even much smaller differences in capacitance can be important at low frequencies.

Although the average experimenter does not possess equipment for matching condensers accurately, in most cases he can get this done at no cost. In most cities of medium or large size the high school laboratories will have capacitance and resistance bridges and those in charge of this equipment are usually willing to perform the service of matching a few pairs of resistors and condensers. In the smaller towns where the local high school does not have such equipment, one can usually make contact with the local telephone maintenance engineer. Even small telephone companies have accurate

Fig. 2. Schematic and parts list covering the amplifier section. Quality parts are used throughout to insure good performance. A cable connects this chassis to the power supply. Two Jones six-prong plugs are required for this cable. One pair of sockets and plugs could be eliminated by extending the wiring, cabled, between the amplifier and power supply. The four-prong socket is for connecting a preamp.



R_1—500,000 ohm volume control
R_2—470 ohm, 1 w. res.
R_3—5600 ohm, ½ w. res.
R_4, R_{13}, R_{16}—47,000 ohm, 2 w. res.
R_5, R_8, R_9, R_{15}—22,000 ohm, 2 w. res.
R_6, R_{11}, R_{17}—470,000 ohm, ½ w. res.
R_7—3900 ohm, 1 w. res.
R_{12}—330 ohm, 1 w. res.
R_{14}—200 ohm wirewound pot
R_{17}, R_{18}, R_{19}, R_{20}—100 ohm, 1 w. res.
R_{21}, R_{22}—100,000 ohm, ½ w. res.
R_{23}, R_{24}—1000 ohm, 1 w. res.
R_{25}—100 ohm wirewound pot
R_{26}—7500 ohm, ½ w. res.
R_{27}—5000 ohm, 5 w. wirewound res.
R_{28}—5000 ohm wirewound pot
R_{29}—1000 ohm, 5 w. wirewound res.
C_1, C_6, C_7—.05 μfd., 600 v. cond.
C_2—500 μμfd. mica cond.
C_3, C_4—20/20 μfd., 450 v. elec. cond.
C_5—30 μfd., 450 v. elec. cond.
C_8, C_9—.25 μfd., 600 v. cond.
L_1, L_2, L_3, L_4—1 mhy. r.f. choke
CH_1—15 hy., 40 ma. filter choke (Chicago RS-1540)
SO_1—6-prong socket (Jones)
SO_2—4-prong socket (Jones)
J_1, J_2—Closed-circuit jack (insulated from chassis)
T_1—Output trans. 3000/2500 ohms c.t. plate-to-plate to 600, 16, 8 ohms or 150/4 ohms (Chicago BO-11, see text)
V_1, V_2—6SN7 tube
V_3, V_4, V_5, V_6—807 tube (see text)

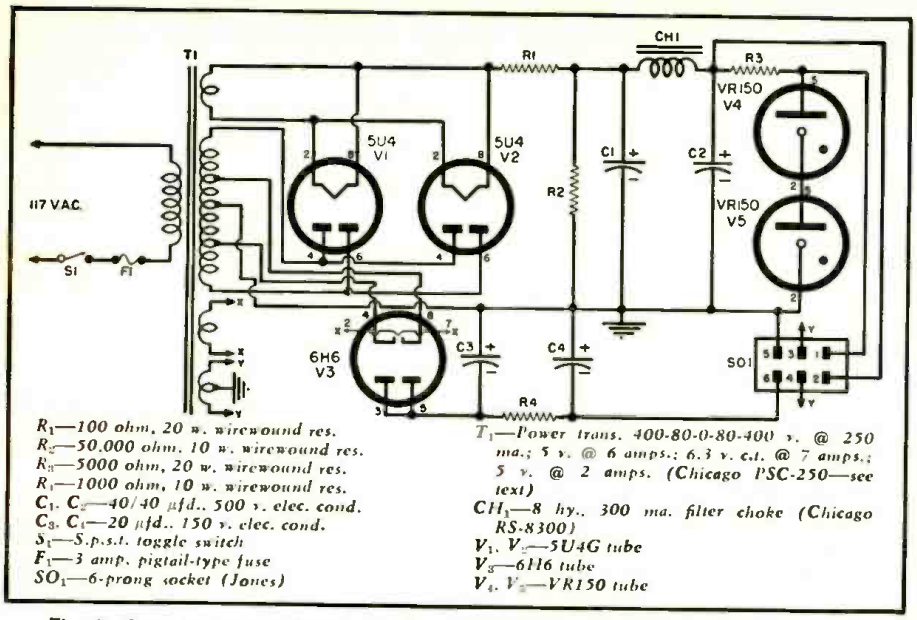


Fig. 3. Complete circuit diagram of the power supply. A separate chassis is used.

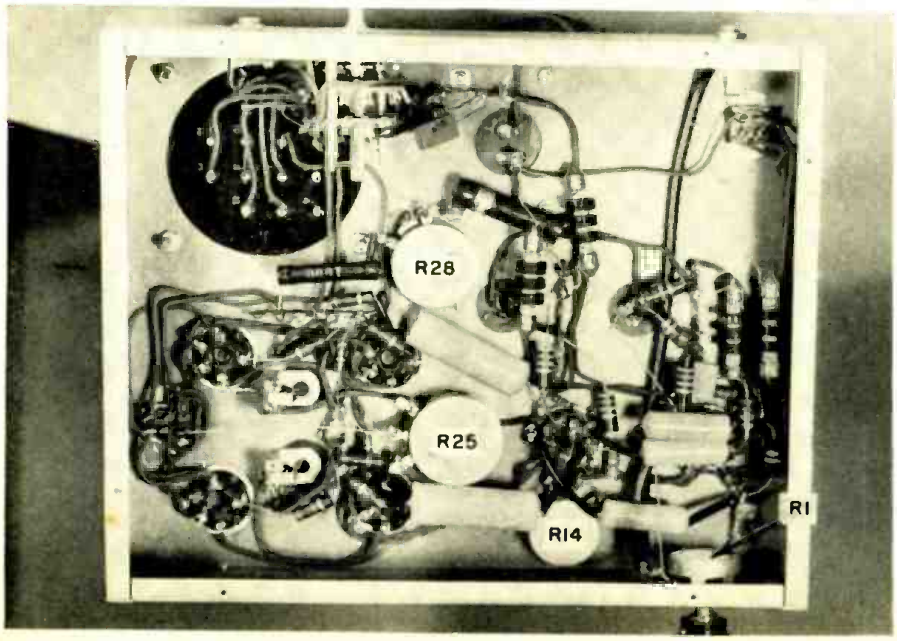
bridges and the officials of such companies are usually very cooperative.

Another innovation in this amplifier is the use of r.f. chokes in series with the load resistors. The purpose of these chokes is to offset the effect of tube and wiring capacitances which tend to reduce high frequency response. They are used in much the same way as the peaking coils in video amplifier circuits. One might think that the addition of such chokes would upset the stability of the amplifier, but such is not the case. Tests without the peaking chokes in the circuits compared with tests made after adding them indicated that they did not in any way reduce the stability of the amplifier.

The four output tubes are connected with a 100-ohm resistor in series with each grid lead. This reduces the chance of oscillation in the output stage without reducing the gain of the amplifier. The plates could be isolated in the same manner, using 20-ohm resistors, but this was found to be unnecessary. Jacks are inserted in the cathode leads on each side of the circuit so that balancing of the output stage can be facilitated. It is important that these jacks be insulated from the chassis.

In any high-quality amplifier, if any one part is more important than any other, that part would be the output transformer. This is particularly true in the case of this amplifier because of the wide range of frequencies to be handled, and because of the high power output requirements. The extended class A type of amplifier using 807 tubes will require an output transformer with a plate-to-plate load resistance of 2500 ohms, and one that is capable of handling in the neighborhood of 50 watts of power. The *Chicago* BO-11 transformer was chosen because it met these requirements so suitably and because of its ability to handle a wide range of frequencies. This unit gives a range of output impedances of from 4 to 600 ohms which can add to the versatility of any amplifier.

Under chassis view of amplifier showing location of the various pots. The output impedance switch control, shown in Fig. 4, has been incorporated. Phone jack shown alongside selector switch and mounted on rear flange of chassis, is used to accommodate speaker phone plug. Jack on right rear flange of chassis is for input to amplifier.



A heavy-duty power supply, Fig. 3, is needed. In addition to the filament, plate, and screen voltages, it is necessary to provide a voltage supply for the fixed bias used in the output stage. This bias supply could be provided by a separate transformer, but the method shown in the schematic works very nicely, is simple in nature, and requires no additional transformer. The power transformer (*Chicago* PSC-250) supplies the bias through a special arrangement of taps on the high-voltage winding. Each of these taps is connected to a cathode of a 6H6 tube, and the plates of the tube are tied together, supplying a voltage which is negative in polarity with respect to the center tap of the transformer winding. This voltage is filtered and is fed to the grids of the output tubes through the voltage dividing potentiometer R_{28}. This arrangement provides a very simple and convenient means of adjusting the output tube bias. The PSC-250 transformer has three heater windings, one which delivers 6.3 volts and two which deliver 5 volts each. One of the 5-volt windings is used for the heater of the 6H6, and although this tube's heater rating is 6.3 volts this slight difference in voltage does not impair the operation of the tube. Two 5U4G tubes are used as high-voltage rectifiers. The resistors R_1 and R_2 in the power supply are instrumental in protecting the condensers C_1 and C_2 from voltage surges during the warm-up time of the amplifier. The filter choke is a *Chicago* RS-8300 which will handle up to 300 ma., and which has a d.c. resistance of only 70 ohms. Excellent filtering is obtained with low voltage drop. This power supply very adequately meets the requirements of the amplifier. After several hours of operation the power transformer becomes only slightly warm, and what little heat is present seems to be acquired as much from the heat generated by the rectifier tubes as from within the transformer itself.

If low distortion is to be maintained during peak power, it is necessary that the voltage supplied to the screens of the output tubes be kept as stable as possible. Quite good stability could be obtained by means of a heavy bleeder circuit, but it was felt that somewhat better results could be obtained if voltage regulator tubes were used. Two VR150 tubes are used in series, and are fed from a 5000 ohm, 20 watt resistor, R_3. This regulated

(*Continued on page* 146)

ELECTRONIC COUNTER

Fig. 1. The electronic counter with its associated pulse shaper in its cabinet.

By ERWIN LEVEY

A simple electronic unit which can be used for innumerable counting tasks. It may be elaborated at will by the builder.

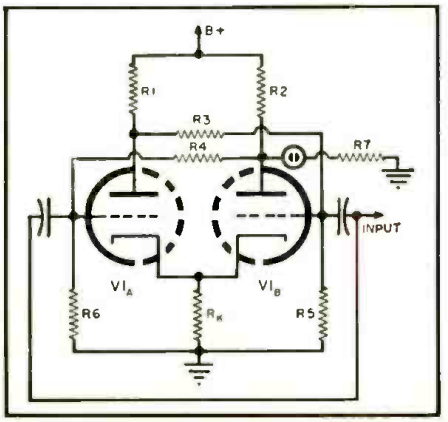
ELECTRONIC counters are used in many new types of instruments and equipment that have been developed in the past few years. They are utilized in computers, radiation counters, precision timers, and automatic control systems for counting and sorting. Some of these devices, especially computers, require hundreds or even thousands of tubes. In order to simplify fabrication and maintenance, a unitized system of construction is often used. Small plug-in chassis which contain a number of tubes and their associated components are built as separate units. Identical prototypes can then be used to assemble the final machine. In addition, these units are often interchangeable in different pieces of equipment.

A basic counter unit built for experimental purposes is shown in Fig. 1. The tally of this four-stage prototype, which can count up to sixteen, is shown visually on the front panel by means of neon lamps. Only four indicators are needed since a binary rather than a decimal counting system is used. This will be explained separately in a later section of the article.

Most counters are derived from the basic *Eccles-Jordan* trigger circuit shown in Fig. 2. The circuit, which uses a dual triode, has two stable conditions of operation. In one, V_{1A} is conducting and V_{1B} is cut-off; in the other, V_{1A} is cut-off and V_{1B} is conducting. The circuit will maintain either of the two states until a signal is applied to reverse the action. Because of this unique characteristic it is frequently referred to as a "flip-flop."

Each stage functions basically as an amplifier. However, the plate of V_{1A} is directly coupled to the grid of V_{1B} by resistor R_3, and the plate of V_{1B} is directly coupled to the grid of V_{1A} by resistor R_4. Actually, the circuit components form two voltage divider networks. This can be seen more clearly by reference to Fig. 3A where the circuit has been redrawn to accentuate this fact. Here, V_{1A} is cut-off and V_{1B} is conducting; this will be referred to as condition 1. The two grids are tied together through blocking condensers. If a negative pulse is applied to the input it will have no effect on V_{1A} since this tube is already cut-off. However, it will overcome the positive bias on the grid of V_{1B} and force this tube to stop conducting. As a result, the status of the two tubes will be reversed. When V_{1B} is biased to cut-off by the negative input pulse, the plate current will decrease and the plate voltage will increase. This positive voltage change impressed on the grid of V_{1A} will immediately cause the tube (V_{1A}) to conduct heavily. This in turn means a low plate voltage on V_{1A}. This drop in voltage is essentially negative when impressed on the grid of V_{1B}. This feedback pulse will augment the input signal to insure that V_{1B} will remain cut-off. The

Fig. 2. Basic Eccles-Jordan trigger circuit.



voltages which exist in the circuit for this condition of operation are shown in Fig. 3B. With V_{1A} conducting and V_{1B} cut-off condition 2 exists. The circuit will remain in this state until another signal pulse is applied to the circuit. The negative pulse will always cause the conducting tube to cut off and thereby reverse the operating states. The change is produced instantaneously. A separate pulse is required for each change, two pulses are necessary to produce a complete cycle.

Visual indication is provided by a neon bulb connected from the plate of V_{1B} to ground through a series-limiting resistor, R_2. A neon bulb requires approximately 60 volts for firing, that is, to be illuminated. In condition 1 (see Fig. 3A) when V_{1B} is conducting the plate voltage is lower than the critical value and the lamp is extinguished. In condition 2 (see Fig. 3B) V_{1B} is cut off and the plate voltage is high enough to light the lamp.

The explanation of the basic circuit serves to point out the important features of operation. However, the circuit shown has several limitations which tend to limit the stability of the system. Since the two grids are coupled together at the input, a "pulse-dodging" problem is encountered. When the negative input trigger is applied, it will tend to override the positive signal fed back to the other tube. As a result, the circuit is critical with respect to pulse amplitude and shape. In order to overcome this, several variations have been devised. The circuit used in the model constructed is shown in Fig. 4. A resistor common to each of the plate load resistors is added in the "B-plus" line. The signal is fed in at the junction of the plate load resistors and the series resistor, R_k. This overcomes the mutual coupling of the grids and improves

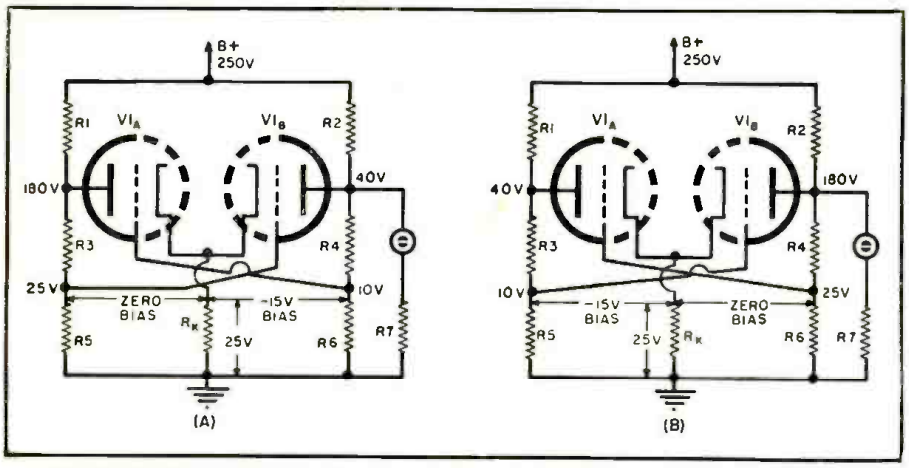


Fig. 3. (A) Trigger circuit in Condition 1. V_{1A} cut-off and V_{1B} conducting, neon lamp extinguished. (B) Circuit in Condition 2 with V_{1A} conducting, V_{1B} cut-off, lamp lighted.

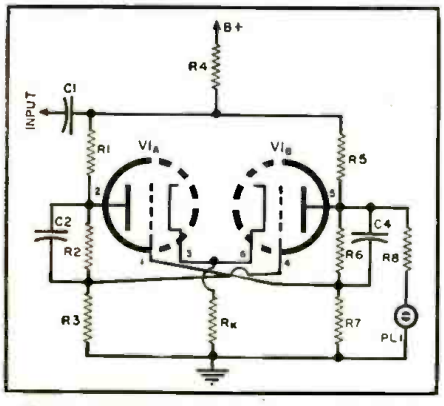


Fig. 4. Modified counter stage. The final unit is made up of four of these stages. They are identical with the exception of change in cathode circuit (Fig. 5). Refer to Fig. 5 for parts identification, values.

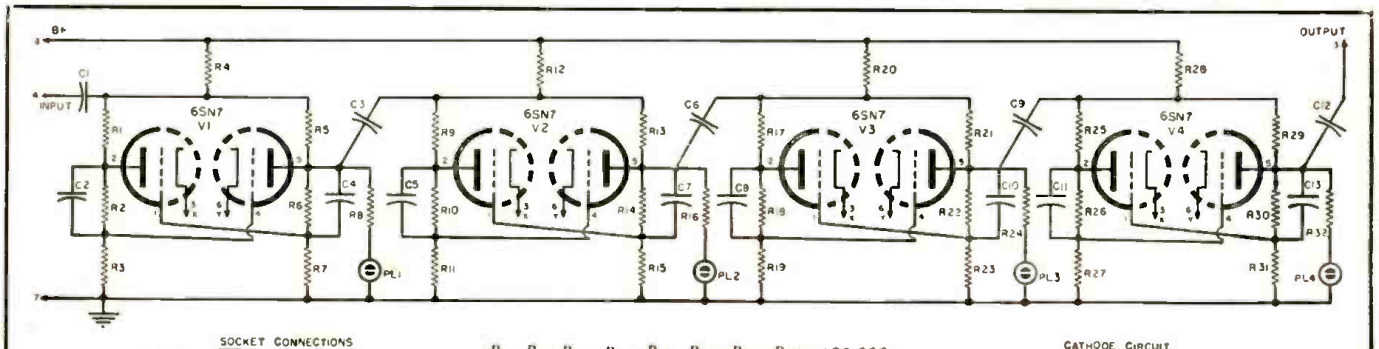
the stability. In addition, a small condenser is connected in parallel with each of the plate-to-grid coupling resistors in a single stage. This helps to sharpen the abrupt action of the changeover during operation. The complete circuit, which uses four identical counter stages is shown in Fig. 5. (A more detailed description of trigger and counter circuits is given in the references listed at the end of this article).

The chassis is constructed from four pieces of aluminum. The upper and lower plates, made of heavy gauge metal, are 8½" x 2½"; the front panel is 6" x 2½"; the rear panel is 3¼" x 2½". The individual parts are screwed together for final assembly. The sockets are spaced two inches on centers. From the photographs it can be seen that all the parts for an individual stage are mounted on a turret socket. The circuit diagram for each of the identical counter stages is shown in Fig. 4. Since a comparatively large number of components is used, the layout is simplified by using this method of construction. Wire the four individual stages on their sockets before mounting. The values of all similar resistors should be checked to insure that they are closely matched. The values should be within 10%; a 5% tolerance is even more desirable. (When the unit shown was first constructed this fact was overlooked and as a result it was necessary to replace numerous parts to secure proper results). A check of all parts before mounting will eliminate many headaches when the unit is finished.

After the individual turrets are wired and checked they should be mounted; the connections between units can then be made. The next step is to mount the neon lamps. These are type NE-2 and are secured individually in ¼" rubber grommets. The ¼" holes for the grommets are 1" apart. The cathode resistor and bypass condenser are placed at the rear of the bottom plate. After all the parts are mounted on the individual plates the complete unit can be assembled. The external connections are made to an octal socket on the rear plate. Because of the type of layout, the circuit is relatively easy to assemble. The directions have been given in detail to simplify the process.

One feature not noted previously is that a counter must have provision for a "zero-set." That is, each time the circuit is put in operation the count must start from zero. In the circuit shown, this is accomplished in the cathode circuit. By referring to the circuit in Fig. 5 it can be seen that there are essentially two separate cathode circuits. The cathodes (pins 3 and marked *X*) are connected together, while the cathodes (pin 6, marked *Y*) are also connected together. These are brought to opposite sides of resistor R_{33} (47,000 ohms) marked respectively *X* and *Y*. This resistor is paralleled by a normally-closed "*Microswitch*" which shorts out the resistor during normal operation. The main cathode bias is provided by resistor R_K (5000 ohms) and its associated bypass condenser C_K (100 μfd.). For reset, the switch is pushed momentarily. Resistor R_{33} is thereby inserted in series with one of the cathode circuits. The unequal bias on the tubes will force the left-hand triode of each tube to cut off (and thereby extinguish all neon lamps).

Fig. 5. Complete circuit diagram and parts list for the four-stage electronic counter. See Fig. 4 for detailed drawing of single stage.



R_2, R_6, R_{10}, R_{14}, R_{18}, R_{22}, R_{26}, R_{30}—100,000 ohm, 1 w. res.
R_4, R_{12}, R_{20}, R_{28}—15,000 ohm, 1 w. res.
R_8, R_{16}, R_{24}, R_{32}—470,000 ohm, ½ w. res.
R_K—5000 ohm, 10 w. wirewound res.
C_1, C_3, C_6, C_9, C_{12}—100 μμfd. mica cond.
C_2, C_4, C_5, C_7, C_8, C_{10}, C_{11}, C_{13}—50 μμfd. mica cond.
C_K—100 μfd., 50 v. elec. cond.
PL_1, PL_2, PL_3, PL_4—1/25 w., wire terminal, neon bulb (Type NE-2)
S_1—Reset switch (normally closed "Microswitch")

R_1, R_5, R_9, R_7, R_{11}, R_{13}, R_{15}, R_{17}, R_{19}, R_{21}, R_{23}, R_{25}, R_{27}, R_{29}, R_{31}, R_{33}—47,000 ohm, 1 w. res.

V_1, V_2, V_3, V_4—6SN7 tube
Note: All parts are mounted on octal turret socket (Vector type 8-0-9T)

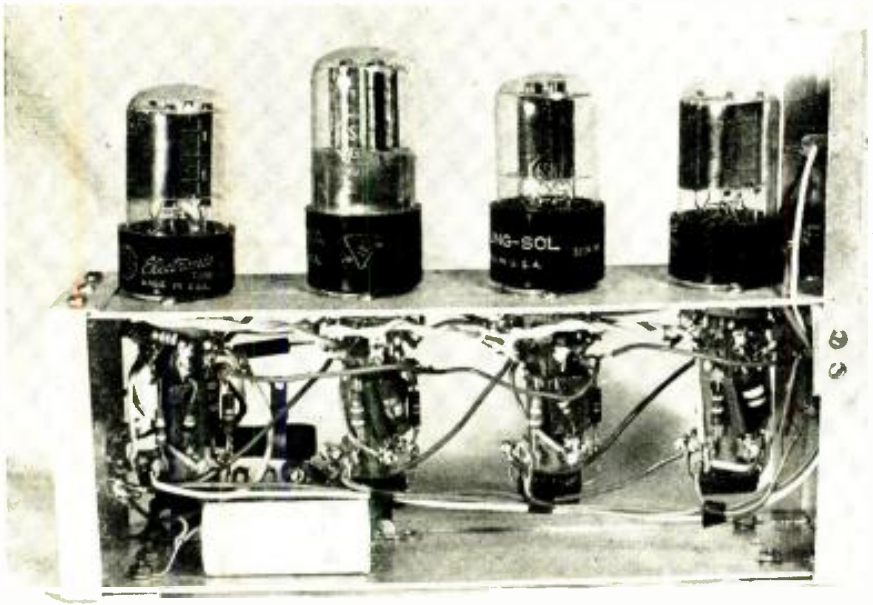


Fig. 6. Side view of the electronic counter. Note the turret socket construction.

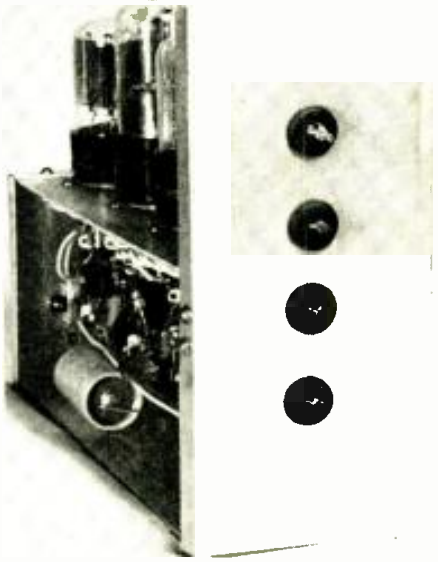


Fig. 7. Front view showing neon lights.

The reset switch does not show in the photographs. It is mounted at the rear of the counter chassis. However, it can be placed on the front panel below the neon indicator lamps. This is a more accessible position for normal use.

An input stage is usually required to provide the coupling between the original signal source and the counter itself. The circuit used depends upon the type of pickup device. In this case, a modified *Eccles-Jordan* trigger is used as a pulse shaper. The circuit is shown in Fig. 8. It is similar to the type originally illustrated in Fig. 2. However, in this case an unsymmetrical system is used. The grid leak resistor of V_{1A} (R_2) is much larger than the grid leak resistor of V_{1B} (R_3). With this arrangement V_{1A} will always be cut off. The pickup switch which activates the counter is a normally-open "*Microswitch*" connected across the grid leak resistor of V_{1A}. When the switch is actuated, the resistor is shorted; this reverses the operating states of the tubes. As soon as the switch is opened the circuit returns to its original state. A momentary push is sufficient to produce a pulse. The circuit operates as a single-shot pulser; only one input pulse is required for a complete cycle. The signal from the grid of V_{1A} provides a 150 volt negative pulse. The output from the plate of V_{1B} provides a 30 volt negative pulse. For the system described, the signal was coupled from the grid. (It is possible to operate a counter from any type of pickup device, the critical part is the input pulse-shaper).

The components for the pulse-shaper are mounted on a turret socket. The pulse-shaper and pickup switch are mounted in a small 4" x 4" x 2" utility box. The switch is placed on one of the side panels. Fig. 9 is a photograph of this unit. A well-filtered power supply which can supply about 250 to 300 volts at 50 ma. is required. If available, a regulated supply is even better.

After the circuit has been completely assembled and all wiring closely checked, the unit can be placed in operation. When the power supply is first turned on all four neon bulbs will probably be lit. As the tubes warm up some of them will flicker and then go out. After sufficient warm-up time (about one minute) push the reset switch. This will extinguish all lamps and represent a zero count.

Another word of caution. The four tubes used in the counter stages should be closely matched. They do not all have to be new, but should have similar emission characteristics. A quick check on a tube checker is a good idea.

As mentioned in the beginning of the article, the binary system is utilized in the counter. Each circuit has two conditions of operation. These are shown by a neon lamp which is either on or off. This is indicated mathematically as 2^N. N stands for the number of stages, which in this case

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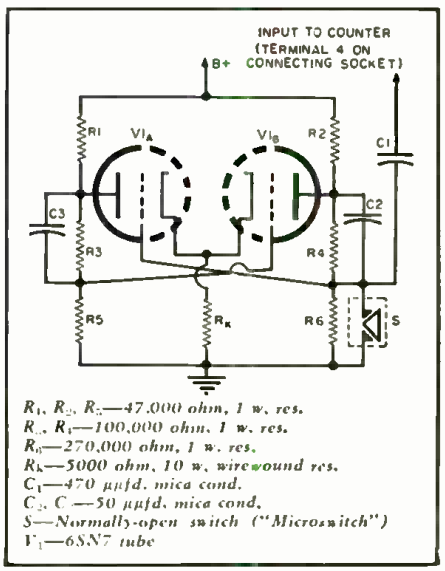


R_1, R_2, R_3—47,000 ohm, 1 w. res.
R_4, R_5—100,000 ohm, 1 w. res.
R_6—270,000 ohm, 1 w. res.
R_K—5000 ohm, 10 w. wirewound res.
C_1—470 μμfd. mica cond.
C_2, C_3—50 μμfd. mica cond.
S—Normally-open switch ("Microswitch")
V_1—6SN7 tube

Fig. 8. Circuit of the pulse shaper which is used in conjunction with the counter.

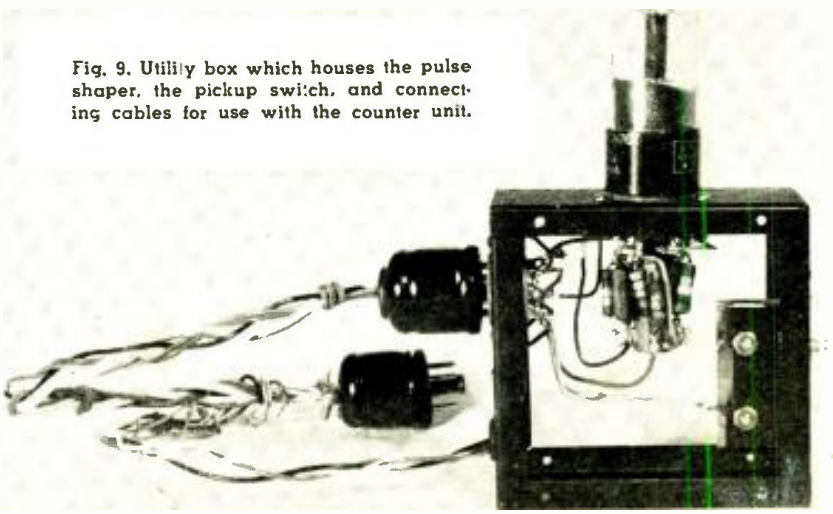


Fig. 9. Utility box which houses the pulse shaper, the pickup switch, and connecting cables for use with the counter unit.

ASSEMBLE YOUR OWN HEARING AID

Fig. 1. Over-all view of hearing aid. An even more compact assembly is possible.

By
E. G. LOUIS

Using a printed circuit and subminiature parts, this tiny instrument can be assembled in from four to six hours.

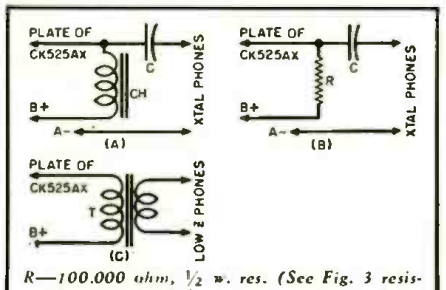
ALTHOUGH commercially-built hearing aids generally cost from $75 to well over $150, the basic electronic parts needed for the construction of a small hearing aid may *cost less than $35 at regular wholesale prices!* Neither "special" components nor unusual skill is required to assemble such a unit. All the parts needed are commercially available at most wholesale radio supply houses, and the average technician should have little or no trouble completing the assembly of such a compact hearing aid, similar to the one shown in Fig. 1, in from four to six hours.

Even though "home-built," the hearing aid shown in Fig. 1 is quite small, as can be seen by comparing it to the package of king-size cigarettes. However, it can be assembled in a still smaller size if desired! Referring to the interior view of Fig. 4, it is readily apparent that considerable "waste space" is present inside the plastic case. If a smaller case had been available at the time of construction, the unit could have been assembled even more compactly, without appreciably more skill required for construction, or at any greater cost.

Probably the only major differences between the hearing aid shown and commercially-manufactured units are: (a) the use of a standard midget earset in place of a "custom-molded" earpiece; (b) the use of a standard crystal microphone cartridge rather than a difficult-to-obtain subminiature microphone; and (c) the use of a plain plastic case.

However, the important characteristics of sensitivity (amplifier gain), power output, frequency response, and long battery life compare favorably with most commercially available units.

Fig. 2. Alternate circuits for hearing aid shown in Fig. 3. (A) Choke output for crystal earset. (B) Resistor output for crystal earset. (C) Transformer output circuit, required for low impedance earset.



R—100,000 ohm, ½ w. res. (See Fig. 3 resistor output circuit)
C—.01 μfd. disc ceramic cond.
CH—Small choke (UTC SO-5, SSO-5 or Stancor HC-101)
T—Small output trans. (UTC SO-4, SSO-4, or Stancor HA-201)

Circuit Description

As can be seen by reference to the schematic diagram given in Fig. 3, the complete hearing aid consists of a microphone, a three-stage audio amplifier, and an earphone output, with power supplied by small batteries. The amplifier itself is a complete printed circuit unit, with the only connections required by the builder shown outside the dotted line rectangle, that is, the builder need only wire the leads to R_1 and the "mike," to the volume control, to the tone control and headset, and to the batteries and "on-off" switch.

In operation, sound picked up by the microphone is converted into electrical signals and applied across grid resistor R_1 to the grid of the first voltage amplifier tube (CK512A). The amplified signal appearing in the plate circuit of this stage is applied through a .001 μfd. d.c. blocking condenser to the volume control (R_2) and thence to the grid of the second voltage amplifier stage.

Additional gain is supplied by the second stage, with the audio signal appearing across the 1 megohm plate load resistor applied through another .001 μfd. coupling condenser to the grid of the power output stage (CK525A). From here the signal is applied to the midget earset.

The tone control is a conventional high frequency "losser" type circuit and consists of C_1 and R_3. As the value of R_3 is reduced, C_1 becomes more and more effective in bypassing the higher frequency components of the amplified signal.

A few characteristics of the printed circuit amplifier are worth noting. First, the two voltage amplifier tubes have their filaments connected in series, with the voltage drop acting to provide bias for the second stage. Bias for the output stage is obtained from the voltage drop across a 1500 ohm resistor between "B—" and circuit "ground." Stage decoupling is provided for the first voltage amplifier by a 700,000 ohm resistor and a .04 μfd. bypass condenser in the "B" supply circuit.

Construction Hints

The entire assembly, including batteries, is mounted in a small plastic

case. Although the layout used by the author is easily observed in Fig. 4, this layout need not be followed exactly, if care is taken to keep the "input" and "output" leads of the amplifier well separated. In fact, "layout" becomes primarily a matter of conveniently fitting the necessary components into the case used.

Batteries are mounted in the model shown by cementing small metal strips along one side of the case for the "B—" and "A+" connections, and using an "expanded" *Fahnestock* clip and a small "L" bracket for the "B+" and "A—" connections, respectively. Small machine screws are used for mounting the clip and bracket in place.

Volume and tone controls are mounted using the small machine screws and nuts furnished with them. A mounting template is also furnished by the manufacturer with each of these two components, and it is only necessary to drill the indicated holes.

The "output" jack is a *Walsco* type 791 jack which was cut to about half its normal length before assembly. It is cemented in place using *Duco* cement or its equivalent. The microphone and printed circuit amplifier are similarly cemented to the plastic case.

It was necessary to replace the phone plug furnished with the *Telex* midget earset with a *Walsco* type 790 plug to match the midget output jack.

The microphone used by the author was purchased as a surplus item for less than $1.50 from the *Leotone Radio Corporation*, 67 Dey Street, New York 7, N. Y. However, if this item is not available, any standard high impedance "mike" cartridge may be used instead—the *Shure* type R7 cartridge is excellent for use in this application.

Wiring Hints: When wiring subminiature components, certain precautions should be observed to avoid damaging parts. Use small diameter hook-up wire, preferably *smaller* than #22. Use a small soldering pencil and keep it well tinned. Complete the soldering as quickly as possible to avoid overheating.

Most connections are made as simple "lap" joints without attempting to make a good mechanical connection first (as is general practice in conventional wiring).

Once the wiring is completed, and before the unit is tried, a careful check of the wiring and of all connections should be made. Make sure that there are no errors in wiring, that no parts are accidentally shorted, and that excessive amounts of solder have not been used. If too much solder has been used on any terminals, carefully remove the excess using a clean soldering iron.

Circuit Modifications

A number of circuit modifications are possible to suit the individual requirements of the builder.

First, the tone control circuit may be left out completely if desired. Or, if more effective control is preferred, C_1 may be replaced by a larger condenser—as high as .05 μfd. may be used here.

Several output circuits which may be used instead of the circuit shown in the schematic diagram are illustrated in Fig. 2. Any of these circuits will give satisfactory results with the type of earphones suggested.

For a crystal earset, either the circuit shown in Fig. 2A or 2B is satisfactory. Somewhat greater gain is obtained with the choke output (Fig. 2A), but better frequency response is obtained with a resistor output (Fig. 2B).

If a low impedance earset is to be used, transformer output is mandatory, as illustrated in Fig. 2C.

Should the builder use a high impedance output circuit, he may find it necessary to shield the amplifier to prevent feedback and oscillation. This step is best accomplished by using a small metal case rather than a plastic case when carrying out the assembly, taking care to mount any exposed parts on plastic to prevent shorts. The case is connected to "A—". Another alternative is to use aluminum foil or tinfoil to form an interior shield, cementing the foil to the case.

Either higher or lower "B" voltages may be used, with satisfactory results being obtained from as little as 15 volts to as high as 67½ volts. A 67½ volt supply should be used only with a resistor output. The lower "B" voltages will give better results when used with transformer output.

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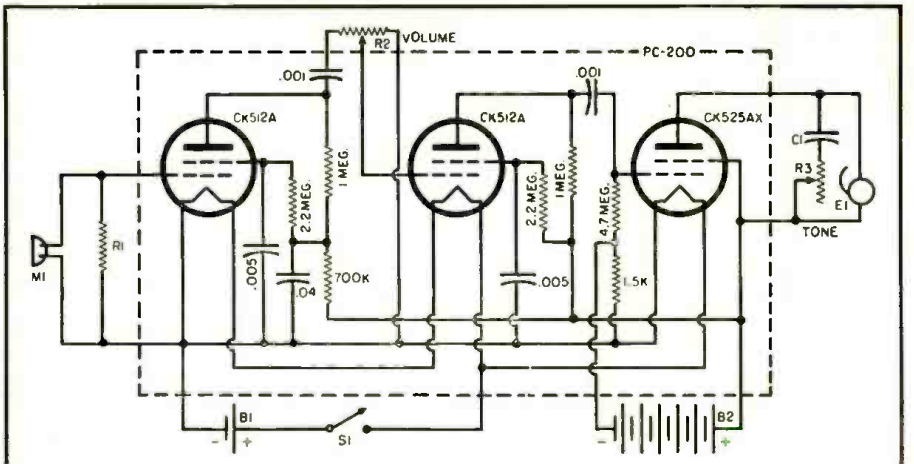


R_1—4.7 megohm, ½ w. res.
R_2—3 megohm miniature volume control with sw. (Centralab ±B16-224) "Volume"
R_3—1 megohm miniature volume control (Centralab ±B16-120) "Tone"
C_1—.01 μfd. disc ceramic cond.
S_1—S.p.s.t. switch (on R_2)
B_1—1.5 volt "Z" penlight cell or Mallory 1.2 volt RM-1200 mercury cell
B_2—30 volt hearing-aid battery (Burgess U20E)
M_1—Crystal mike cartridge (Shure R7)
E_1—Hearing-aid type earset (Telex A4680 or Type 4670 if transformer output is used)
PC-200—Printed circuit amplifier (Centralab "Ampec"). Type PC-201 may also be used.
2—CK512A tubes (use CK512AX)
1—CK525AX tube (tubes supplied with PC-201)
1—Small plastic box
1—Type 790 plug (Walsco)
1—Type 791 jack (Walsco)

Fig. 3. Complete schematic. Circuit within dotted lines is a printed circuit amplifier.

Fig. 4. Hearing aid layout. Parts placement is not critical and may be changed at will.

KEYED A.G.C. SYSTEMS

By **MILTON S. KIVER**
Pres., Television Communications Institute

Typical keyed a.g.c. circuits with explanation of how they operate to increase TV receiver noise immunity.

KEYED a.g.c. systems for television receivers have grown in popularity ever since their introduction several years ago. While many simpler a.g.c. systems exist, they do not possess the ability of the keyed system to react quickly to rapid fluctuations in signal strength nor can they equal the stability of the keyed system in the presence of noise pulses. Thus, while cost is an important factor in receiver design, it is partially sacrificed here in the interests of improved receiver operation.

In dealing with keyed a.g.c. systems, the service technician will find that although all are essentially similar, sufficient variations exist to require a careful analysis of each circuit before any service work is attempted. In this article the more popular keyed a.g.c. systems will be analyzed and discussed.

A simplified illustration of the basic keyed a.g.c. system is shown in Fig. 1. A 6AU6 pentode is so connected that a portion of the detected video signal is applied to its control grid. The signal is chosen with the sync pulses extending upward, *i.e.*, in the positive direction. The plate of the 6AU6 is connected to a winding on the horizontal output transformer and receives from this transformer a positive pulse of voltage at the end of each horizontal line.

Now, the 6AU6 is biased so that it will not conduct unless the grid and plate are simultaneously driven positive. If just one of these voltages is present, without the other, the 6AU6 does not ordinarily conduct.

The pulses applied to the grid are the incoming horizontal sync pulses. When these pulses arrive, the electron beam traveling across the face of the picture tube is about to start its retrace. At the moment this occurs, a large pulse of voltage is developed in the horizontal output transformer and a portion of this pulse is fed to the plate of the 6AU6. With both positive pulses of voltage present, the 6AU6 a.g.c. tube is keyed into conduction and the a.g.c. network bias is established.

Note the foregoing sequence of events carefully because they contain the key to the operation of this system. Positive pulses must be present at both control grid and plate of the 6AU6 in order for the tube to pass current and establish the proper a.g.c. bias. The plate receives no positive voltage other than that furnished by the horizontal output transformer.

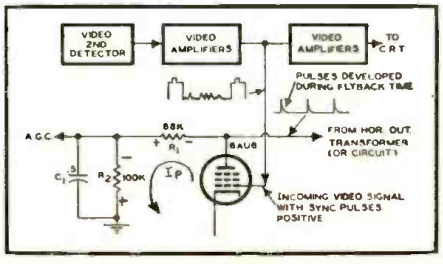
Since the 6AU6 conducts only when the sync pulses are active at its control grid, and is inactive throughout the remainder of the video signal, it is evident that this tube and, consequently, the a.g.c. network is responsive to undesirable noise pulses for only a very short time. Actually, the sync pulses occupy but 5% of the composite video signal and therefore only 5% of the total noise can be effective.

Typical Keyed A.G.C. Systems

Typical of the simpler keyed a.g.c. systems in use is the one shown in Fig. 2. The video signal, with sync pulses positive, is tapped off the load resistor, R_1, of the video amplifier and fed directly to the control grid of the 6AU6 keyed a.g.c. tube. The 39,000-ohm series resistor, R_2, in this connecting line serves to isolate the input capacitance of the 6AU6 from R_1. The video signal is in its d.c. form (*i.e.*, still retains both a.c. and d.c. components) because of the d.c. path from the output of the video second detector to the grid of the 6CB6 video amplifier tube.

Since the control grid of the 6AU6 is directly connected into the plate

Fig. 1. Simplified block diagram of the basic components of keyed a.g.c. systems.



circuit of the video amplifier stage, it possesses a positive potential. To offset this, both the cathode and screen grid of the keyer tube are given even greater positive voltages. The d.c. voltage between grid and cathode here is −15 volts and this is sufficient to prevent tube conduction, even when the plate receives a positive pulse. However, the peak-to-peak voltage of the video signal from the 6CB6 video amplifier is on the order of 25 volts and thus the bias is overcome when the sync pulses are active.

The required pulsing voltage for the keyer plate is obtained from a tap on the secondary of the horizontal output transformer. These pips have an over-all voltage value of 450 volts, which is more than sufficient to drive the tube.

When current does flow through the tube and plate circuit, a negative voltage is developed across R_2 and R_1. This voltage is divided equally between the resistors, and that portion which R_1 receives is used as the a.g.c. bias. The r.f. amplifier, and the first and second video i.f. amplifiers are the tubes controlled. R_1 and C_1 form the principal filtering components, although other resistors and condensers aid in this purpose, too.

Zenith television sets (in 1951) employed a keyed a.g.c. system which differed slightly from the foregoing circuit. The *Zenith* circuit is shown in Fig. 3. The video second detector is a germanium crystal, a 1N64. The detected video signal is developed across R_{61} (4700 ohms) and applied *via* L_{55} to the grid of V_{5A}. Although the manufacturer labels this tube as a noise limiter and inverter, it is essentially an amplifier, with the signal which is developed at the plate being fed to a second video amplifier.

The cathode resistor for V_{5A} (R_{53}, 820 ohms) is also the cathode resistor for V_{12A}, which is the keyed a.g.c. tube. Hence, the full video signal is applied to the cathode of the 6SN7 a.g.c. tube. The polarity of the video signal here is such that the sync pulses are negative.

The plate of V_{12B} is connected to the cathode of the horizontal sweep oscillator. The voltage waveform developed here is a modified sine wave, with the positive peak somewhat more pronounced than the negative peak. When this oscillator is properly synced to the incoming signal, the

positive peak of the sine wave occurs at the same time that the sync pulses appear at the cathode of V_{12a}. Since negative pulses at the cathode are equivalent to positive pulses of voltage at the grid of V_{12a}, the tube is thus triggered into conduction and plate current flows. Condenser C_{29} charges up to a negative value determined by the strength of the current flowing. When the signal is strong, the negative voltage developed is high; when the signal is weak, less negative voltage appears. This a.g.c. voltage is then fed to the 1st, 2nd, and 3rd i.f. amplifiers and to the r.f. amplifier and converter as a control voltage.

An a.g.c. delay voltage is applied to the grid of V_{12a}. Its purpose is to permit adjustment of the amount of negative a.g.c. voltage which V_{12a} develops in order that this voltage may be set for the particular signal conditions prevailing at the receiver location.

The procedure for correctly setting this control is as follows: Connect a calibrated oscilloscope through a 10,000-ohm isolating resistor to the grid of V_{3a}. This will show you the video signal at this point. Select the strongest TV signal available and observe it on the screen. Adjust the a.g.c. delay control for 2.5 volts peak output.

A.G.C. with Diode Clampers

Since it is frequently desirable for the reception of weak signals that the negative bias on the r.f. amplifier be as low as possible, a number of manufacturers have been incorporating an additional diode tube (or a triode connected as a diode) into the a.g.c. system. The purpose of this tube is to keep the bias on the r.f. amplifier close to zero until the incoming signal reaches a moderate level. In this way the sensitivity of the set is high for weak signals, and properly reduced when the signal level is high. Diode clampers may be used with any a.g.c. system, keyed or otherwise.

A keyed a.g.c. circuit containing a diode clamper tube (as these tubes are called) is shown in Fig. 4. V_1, the keyer tube, develops a negative bias voltage across R_1, R_2, and R_3 by means of the pulses of current that flow through these three resistors. The control bias for the i.f. stages is that developed across R_2 and R_3. The r.f. amplifier receives less negative voltage because it obtains only the voltage developed across R_3.

Consider, now, the circuit shown to the right of point "A." Here we find a fourth resistor (R_4) and a diode tube. Both of the new components are tied into the r.f. line and the manner in which they affect the voltage on this line depends upon the negative voltage which the a.g.c. tube develops. Let us, as a start, assume that in the absence of V_2 and R_4, point "A" is negative by 1 volt. If, now, we add R_4 to the circuit, then R_3 and R_3 form a voltage divider network across the 325-volt "B+" line and part of this positive voltage will appear across R_3. To be exact, about 3 volts positive, due to the high value of R_4 and the relatively low value of R_3. Thus, we have +3 volts across R_3 from the +325 volt line, and −1 volt from the a.g.c. tube. The net result is to make point "A" positive by 2 volts.

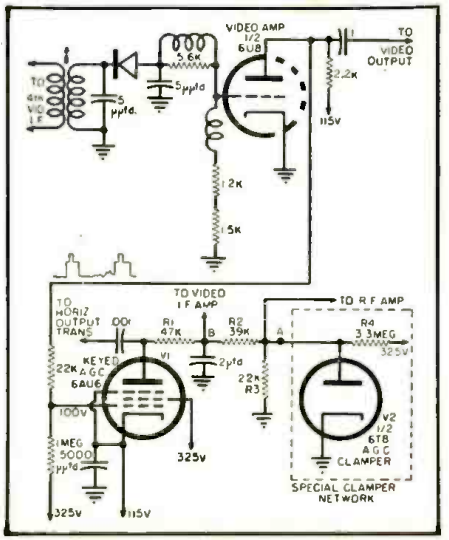
Now, all this did not take V_2 into account. Since the diode is connected from point "A" to ground, its plate will be made 2 volts positive with respect to its cathode, and conduction through the tube will occur. A diode conducting has a fairly low internal resistance so that, for all practical purposes, point "A" is brought to ground potential and the full 325 volts is dropped across the 3.3 megohm resistor.

Note that the key to this particular behavior is based upon two factors: First, the use of a high-value resistor between the "B+" point and the tube; and second, the fact that the internal resistance of V_2 is low when the tube conducts. This sets up a voltage divider network wherein practically all of the positive voltage is dropped across R_4, leaving very little at point "A."

The r.f. amplifier tube is tied into point "A" and so, when the negative voltage that the a.g.c. tube produces is low, the r.f. tube receives essentially a zero bias. The i.f. tubes, under the same conditions, receive a negative voltage. This is because they are isolated from point "A" by R_2 (a 39,000-ohm resistor) and also because the line going to the i.f. tubes ties in at point "B," which is closer to the keyed a.g.c. tube and hence subject to a greater negative voltage.

When the incoming signal increases in strength, the negative voltage produced by V_1 rises, too. This means that the i.f. tubes are given a higher negative bias. At point "A," the diode will continue to conduct as long as the positive voltage (provided by the 325-volt line) exceeds the negative

Fig. 4. Keyed a.g.c. circuit using a diode for better r.f. gain control.



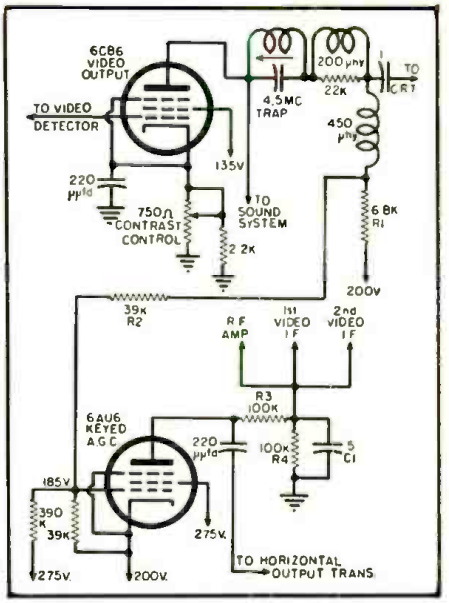


Fig. 2. Partial schematic diagram of a.g.c. circuit used in Pacific Mercury TV receivers. For explanation see text.

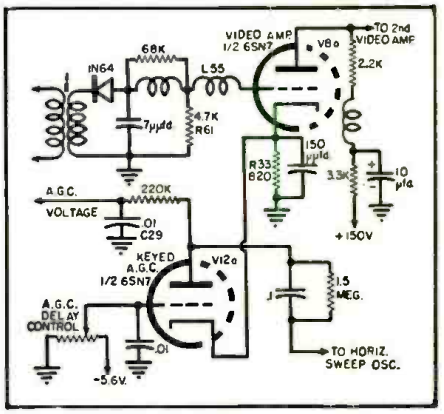


Fig. 3. Early Zenith keyed a.g.c. system.

voltage (produced by V_1). However, when the negative voltage at point "A" exceeds 3 volts, the positive voltage is overridden and the diode tube stops conducting. Thereafter, the r.f. bias will be governed by the voltage variations of the a.g.c. tube. Of course, should the signal strength decrease, a point would be reached when the negative voltage at point "A" would be unable to overcome the small positive voltage present here and V_2 would again conduct, bringing point "A" to zero. Under normal conditions, point "A" does not become positive.

To reiterate, then, the foregoing clamper arrangement is designed to keep the bias on the r.f. stage zero (or close to it) under weak signal conditions, but to permit it to receive a negative voltage when the signal becomes stronger.

When a very sensitive tuner is employed and it is not desired to run the r.f. amplifier bias completely down to zero, then the arrangement shown in Fig. 5 may be employed. This has a keyed a.g.c. tube and load resistors R_1, R_2, R_3 (variable) and R_4. Whenever plate current pulses flow through the

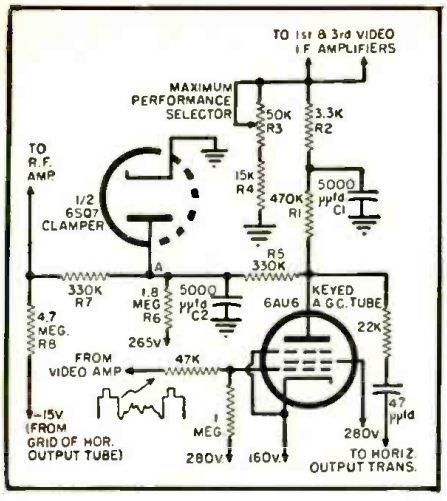


Fig. 5. Schematic of keyed a.g.c. circuit used by Hoffman in its model 21B116.

keyer tube, a negative voltage is developed across these resistors with the plate end of R_1 possessing the most negative potential. The video i.f. stages receive their bias from the voltage developed across R_3 and R_4. R_3 is made variable in order that the i.f. bias may be adjusted for the particular location of the receiver. Reducing R_3, by rotating its center arm, will lower the negative voltage applied to the i.f. stages and thereby increase their gain. This might be desirable in a weak signal area. When the signal level is high, more of R_3 is brought into the circuit, thereby raising the negative bias of the controlled video i.f. stages.

Leading off from the plate of the a.g.c. tube in a separate circuit is the bias line for the r.f. amplifier. R_5 and C_4 serve as a filter and isolating network, filtering the horizontal sync pulses present in the plate circuit and isolating the clamper tube from the a.g.c. tube and its i.f. line. The presence of R_6 and the diode maintain point "A" at zero potential whenever the incoming signal is weak; when the signal becomes stronger, the potential at point "A" goes negative and the diode ceases to conduct.

Note, however, that point "A" does not connect directly to the r.f. stage, as it did in the previous circuit. Instead, between "A" and the r.f. amplifier there is another network consisting of R_7 (330,000 ohms) and R_8 (4.7 megohms). One end of R_8 is connected to the grid of the horizontal output tube where it receives a potential of −15 volts. If, now, point "A" is at zero volts, then the −15 volts will divide itself between R_7 and R_8, with R_8 getting all but about −1.3 volts which goes to the r.f. amplifier tube grid as a biasing voltage.

Thus, as matters stand, the grid of the r.f. amplifier in this circuit can never become more positive than −1.3 volts unless the horizontal deflection system somehow becomes defective. With strong signals, point "A" is driven negative and this, in turn, raises the negative bias on the r.f. amplifier to above −1.3 volts.

Double-Delayed Keyed A.G.C.

A circuit which is known as a double-delayed keyed a.g.c. system is employed by *Zenith* in its 1953 line of television receivers. The operation of the keyer tube is somewhat reminiscent of the earlier *Zenith* circuit shown in Fig. 3. The rest of the circuit, however, is markedly different.

A diagram of the double-delayed a.g.c. system is shown in Fig. 6. The keyer tube is a triode (½ of a 12AX7). It receives the video signal at its grid with the sync pulses extending in the positive direction. The plate, in its turn, is connected to the grid of the discharge tube located in the horizontal deflection system. From this point, positive pulses are received by the plate of the keyer tube during the horizontal retrace interval. Thus, the positive pulses at the plate and grid of the 12AX7 tube act in concert to produce a voltage in the output circuit of the tube that can vary from about +8 volts under weak signal conditions to −5 volts under moderate-to-strong signal conditions. Positive values of voltage are new to keyed a.g.c. systems and are brought about by (*a*) using a triode tube for the keyer tube instead of the more common pentode and (*b*) by carefully choosing the operating potentials for the various tube elements.

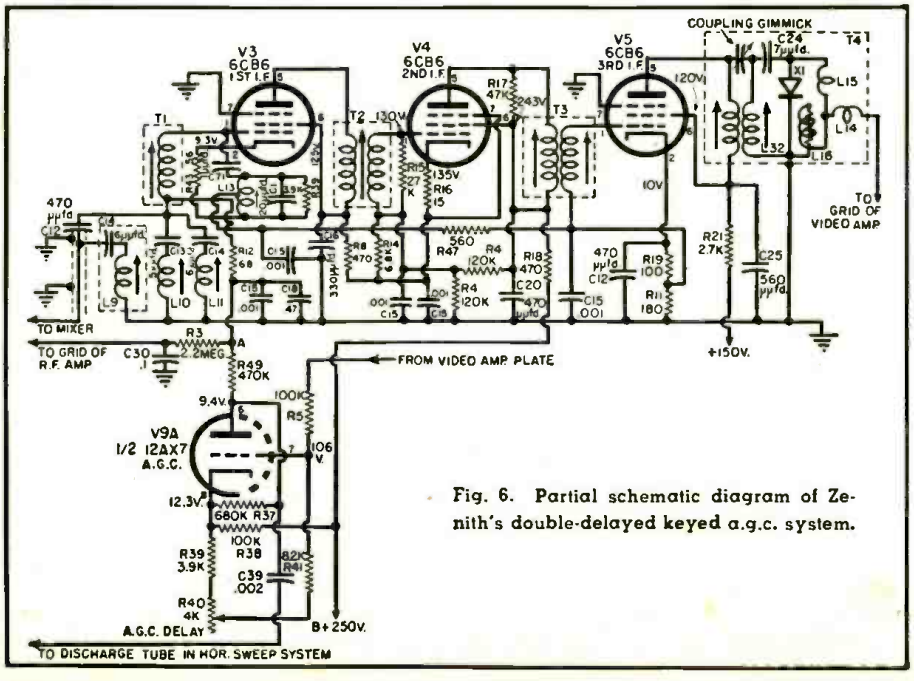


Fig. 6. Partial schematic diagram of Zenith's double-delayed keyed a.g.c. system.

Now let us consider the over-all circuit operation under weak and strong signal conditions. When the incoming signal is weak, the output of the a.g.c. at point "A" is approximately 8 volts positive. This positive voltage is applied to the grid of the 1st video i.f. amplifier, a 6CB6. At the same time, the cathode of the 6CB6 has a positive potential of approximately 9.3 volts. 8 volts of this 9.3 volts is obtained from the drop across one of the cathode resistors of the 3rd i.f. tube. The remaining 1.3 volts is derived from the tube's current flow through L_{13}, and R_{28}, located in its own cathode circuit. Thus, the grid of this first i.f. tube is actually 1.3 volts negative with respect to its cathode.

It will also be seen, from Fig. 6, that the second i.f. amplifier is in series with the first i.f. stage. Hence, any changes in the plate current of the first tube will also affect the second i.f. tube and thus both tubes are directly controlled by the a.g.c. bias.

During these same weak-signal conditions, the grid of the r.f. amplifier is run at a slight negative potential. It might appear from the diagram that the r.f. grid would be positive since it connects to point "A" on the now positive a.g.c. line. However, the 2.2 megohm resistor between the r.f. grid and point "A" is so high that the small amount of grid current (due to contact potential) from the r.f. amplifier is enough to produce a slight negative grid voltage.

When the receiver is used with normal-to-strong signals, the signal voltage applied to the grid of the a.g.c. tube will increase, causing the output of the a.g.c. tube to become 5 or more volts negative. This negative voltage will be applied to the r.f. grid through the 2.2-megohm resistor and decrease the gain of this stage. (With a negative voltage at point "A", no contact current flows through the 2.2-megohm resistor.)

The same negative voltage will also go to the grid of the first video i.f. stage. Under strong signal conditions, the cathode of this 6CB6 is not as positive as it was with a weak signal because it receives less positive voltage from the 3rd i.f. cathode resistor. The voltage at this latter point varies from 8 volts with no signal to 4 volts with strong signals.

The a.g.c. delay control is adjusted as previously described for Fig. 3.

—30—

COUNTER IMPROVES TAPE RECORDER

By
RICHARD H. DORF
Audio Consultant

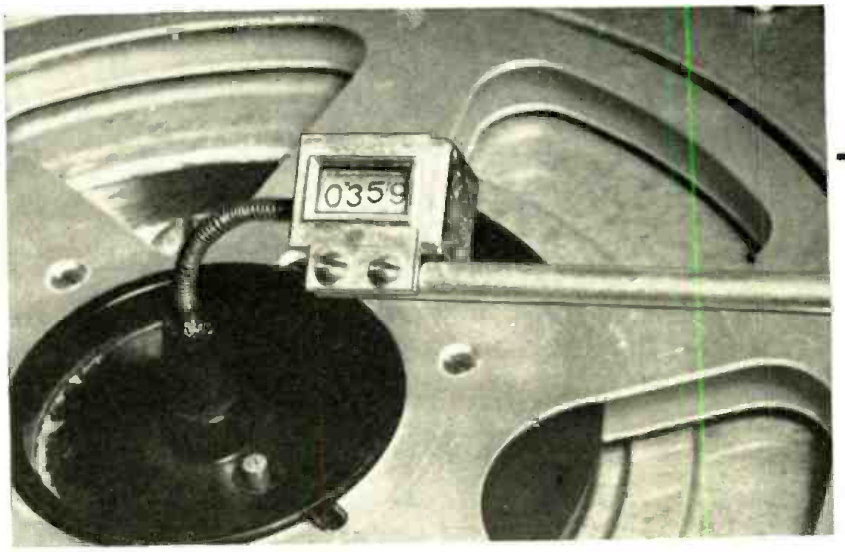


Fig. 1. Close-up view of counter mounted on brass rod. The rod is bent at right angle with lower end pushed into a hole in the wooden case. The counter shaft is connected by a spring to a rubber eyedropper bulb which slips over the take-up reel spindle.

Increase the versatility of your tape recorder by adding an inexpensive counter. All components are readily available.

TAPE recorders have many advantages over disc machines—erasability, noiselessness, long play, and so on—but they are lacking in one great convenience we have become accustomed to in the use of discs. That is the possibility of locating a given portion of the recording in quick order. In tape, if we want to play the second movement of the quartet, for example, we have to thread the tape, then roll it forward until we think we have hit the right place. It usually takes several tries and it is generally an annoying procedure—and all because we really have no good way of knowing just where we are on the 1200 or 2500 feet of the tape.

The counter arrangement shown in the photograph does away with this kind of headache once and for all. Not only is it an advantage for the ordinary home use of tape, but it is indispensable for the professional and semiprofessional user who edits tape or who (like the writer) records music on tape for later transfer to discs. The counter makes it possible to spot any point on the tape and later return to it within an accuracy of about 1 second; it also makes possible the timing of complete selections or portions of selections without playing anything but a few seconds of their beginnings and endings. This is done with the "Timing Chart".

The photograph of Fig. 1 shows a portion of the author's *Concertone* recorder with the timer installed, but the extremely simple system can be placed in the same way on almost any tape recorder which has the standard 5/16-inch center spindles for the reels. In the case of the *Concertone* the NARTB reel adapters cover most of the length of the spindles but there is still enough showing above the adapters to allow connection of the counters. In other machines the spindle may be almost entirely covered by the RTMA reel, but as long as there is a bare sixteenth of an inch showing it is enough.

Four elements make up the counter device. The counter itself is a standard *Veeder-Root* unit obtained by the writer for less than a dollar from *Herbach & Rademan*. The model number of the particular one at hand is A-0114214, but there are probably other models that will do as well. The essential characteristic is that it must have a shaft which advances the count by 1 each time it makes a complete revolution in the clockwise direction (looking at the shaft end) and reduces the count by one for each revolution in the other direction. A unit in good condition should be obtained, one which has negligible shaft friction and needs almost no power to drive it. If the counter is new (not used) it will be satisfactory. A 4-digit counter is necessary although only numbers up to a little over 1400 are used.

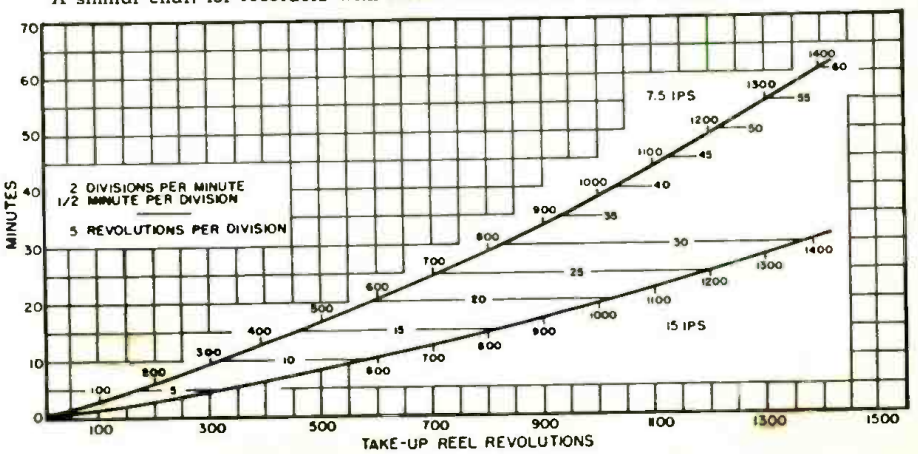
Item 2 is a small spring about 1½ to 2 inches long. The spring should be very light and flexible so that practically no force is required to bend it to a right angle. The spring used by the writer was closewound and its flexibility was increased by pulling it out a little to separate the turns slightly.

The third piece is a rubber bulb from a medicine dropper. They come in different sizes. The one selected should have an inner diameter enough smaller than the outer diameter of the reel spindle so that when it is placed over the spindle it will grip tightly. A bulb with a bevel around the open end is best since that gives a thin wall at the spindle end and will work even with a very small amount of the spindle showing above the reel.

The last item is a length of quarter-

(*Continued on page* 159)

Fig. 2. Timing Chart. Use it to translate counter readings to time any recorder using the NARTB standard hub or reel and at speeds of 7½ or 15 inches-per-second. A similar chart for recorders with RTMA reels can be easily devised by the user.

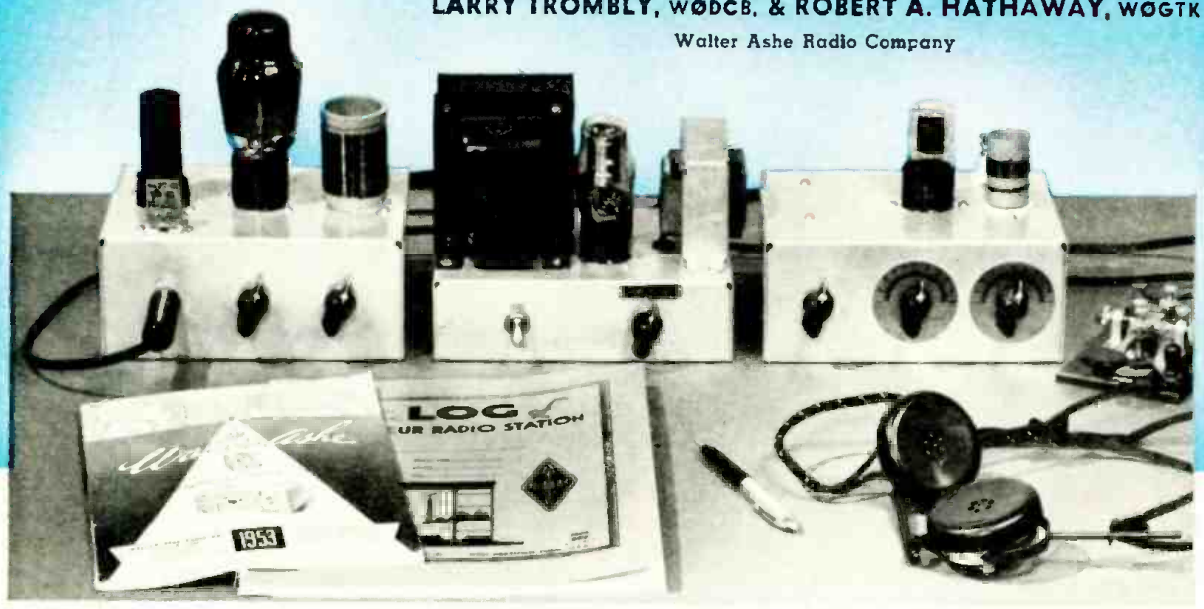


INEXPENSIVE NOVICE STATION

By

LARRY TROMBLY, WØDCB, & ROBERT A. HATHAWAY, WØGTK

Walter Ashe Radio Company



The complete Novice station: an efficient two-tube transmitter, a surprisingly effective simple receiver, and a single power supply for both. With the power supply switch in "receive" position, transmitter may be used for code practice.

Part 1. The transmitter and power supply of a complete station which can cost less than fifty dollars, including the receiver. The receiver will be described next month.

A GLANCE through radio catalogues or at the advertisements in radio periodicals may lead one to the conclusion that amateur radio is a fairly expensive hobby. In fact this belief has discouraged a number of beginners, particularly the younger ones whose supply of cash is limited. With this in mind, the writers have set out to show that it is still possible to get started in amateur radio with a very modest outlay. Twenty-two years ago, one of the writers got on the air after having spent about $22.00. Considering the rise in the cost of living since that time, the cost of the equipment to be described here is comparable and performance is better. Certainly the $22.00 outfit didn't provide you with a T9X signal.

With slight modifications of circuits found in *ARRL's* "How to Become a Radio Amateur" and "The Radio Amateur's Handbook" and using all new standard parts, a complete novice station was built at a cost of slightly less than $50.00. This equipment consists of three units; transmitter, receiver, and power supply. The receiver will be described next month.

The transmitter uses a 6AG7 modified Pierce crystal oscillator which has an untuned plate circuit using a small peaking coil whose inductance approaches self-resonance on 80 meters. The amplifier uses a 6L6 with a pi-section output circuit which permits use of random lengths of wire as antennas. Coil data for both 80 and 40 meters is given in the parts list. An 80-meter crystal can be used for both bands; however, the output is better when the 6L6 is used as a straight amplifier. Therefore a 40-meter crystal is recommended when the transmitter is used on that band.

Considerable effort was spent in an attempt to make this transmitter "foolproof" in that it will not oscillate with any setting of the controls when the crystal is removed from the socket. This insures that output will be crystal controlled and on the proper frequency, a condition which is quite often unobtainable in transmitters using high-gain tubes such as the 6AG7 and 6L6. The size of the 6AG7 plate coil, 180 microhenrys (a *Miller* #6180 peaking coil), was critical in eliminating any sign of oscillation when the crystal was removed from its socket.

EDITOR'S NOTE: *Although the equipment in this and the coming receiver article can be constructed from parts readily available from any distributor, the units are supplied in complete kit form, with the chassis already punched, by the Walter Ashe Radio Company.*

Complete TVI-proofing has not been provided in this transmitter; however, the type of construction used gives a good basis for such measures. Operated some 10 miles from a TV station on Channel 5, there was no disturbance to the picture with the transmitter and the TV receiver sitting side by side. Use of a metal 6L6, a coil shield, and a bottom plate on the chassis should eliminate TVI even in weak-signal TV areas.

The parts of the transmitter are mounted on a 5" x 7" x 3" chassis. The photographs will give an idea of the parts location which is not critical. Instead of a milliammeter, a pilot lamp PL_1 is used as a tuning indicator. It protrudes through a hole in the top of the chassis to the rear of the oscillator tube. A half-inch rubber grommet is fitted into the hole. The bulb is screwed into its socket and both the bulb and socket are held securely in place by pushing the bulb up through the grommet. Along the front edge of the chassis, from left to right, are mounted the keying jack and tuning condensers C_1 and C_2. At the center of the inside back edge, a five-terminal tie strip is used to terminate the power cable, which enters the chassis through a hole fitted with a rubber grommet. This cable is shielded and ends in a five-prong plug which plugs into the

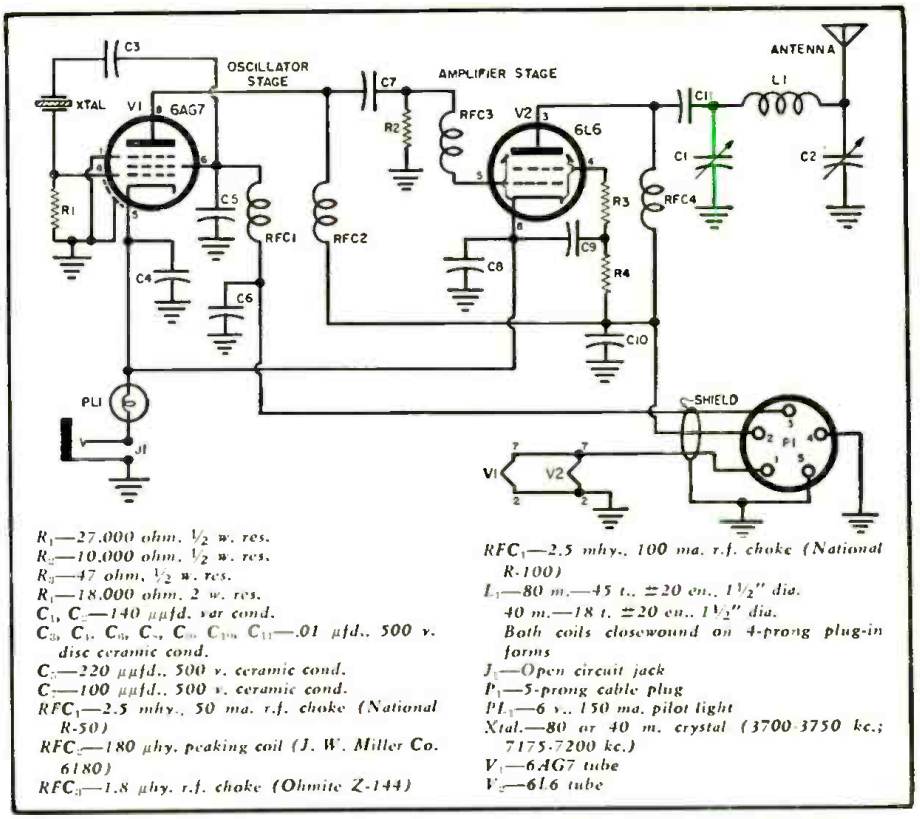
power supply. (The receiver power cable connector will be a four-prong plug. This arrangement eliminates the possibility of plugging the transmitter and receiver power cables into the wrong power supply outlets.) The heater leads should be of well-insulated hookup wire and should be kept close to the underside of the chassis. Keep all of the other leads as short as possible; in fact very little wire is required other than the leads on the components themselves and these are trimmed down in most cases.

In designing an economical novice station, the use of one power supply to furnish power for both receiver and transmitter seemed appropriate, especially since little more than a switch would have to be added to permit this operation. This supply delivers 350 volts at 100 ma. for the tube plates, and 150 volts regulated for the screen of the oscillator and for the receiver. The regulated voltage on the oscillator provides excellent keying and this 150 volts is supplied to the oscillator screen grid even when the "send-receive" switch is in the "receive" position, which permits the operator to spot his frequency on his receiver.

This arrangement is also ideal for code practice but, although very low power is used, it is advisable to disconnect the antenna from the transmitter before practicing. The previously discussed features hold true if the transmitter and power supply are used along with other makes of amateur receivers instead of the receiver to be described next month. The "send-receive" switch should be in the "receive" position for both frequency spotting and code practice, irrespective of the receiver being used.

The power supply parts are mounted on a 5" x 7" x 2" chassis as shown in the photograph. The "on-off" switch and the "send-receive" switch are mounted along the front face of the chassis and the output sockets and line cord are mounted on the back face. A hole is cut in the chassis large enough to clear all the leads from the power transformer, and the leads from the choke are likewise fed through the chassis in a rubber grommet. Care should be taken in wiring up the "send-receive" switch; close inspection of its operation will indicate the correct terminals to use. The a.c. power cord is connected through the internal jumper of the 0D3 as a safety measure (the supply is "killed" if the tube is removed); the connections to pins 3 and 7 of the 0D3 are not needed for the voltage regulating function.

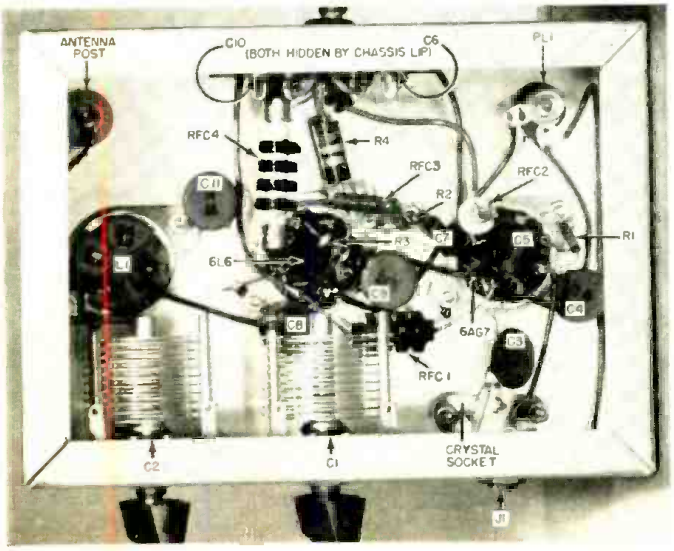
After having carefully checked the wiring of both power supply and transmitter, you are ready to test these units. With the "send-receive" switch in the "receive" position, turn on the power supply. The 0D3/VR150



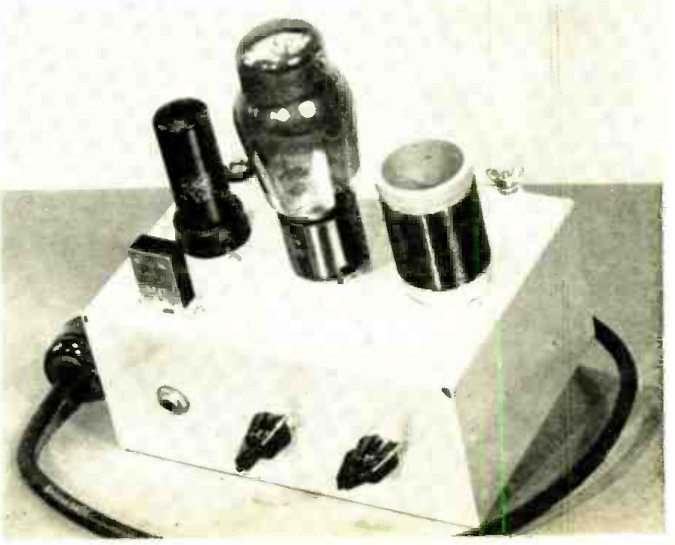
R_1—27,000 ohm, ½ w. res.
R_2—10,000 ohm, ½ w. res.
R_3—47 ohm, ½ w. res.
R_4—18,000 ohm, 2 w. res.
C_1, C_2—140 μμfd. var cond.
C_3, C_4, C_6, C_7, C_8, C_9, C_{10}, C_{11}—.01 μfd., 500 v. disc ceramic cond.
C_5—220 μμfd., 500 v. ceramic cond.
C_{12}—100 μμfd., 500 v. ceramic cond.
RFC_1—2.5 mhy., 50 ma. r.f. choke (National R-50)
RFC_2—180 μhy. peaking coil (J. W. Miller Co. 6180)
RFC_3—1.8 μhy. r.f. choke (Ohmite Z-144)
RFC_4—2.5 mhy., 100 ma. r.f. choke (National R-100)
L_1—80 m.—45 t., ±20 en., 1½" dia. 40 m.—18 t. ±20 en., 1½" dia. Both coils closewound on 4-prong plug-in forms
J_1—Open circuit jack
P_1—5-prong cable plug
PL_1—6 v., 150 ma. pilot light
Xtal.—80 or 40 m. crystal (3700-3750 kc.; 7175-7200 kc.)
V_1—6AG7 tube
V_2—6L6 tube

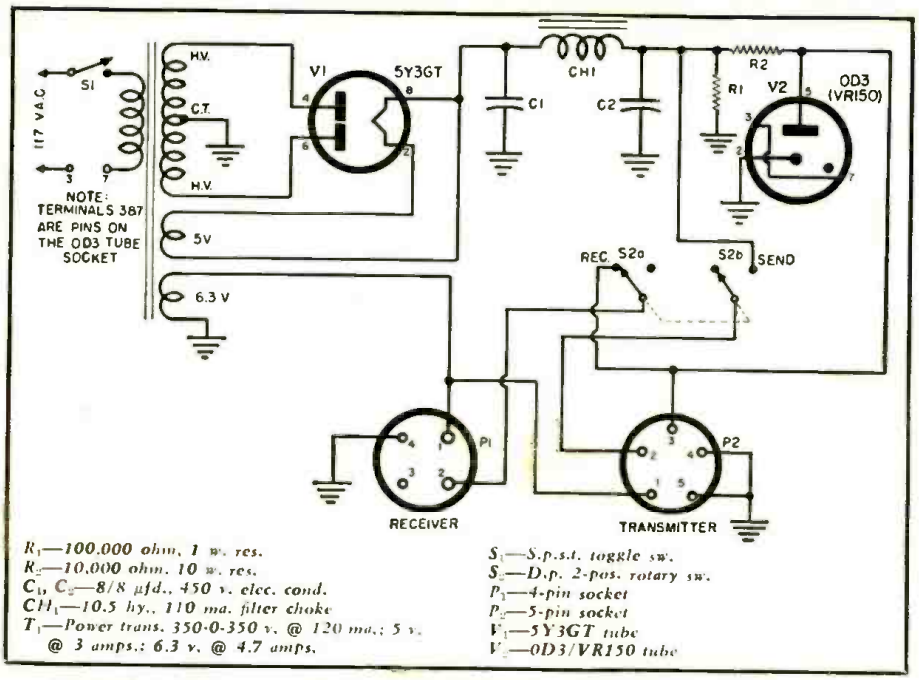
Schematic of the inexpensive transmitter. The separate power connection for the 6AG7 screen grid (P_1, pin 3) provides a regulated voltage supply for the screen, resulting in improved oscillator stability and enabling oscillator to be used with a receiver for code practice and frequency spotting without putting the whole transmitter on the air. Two-tube circuit has many advantages over simpler rigs.

Under-chassis view. Although a compact chassis is used, wiring is not crowded or difficult. Care should be taken not to overheat parts while soldering. Note that stator connections on the tuning condensers are made to ends of the stator bars rather than to the lugs (near chassis lip) to insure short leads.



The completed transmitter has a neat, businesslike appearance. Its power and performance are similar to those of "standby" rigs used by experienced amateurs. J_1 and knobs for C_1 and C_2 are along front face of chassis; the tuning indicator bulb can be seen at left rear corner, antenna stand-off at right.





R_1—100,000 ohm, 1 w. res.
R_2—10,000 ohm, 10 w. res.
C_1, C_2—8/8 μfd., 450 v. elec. cond.
CH_1—10.5 hy., 110 ma. filter choke
T_1—Power trans. 350-0-350 v. @ 120 ma.; 5 v. @ 3 amps.; 6.3 v. @ 4.7 amps.
S_1—S.p.s.t. toggle sw.
S_2—D.p. 2-pos. rotary sw.
P_1—4-pin socket
P_2—5-pin socket
V_1—5Y3GT tube
V_2—OD3/VR150 tube

Schematic of the power supply for the inexpensive Novice station. As the screen grid of the 6AG7 transmitter oscillator is connected in both positions of S_2, the tube can oscillate weakly and may be used with a receiver for code practice.

regulator tube should show a blue glow. On the receiver, tuned to the frequency of your crystal, you should hear a clean signal as you close the key. Next, with both tuning condensers set to maximum capacity, throw the "send-receive" switch to "send". The tuning lamp will glow brightly. Tune C_1 for a dip in the brilliance of the tuning lamp, PL_1. This point indicates resonance of the 6L6 plate circuit. If all has gone well so far and you are a licensed amateur, you are ready to load the transmitter with an antenna.

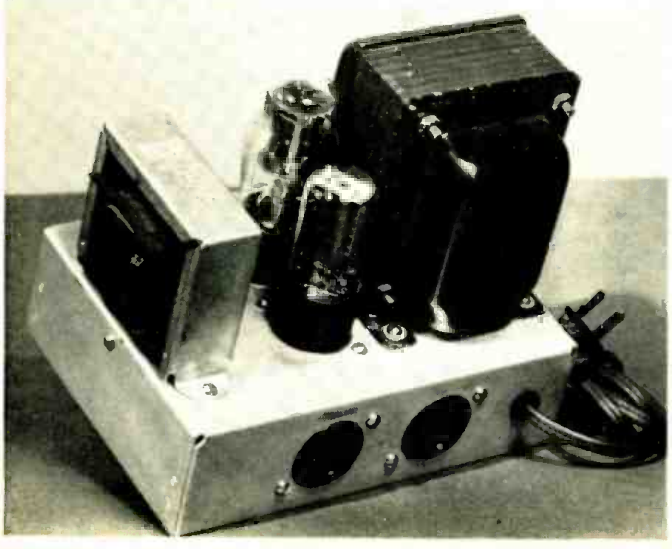
Any piece of wire 60 feet or longer can be used for both 80- and 40-meter operation. The optimum length for the 40-meter Novice band is about 65 feet and for the 80-meter Novice assignment it should be 125 feet. With the antenna connected to the transmitter, check for resonance by swinging C_1 slightly back and forth and watching PL_1. Now slowly open condenser C_2 a little bit at a time and, after each change of C_2, check for resonance with C_1. You will find that the dip in the brilliance of the tuning lamp becomes less and less as you continue to open C_2. When you have opened C_2 to a point where you can just detect a dip in the tuning lamp as you tune C_1, the transmitter is fully loaded and ready to go.

As much tuning as possible should be done with the transmitter connected to a dummy load rather than to the antenna to prevent unnecessary QRM on the heavily loaded amateur bands. A satisfactory dummy load can be made with a 25-watt light bulb and two short clip leads. The leads are soldered to each connection of the bulb and then one lead is clipped to the antenna terminal and the other one to the metal chassis of the transmitter. Tuning procedure is the same as that outlined before when feeding power to the antenna. The 25-watt light bulb will glow to nearly full brilliance if your transmitter is properly tuned. It should be noted that the setting of C_1 and C_2 quite likely will not be the same when operating the transmitter into the dummy load as when feeding the antenna. This is true unless by chance the antenna and dummy load present the same impedance to the transmitter.

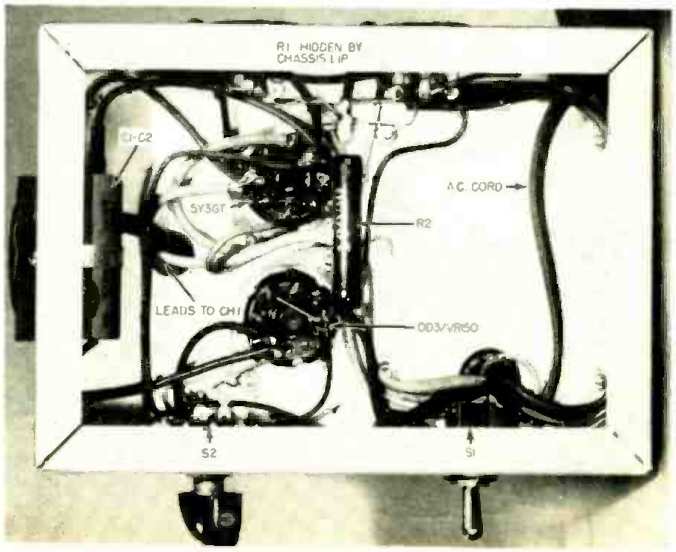
This transmitter and its companion receiver have been used successfully on the 40- and 80-meter bands, including the crowded Novice portions of these two bands. Reports on the signal from the transmitter have been excellent and both coasts were worked with no difficulty. 579X reports at distances over 1000 miles have been consistently received and it was gratifying to be able to hold our own in competition with transmitters of much higher power. Naturally the best results will be obtained when the best possible antenna is used. Running 30 watts input, and with a little patience and some late night hours on your part, this transmitter is quite capable of producing foreign contacts.

Experienced amateurs will recognize the fact that the transmitter and power supply are not only well suited for the Novice, but that they can do a fine job as the regular rig for the old-time "c.w. hound". Many of the present day hams who have been weaned and raised on higher power will be surprised to see what can be accomplished with this small compact outfit. It is ideal for the high power man as an inexpensive standby rig in the event of rebuilding or breakdown of the "big rig", too much TVI, or high electric bills. (*To be continued*)

Rear view of the power supply. Along the back edge, left to right, are the receiver and transmitter power sockets and the a.c. cord. The larger tube is the 0D3 voltage regulator.



Under-chassis view. Ground connections are made to lugs under socket mounting screws. Power transformer leads come through grommeted hole near S_1 at right. Wiring will be fairly easy.



BREAK-IN WITHOUT RELAYS

By **BRUCE F. BROWN, W6TWW**

The all-electronic break-in system is small and is easily adapted to most stations using voice control. Well-filtered negative power supply is needed.

Voice-controlled break-in without relays switches receiver and transmitter without bothersome clicks or noise blasts.

VOICE-CONTROLLED break-in systems employing relays for transmitter and receiver control are slow-acting, causing undesirable clipping of first letters or syllables. In addition to acoustical noise in the "shack", relays cause distracting clicks and pops in the receiver and may even cause TVI.

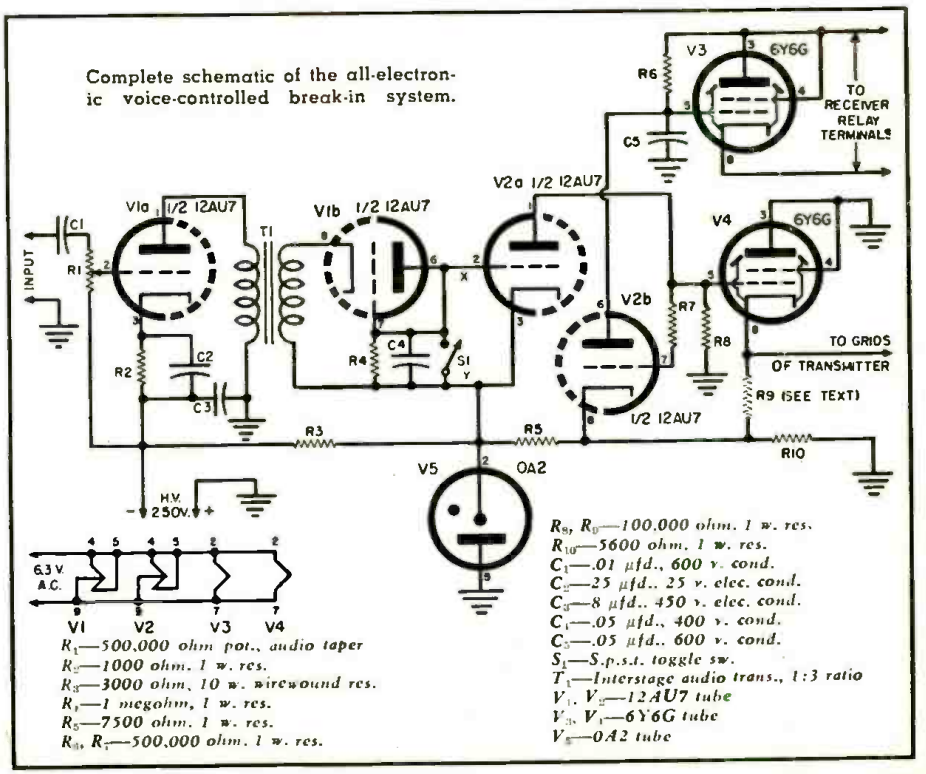
The electronic break-in system to be described has none of the attendant disadvantages of relays, and it may be added to the station with little or no modification of existing control circuits. It is fast-acting, it makes clipping virtually undetectable, and it causes no distracting noise. Since the receiver is operative during every pause in speech the channel can be monitored for interfering signals. This same feature makes it possible to interrupt a station equipped with this system. The parts values in the system have been chosen so that the receiver cuts off before the transmitter is energized, and the transmitter cuts off before the receiver is re-energized. Any possibility of feedback is thus eliminated.

For the principle of operation, refer to the schematic. Audio is picked up from an existing speech amplifier and applied to the input circuit of V_{1a}. V_{1a}, in turn, amplifies the audio signal and applies it to V_{1b} which produces a rectified negative control voltage across R_1 and C_1. This negative control voltage biases V_{2a} to cut-off causing V_{2b} and V_4 to conduct. The conduction of V_{2b} biases V_3 well past cut-off, thus removing screen voltage from the r.f. and i.f. screens of the receiver. When V_4 conducts, the 60-volt negative blocking bias produced at its cathode is shorted to ground thus unblocking the transmitter grids.

The time constant of R_1 and C_1 has been chosen so that with continuous talking the receiver will remain cut off and the transmitter will remain energized. However, at the ends of sentences or during any other break in continuous speech, the receiver will become operative, and the transmitter will be de-energized. If it is desired that the receiver be operative between words, the value of C_1 should be reduced. The correct capacity can be determined easily with a little experimentation. Switch S_1 disables the voice-control circuits when manual-control switching of the receiver and transmitter is desired.

In order to simplify the power supply, V_{1a} is operated with a grounded plate. This eliminates the need for a separate positive supply. A well-filtered negative power supply is necessary, however, since any ripple voltage appears as input to V_{1a} and would cause false operation of the circuit. Although the maximum heater-to-cathode voltage ratings of V_1 and V_3 are exceeded, no trouble has been experienced. The purist, however, may wish to use separate heater supply windings. (*Continued on page* 132)

Complete schematic of the all-electronic voice-controlled break-in system.



U.H.F. TEST EQUIPMENT ADAPTER

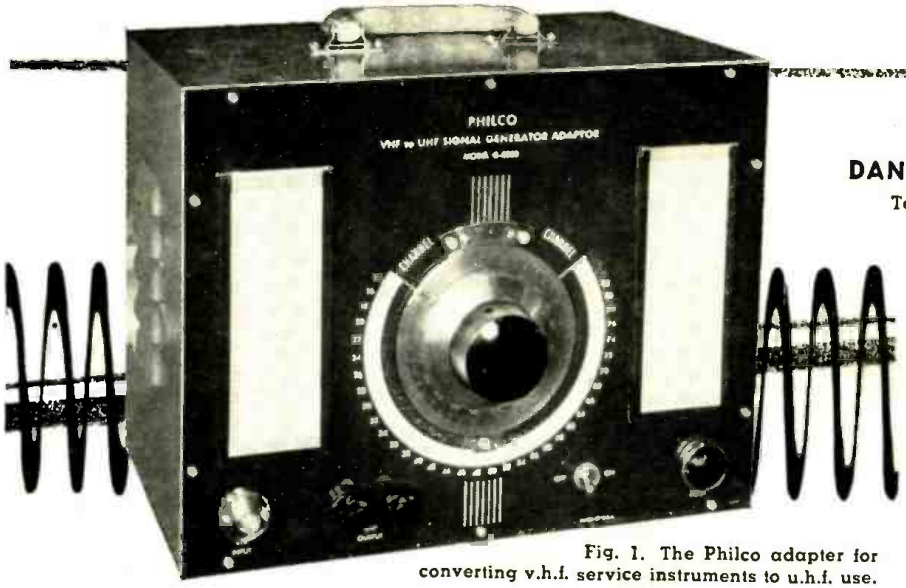


Fig. 1. The Philco adapter for converting v.h.f. service instruments to u.h.f. use.

By
DAN LERNER and **WINSTON STARKS**
Test Equip. Section. Philco Accessory Div.

You can adapt your v.h.f. signal or sweep generator to u.h.f. measurements with the unit described here.

DUE to the speed with which u.h.f. television was launched, there has been an urgent need in all service shops and laboratories for quality-engineered and low-priced u.h.f. service equipment.

The need for this type of equipment was foreseen by many electronic manufacturers. The result of a great deal of research and design work at *Philco* is a unit which prevents obsolescence of existing v.h.f. signal generators. This unit, the *Philco* Model G8000 v.h.f.-to-u.h.f. signal generator adapter (see Fig. 1), uses the *Philco* u.h.f. tuner as its heart.

This instrument will adapt any present v.h.f. signal or sweep generator, set at 60-mc. output, to any ultra-high frequency between 470 to 890 mc. This gives full channel coverage, from Channel 14 to 83. The adapter has sufficient handpass (15 mc.) to convert the entire sweep range of a sweep generator to u.h.f. frequencies. Markers may be fed into the adapter and measurements made the same as at v.h.f. Field strength meters may also be converted by the instrument to operate on u.h.f.

The adapter may also be used to convert any u.h.f. signal to Channels 2 or 3 on a TV receiver. Thus, it serves to check the over-all operation of u.h.f. converters and tuners rapidly.

As will be described later, this adapter has certain advantages over regular u.h.f. generators—and is less expensive. Basically, the G8000 employs a continuous-tuning variable condenser system to cover the u.h.f. channels by the superheterodyne principle in which the oscillator frequency beats with a 60-mc. signal, and the resultant frequency sum is used as a u.h.f. signal. (See Fig. 4.) Since there are no vacuum tubes used in series with the signal, and since the mixing is done by a crystal, it follows that the adapter can be used in reverse to change u.h.f. to v.h.f.

A v.h.f. signal having a frequency of approximately 60 megacycles is fed into the 75-ohm input connector of the adapter, and is coupled by means of the low-impedance winding on transformer, T_2, to the slug-tuned secondary of this transformer. (See Fig. 6.) From this point the signal is applied to the crystal mixer assembly, consisting of L_5-L_6 and C_3, and CD_1. A signal generated by a local oscillator consisting of a type 6AF4 u.h.f. triode, V_1, and its associated circuit, is introduced into the crystal mixer circuit by means of a 300-ohm miniature transmission line and the mutual coupling between L_7-L_8 and L_5-L_6. This results in a beating together of the v.h.f. input signal and that from the local oscillator.

The beat frequency, which is equal to the *sum* of the local oscillator frequency and the v.h.f. input frequency, is passed on toward the u.h.f. output of the adapter by the mixer tank and tuned output tank circuits. All other beats and responses are greatly attenuated. The transfer of signal energy between the mixer assembly (or board) and the mixer tank circuit is accomplished by means of the mutual coupling between L_4 and L_5, while signal transfer between the mixer and the u.h.f. tank circuits is brought about by the mutual coupling between L_2 and L_3 and the stray capacitance, C_3. From the output tank circuit, the u.h.f. signal is coupled, through a 150-ohm transmission-line matching section and two 680 $\mu\mu$fd. condensers, to the 300-ohm u.h.f. output terminals of the adapter.

The transformer-type supply provides a 6.3-volt a.c. power source for the heater of the local oscillator tube. A cathode-type full-wave rectifier tube, the 6X4, is used in conjunction with a resistance-capacitance filter to furnish a hum-free plate-supply voltage for the oscillator.

The use of the G8000 adapter is simple and straightforward in all of its applications. Whenever a v.h.f. signal is to be converted to u.h.f., it is simply fed through 75-ohm coaxial cable to the v.h.f. connector on the adapter. This signal must be at a frequency of 60 mc. for the dial calibration to hold true. Variation from 50 to 70 mc. is possible with a proportionate reduction in conversion efficiency, plus a loss of frequency calibration. The resulting u.h.f. signal appears at the u.h.f. connector. In this case, the u.h.f. connector is treated as the signal source.

When used to convert to u.h.f., the attenuator of the regular v.h.f. generator can still be used. To anyone who has ever tried to attenuate a u.h.f. signal, this feature will be welcomed as the logical solution for accurate and convenient control of u.h.f. signals.

Markers can be produced by v.h.f. generators coupled into the v.h.f. input cable to the adapter. The marker generator is handled just as if it were being used on a response curve at 60 mc.

Operation of the G8000 adapter in reverse is also a simple and straightforward procedure. A u.h.f. signal is fed into the u.h.f. antenna terminals. The v.h.f. output terminals are connected to whatever device is intended to accept the v.h.f. (at approximately 60 mc.). Then the u.h.f. dial is tuned to the incoming u.h.f. signal or for maximum v.h.f. output.

U.H.F. Test Hints

There are a number of precautions which should be taken whenever making tests at u.h.f. frequencies. It is necessary to use some new techniques

and to be more careful about observing some old ones. Some of the points which should be kept in mind are outlined here:

1. All connections at u.h.f. should be made with coaxial cable, except where open-line connectors are provided.

2. Connections should be neat, short, and with the minimum number of splices, bends, or any kind of variation in the line. Even a shielded cable should be carefully placed in a u.h.f. test setup, especially when leakage or standing waves are important in the test.

3. As in the case of v.h.f. generators, the end of any test line must be terminated in the characteristic impedance of the line. The termination should be a resistor of the ½-watt carbon type. The only exception to this is the case where the cable will be terminated by the device which it is feeding. If the device does not have the correct terminating resistance, then a simple resistance matching network can be devised, as shown in Fig. 3, which illustrates how it is possible to match a 300-ohm balanced line to a 75-ohm load (in this case, a 75-ohm u.h.f. tuner input).

4. The input and output cables of the G8000 should be kept apart to avoid signal leakage through the unit.

5. The test setup on the bench should be arranged to avoid crossing or paralleling of cables.

6. Hot cables in a test setup may be due to improper termination of cables or location of cables in such a way that signal leakage causes cancellation effects. When observing a sweep curve, it may be desirable to shift the cables and test equipment around the bench to reduce hot cable effects. It may be desirable, in some test setups, to use a copper or brass sheet on the table as a base for the signal generators and the unit being tested.

7. Matching transformers and attenuators of the type used for v.h.f. tests will generally be found unsatisfactory for use at u.h.f.

8. False responses from sweep generators will be minimized by the tuned circuits of the G8000 adapter. Such responses will be of relatively low amplitude and can be minimized even further, if they appear in some particular setup, by careful placement of cables or test equipment.

The test setup for using the G8000 to observe the response curve and align a TV receiver at u.h.f. is shown in Fig. 5. Fig. 2 shows the adapter being used for standing wave measurements with a suitable delay line. Many other applications are possible for this instrument, both in the service shop and the laboratory.

The feature of being able to convert a Channel 2 or 3 signal to any u.h.f. channel, simply by setting the adapter dial to the desired u.h.f. channel, is valuable for the service technician and the TV dealer. In areas where there is not yet a u.h.f. channel on the air, but where one is expected, service technicians can use the adapter to provide themselves with a u.h.f. signal corresponding to the channel they are expecting. In this way, they can familiarize themselves with u.h.f. techniques. TV set dealers can use the adapter to test and demonstrate the reception on u.h.f. of the converters as well as the u.h.f.-v.h.f. sets they expect to sell. —30—

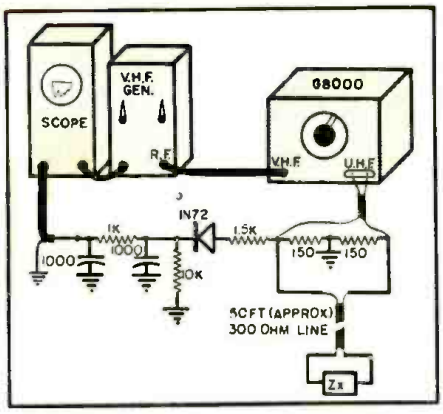


Fig. 2. Test equipment setup for standing wave measurements along 300-ohm lead-in line using the Philco adapter.

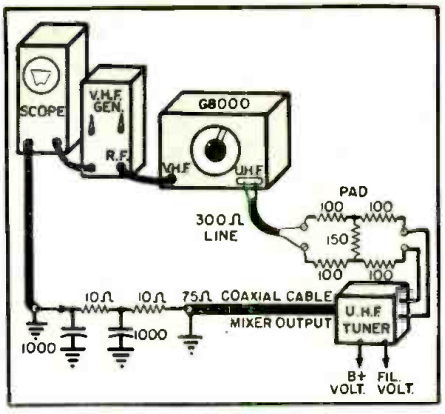


Fig. 3. Test setup for the alignment of u.h.f. tuners using a v.h.f. sweep generator and the Philco G8000 adapter.

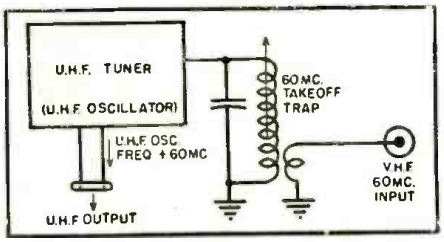


Fig. 4. Simplified diagram showing the basic components of the Philco adapter.

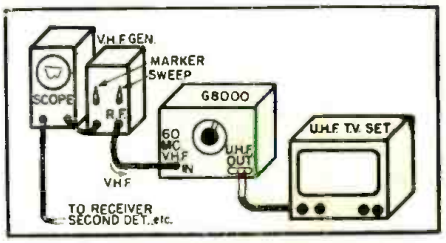
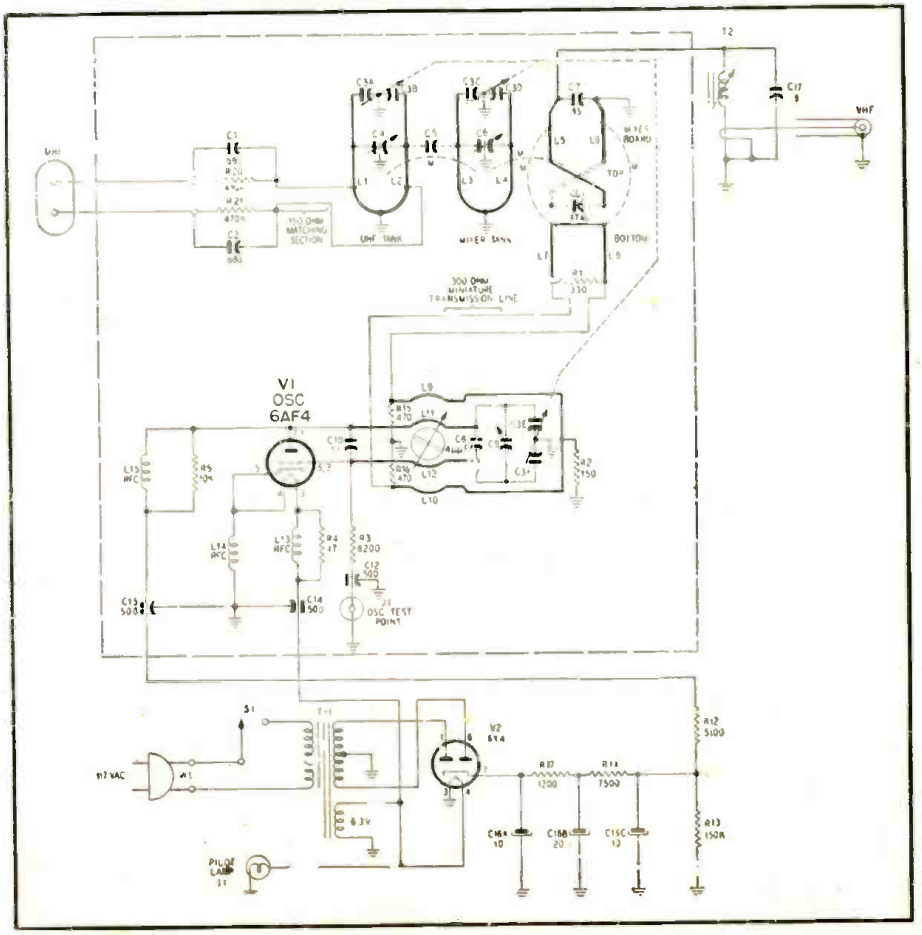


Fig. 5. Test equipment setup for aligning a TV set on u.h.f. with the G8000.

Fig. 6. Schematic diagram of the Philco v.h.f.-to-u.h.f. signal generator adapter.



By **BERT WHYTE**

THE introduction of a record revue section in RADIO & TELEVISION NEWS may cause some lifted eyebrows, inasmuch as the editorial coverage of this magazine has always been on a technical plane. However, the results of a recent survey of our readership has convinced us of the need for this type of coverage. In this section the technical aspects of the recording will be fully covered, as to frequency response, dynamic range, distortion content, tracking, spindle hole eccentricity if present, surface noise, transient response, etc. Since the ultimate goal of most high-fidelity experimentation is the greater enjoyment of music, the section will include pertinent musical data about the recordings reviewed.

It will be the policy of this department to name the equipment used in the reviews, as well as the acoustical environment of the equipment. Each month the equipment used will be tested by an independent group of qualified engineers and "certified" as to the operating perfection of all elements, from pickup through loudspeaker.

Equipment used this month: *Weathers* FM pickup, *RekOkut* T12H, *Fisher* preamp equalizer, *McIntosh* 50 watt amplifier, *Jensen* G-610 "Triaxial" in *Jensen* folded-horn corner enclosure. Speaker was placed in hard plaster corner, room has absorptive wall opposite speaker, carpeted floor, three reflective walls, hard ceiling, usual upholstered furniture. Reverberation time about 2 seconds, practically no slapback.

RESPIGHI
THE PINES OF ROME and THE FOUNTAINS OF ROME
The Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury 50011, 33⅓ rpm, AES curve. Price $5.95.
The Vienna State Opera Orchestra conducted by Argeo Quadri. Westminster 5167, 33⅓ rpm, AES curve. Price $5.95.

These offerings might be called the "dilemma of the db", or "which one has the mostest." Respighi wrote some of the most rip-roaring music in history. The loudness of his music is almost overshadowed by the loudness of the adherents of these discs. Seldom has such vociferous controversy raged over phonograph records! Each camp is firmly convinced that the other is composed of members of that ignoble musical fraternity. Theta Epsilon Beta (Tin Eared Baboons)! Why all this uproar? Armed with both discs, I decided to listen and learn.

One thing is immediately apparent. Both the *Mercury* and *Westminster* discs are highly exciting recordings. Equally apparent is the difference in recording techniques. The engineers of both companies have tried to reach the same goal, but by totally different approaches. The *Mercury* people employed their by-now-famous, single *Telefunken* mike suspended at some optimum point over the conductor's podium. And *Westminster?* Well, I wasn't present when the recording was made (and *Westminster* ain't tellin') but I suspect they utilized a clever new version of an old technique used for "pop" dates! Each choir in the orchestra (brass, woodwind, etc.) is individually miked with reflecting or damping boards as dictated by acoustic outputs of the instruments, and then mixed by the engineer on the console. Usually an omni-directional mike is suspended for hall reverberation to enhance the liveness of the recording.

Both recordings are productive of some terrific sound. If you have a yen for the satisfying thump of bass drum and tympani, the crash of cymbals, then this is your meat. With controls set flat and with proper equalization for each disc, the *Westminster* seemed more strident than the *Mercury,* although string tone was generally well above average. It was in the last movement of the "Pines of Rome," which is fortissimo with a vengeance, that decided me in favor of the *Mercury* version. Now, I'm all for high-fidelity sound and the more cycles per, the better. But I think it is a cardinal sin to overlook the fact that we are still dealing with music, and that certain rules and a modicum of taste should be preserved. What I am referring to is the overblown dynamics and odd phrasing evident in the *Westminster* disc. Partly this is Mr. Quadri's sin, but the greater part is the overzealous "dial twiddling" of the engineers. Had the tremendous climax come over completely free of distortion, it might have passed notice. But alas! the last few bars give far from mute testimony of the heavy hand on the controls. The dynamic range of the *Mercury* disc is unbelievable. I had the good fortune to hear the original tapes on the *Mercury,* "Pines." The transfer from tape to LP, *via* the sensational new *Miller* cutterhead was an astounding demonstration of what can be cut into a disc, in terms of dynamic range, frequency response, and lack of distortion. Performance-wise, Dorati and the Minneapolis have far better command of the score; Dorati, often called a "cold" conductor, displays little of that attitude here and instead is highly evocative in the lyrical sections. Mr. Quadri does a competent job, within the limits of his insight into the score, but suffers from an orchestra far less disciplined than this colorful music demands. Surfaces of both recordings were very good. Summing up; a few years ago either disc would have been manna from heaven. Now with two very exemplary versions around, you've got a problem. Some people like vanilla and some like chocolate. I like the *Mercury.*

Note: Anent the reference to the *Miller* cutterhead most of the *Mercury* "Olympian Series" recordings originally cut with the *Grampian* head have been recut with the *Miller* with results even more spectacular than the original. You can identify the new pressing by the letters "MF."

GOULD
SPIRITUALS FOR ORCHESTRA
GERSHWIN
PORGY AND BESS (arr. by Robert Russell Bennett)
The Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury MG50016, 33⅓ rpm, AES curve. Price $5.95.

Fabulous!! A more apt description of this recording would be hard to find. In many years of listening I have heard many great combinations of performance and score, recording technique and superb orchestras. In this recording a happy amalgam of all these factors has resulted in one of the outstanding listening adventures of this or any other year. The Gould "Spirituals," is the prize side on this disc and the side which I will review, although the "Porgy" is magnificent musically and technically.

I predict that "Spirituals" will supplant Varese's "Ionisation," as the demonstration record *par excellence.* Since the Gould score is also extremely interesting and listenable music, this will come as blessed relief to thousands of wild-eyed and long-suffering wives who have been under siege by 110 db of fire siren, assorted gongs and bells and of course, the lion's roar. As a demonstration piece for transient response and dynamic range, this disc has no peer. In five movements, "Spirituals," encompasses

(*Continued on page* 157)

KNOW YOUR 1954 ZENITH TV RECEIVERS

By
BRIAN J. MAROHNIC
TV Field Engineer, Zenith Radio Corp.

Complete service information on the new 1954 Zenith TV sets, including full schematic and alignment data.

THE 1954 *Zenith* television receivers utilize the following chassis: 19L25, 19L26, 19L27, 19L28, 21L21 and 21L20. These form the "Super K" or "L" series, designed for the best possible reception of both u.h.f. and v.h.f. TV signals in extreme fringe as well as local areas.

Tuner

The "Super K" chassis incorporates an improved signal-to-noise ratio, 12-position turret tuner, using a 6BK7A cascode-type r.f. amplifier, and a 6U8 triode-pentode used as a mixer and oscillator. The turret is shipped from the factory with twelve pairs of v.h.f. strips in place; however, it may be filled with any combination of twelve u.h.f. or v.h.f. pairs of strips. The tuner may be removed from the receiver without taking the chassis from the cabinet. Merely disconnect the fine tuning shaft, remove the antenna lead and plug-in connections, and then remove four small screws.

The complete circuit diagram of the tuner with the channel selector switch in a v.h.f. position is shown in the upper left of Fig. 1. The antenna is connected to a center-tapped primary. Two i.f. rejection traps, resonated to approximately the center of the i.f. bandpass, increase the i.f. rejection on Channel 2 and on u.h.f. These traps are designed so that additional resonant frequencies are not present in the u.h.f. band.

The r.f. grid coil is returned to ground through a trimmer condenser, C_{3}, which is adjusted to approximately equal the value of the input capacitance of the 6BK7A.

The principal reason for using the 6BK7A cascode r.f. amplifier is to obtain the lowest possible noise figure on all channels. The cascode interstage is series-tuned near Channel 13 by means of a series coil, L_{1}, connected between the first plate and second cathode. The two triode sections are connected in series and, therefore, have identical values of plate current. The grid of the second triode is held at a fixed potential by means of a voltage-divider network between "B+" and ground, thus giving a relatively rapid cut-off of the plate current of the first triode section, which is controlled by the a.g.c. voltage.

A pair of double-tuned circuits is provided between the r.f. amplifier plate and the mixer grid. The two coils are returned to ground through a common inductance, L_{2}, which provides some coupling between the circuits on the high channels. On Channel 13 the coupling between the coils on the strip actually opposes this common inductance coupling slightly, while on the lower channels this common inductance coupling is reinforced in varying amounts by the coupling between the coils on the strip. All other coupling media between the circuits have been carefully avoided.

The mixer grid and r.f. plate coils are made identical by returning the converter grid through a 19 $\mu\mu$fd. series condenser, C_{10}. This simplifies the standardization of the coils, thus requiring fewer different types.

The oscillator tube is decoupled from the coil on the strip by means of a 5.5 $\mu\mu$fd. series condenser, C_{12}. This effectively increases the inductance value of the oscillator coil, and thereby minimizes the effect of contact and other stray inductances, and reduces the effect of tube voltage variation on the oscillator frequency. The variable condenser tapped on L_{10}, and designated as the fine tuning control, is used at the factory for standardizing the circuit, and as a fine tuning control by providing a stop which, after the factory trimming adjustment, permits the condenser to be turned only two turns out of the several in its complete range.

Where leads are brought out of the oscillator compartment for the "B+" and heater, feedthrough ceramic condensers and series r.f. chokes provide good isolation of all oscillator r.f. currents. Besides the normal shielding, some extra shielding is provided over the grid and cathode leads to the second triode of the 6BK7A which extends into the oscillator compartment.

All changes, going from v.h.f. to u.h.f., are made by simply turning the channel selector knob from a v.h.f. channel to a u.h.f. channel. The operation of the receiver is exactly the same on u.h.f. as it is on v.h.f., and there are no additional knobs or switches. The u.h.f. antenna, if required, is connected to the same tubular 300-ohm line, through an isolation filter, as that used to feed the v.h.f. signal to the receiver input terminals.

This tuner converts the u.h.f. signal to the 40-mc. i.f. frequency used by the receiver. In the upper left-hand corner of Fig. 1 is shown the circuit of a u.h.f. strip. The u.h.f. strips are similar in size to the strips used for v.h.f. Incorporated on the u.h.f. channel strips is the u.h.f. preselector, the u.h.f. crystal mixer, which derives its local signal from a crystal multiplier between the mixer and v.h.f. oscillator, and coils for tuning the r.f. grid and plate, and the converter grid to the intermediate frequency. The converter output connection remains unchanged. These circuit changes are made entirely on the channel strip itself.

The triode of the 6U8, which is used as the v.h.f. oscillator, is also utilized as the oscillator on u.h.f. The oscillator tube, however, is operated on v.h.f., and its output is multiplied to u.h.f. by the crystal multiplier.

To feed the oscillator power into the crystal multiplier, which is inside the antenna compartment, a short coaxial cable is used. The possibility of coupling oscillator power to the antenna is avoided by providing a stator contact, #6, which has an effective ground finger on either side of it—and the best possible shielding around it. This contact is fed by means of the short coaxial cable, extending into the oscillator compartment to an extra stator contact, which is not used on v.h.f. For u.h.f., a small condenser is connected between this terminal (#11) and the plate end of the oscillator coil. Further isolation between the multiplier contact, #6, and the antenna is provided by the u.h.f. tuned circuits on the channel strip.

Coils *LA* and *LB* are preselector coils tuned to the incoming u.h.f. car-

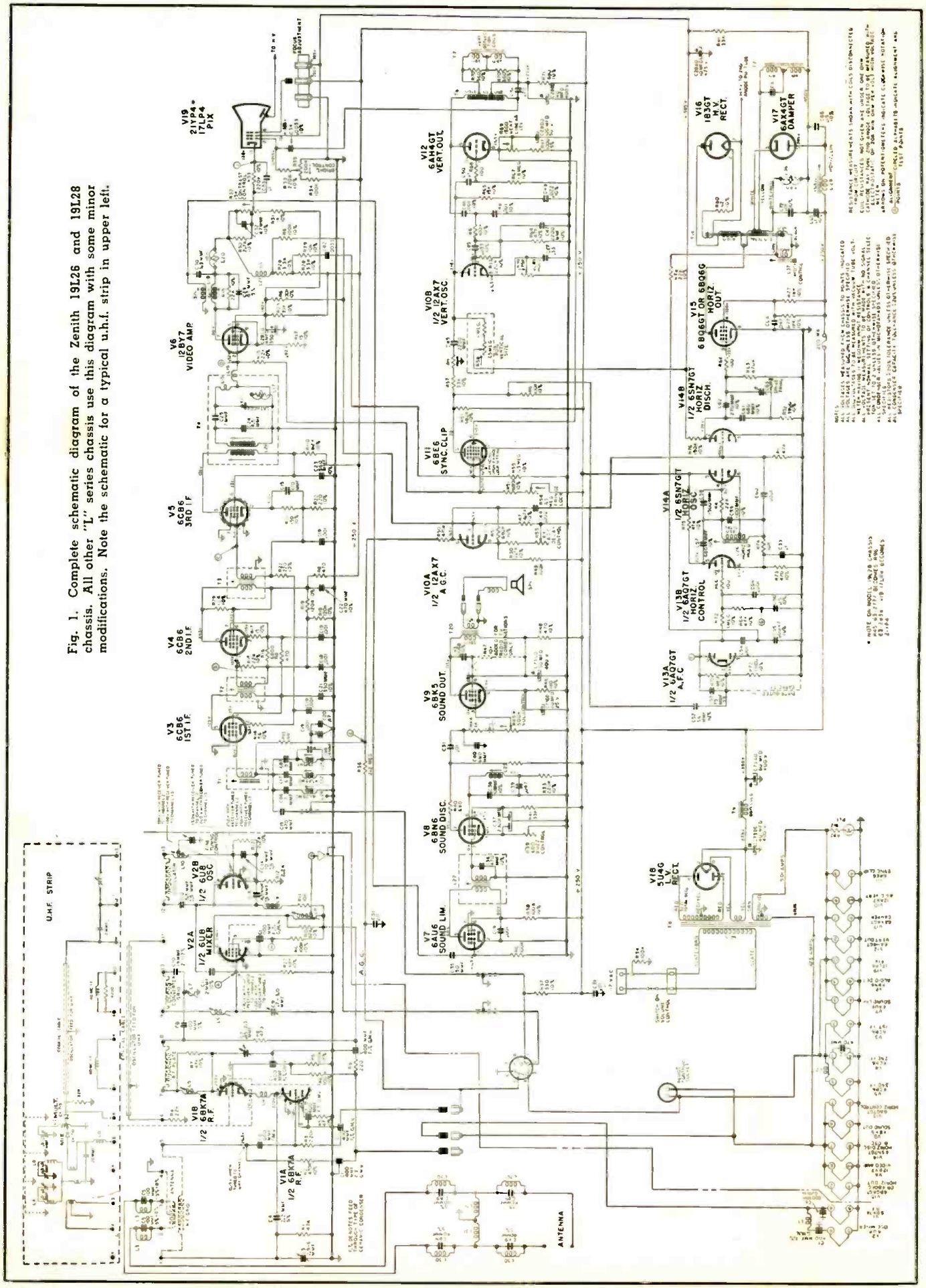


Fig. 1. Complete schematic diagram of the Zenith 19L26 and 19L28 chassis. All other "L" series chassis use this diagram with some minor modifications. Note the schematic for a typical u.h.f. strip in upper left.

rier frequencies. Coil *LC* is a mixer coil which combines the multiplied oscillator frequency with the incoming signal to produce the 40-mc. i.f. Coupling between the antenna and the first tuned circuit is accomplished by means of a very small center-tapped loop, inductively coupled to the low potential end of the coil. Coupling from the second preselector circuit to the mixer is accomplished by a small loop, one side of which is returned to a 20 $\mu\mu$fd. r.f. bypass condenser, and the other side is connected to the crystal. This r.f. bypass condenser also forms a part of the matching network to the 6BK7A grid. The other side of the mixer crystal connects to a tap on the multiplier coil, near the low potential end, to obtain oscillator excitation for the mixer. The multiplier crystal is connected to another tap, slightly higher on the multiplier coil. The other side of the multiplier crystal connects to the oscillator through the turret contact and shielded cable mentioned previously. The entire assembly is mounted in a metal casting, which provides excellent shielding for the preselector and multiplier circuits, both from each other and external influences.

The 40-mc. signal is applied to the 6BK7A grid through a pi network. Resistor, R_2, supplies a steady ½ milliampere of current through the crystal. The steady d.c. current creates a constant load at all times across the tuned circuits.

The main oscillator tuned tank is located in the tuner chassis. This tank circuit is in series with a small tunable coil, mounted on the strip, which adjusts the oscillator to the fundamental frequency desired. The sine-wave output of the oscillator circuit is fed to the germanium harmonic generator crystal. The crystal conducts only on the very peaks of the waves, and its output consists of sharp pulses which are rich in harmonics of the fundamental frequency. The oscillator tuned coil is adjusted to the desired harmonic frequency (by means of a metal screw which enters the coil and changes its inductance), and is excited at that frequency only. This is illustrated in Fig. 2, which is a block diagram of the operation of the tuner for Channel 27 (548-554 mc.). Here the fourth harmonic of the fundamental oscillator frequency, 148.75 mc., excites coil *LC* which is tuned to 595 mc., with the result that this frequency mixes with the video carrier frequency of 549.25 mc. to give the desired video i.f. The actual conversion takes place in the mixer crystal, CK_{510}.

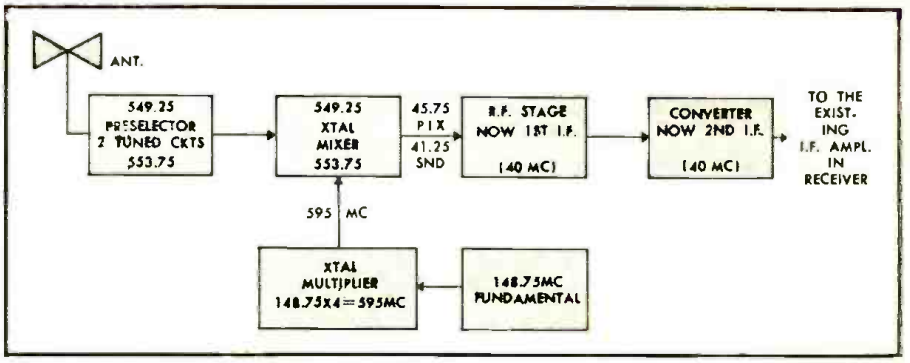


Fig. 2. Block diagram of the Zenith u.h.f. tuner strip conversion method showing how conversion to the receiver's i.f. is effected for Channel 27.

The 6BK7A and the 6U8 pentode section become i.f. amplifiers for u.h.f. by means of i.f. coils inserted into their circuits by the u.h.f. strip. The output of the 6U8 pentode section is fed to the regular i.f. section of the receiver.

The complete change to u.h.f. circuitry takes place as the u.h.f. strip clicks into position. The multiplier circuit can be tuned by connecting a voltmeter which has a full-scale reading of .2 or .3 volt to the turret contact for the 6BK7A grid. With the proper oscillator strip inserted, and the oscillator on the correct frequency, the multiplier tuned circuit can be adjusted for a dip in the voltmeter reading. Optimum excitation is that which causes the voltage across the crystal to drop to approximately

Table 1. Alignment procedure for the video i.f. and sound circuits of the Zenith "L" series chassis.

VIDEO I.F. ALIGNMENT

STEP	SIGNAL GENERATOR FREQUENCY	SIGNAL GENERATOR CONNECT TO	OUTPUT INDICATOR	CONNECT TO	ADJUST	REMARKS
1			V.T.V.M.	Point E in Fig. 1	Bias to −2 volts	Use a 2-volt battery with potentiometer across it. Connect positive terminal to chassis.
2	43.5 mc. center frequency, 5 mc. deviation	Pin 1 of V_5 (Test point "C")	Oscilloscope through 10,000-ohm isolation resistor	Pin 2 of V_6 (Test point "D" and ground)	T_4 (top and bottom) for max. gain with 41.25 and 45.75 mc. markers in valleys of response curve	Adjust generator for 3-volt peak-to-peak detector output.
3	43.5 mc. center frequency, 5 mc. deviation	Pin 2 of V_2 (Test point "A")	Oscilloscope through 10,000-ohm isolation resistor	Pin 2 of V_6 (Test point "D" and ground)	L_{12}, L_{24}, and L_{25} for minimum marker amplitude at freq. shown in Fig. 1	It may be necessary to reduce bias to zero (or go slightly positive).
4	43.5 mc. center frequency, 5 mc. deviation	Pin 2 of V_2 (Test point "A")	Oscilloscope through 10,000-ohm isolation resistor	Pin 2 of V_6 (Test point "D" and ground)	T_2, T_3, T_{14} and L_8 for response curve below 	Readjust bias to −2 volts

SOUND CIRCUIT ALIGNMENT

5	Tune to on-the-air TV channel				L_{19} (top and bottom), L_{22}, L_{23} and R_{39}, for cleanest sound, min. buzz	Adjust step attenuator to level where "hiss" is heard.

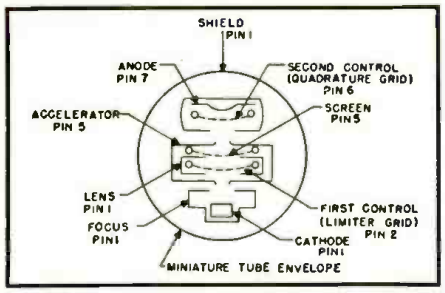


Fig. 3. Element arrangement of the 6BN6 used as the sound limiter-discriminator.

one-half the no-excitation voltage.

I.F., Sound, and Video Circuits

The intermediate frequency amplifier in the *Zenith* "Super K" chassis is of the 40-mc. type, and consists of three transformer-coupled 6CB6 stages.

A crystal diode, X_1, is used to rectify the video and sound i.f. signals. The two i.f. carriers beat together in the diode detector producing a 4.5-mc. carrier, which is FM sound modulated. Both the composite video and sync signal and the 4.5-mc. sound carrier are applied to the 12BY7 grid. The sync pulses are negative with respect to ground. When replacing a crystal diode, the correct polarity of connection must be observed, otherwise, a negative picture will be obtained and sync troubles will develop. The crystal may easily be reached for test or replacement by lifting the top of the last i.f. transformer metal shield can.

Many of the condensers and resistors in the i.f. circuit are of 10% tolerance. When replacing these components, use the same tolerance as the original part.

The video amplifier uses a new type 12BY7 pentode, and is directly coupled to the picture-tube cathode. The contrast control is in parallel with the plate load and directly controls the picture-tube cathode signal level.

The 4.5-mc. FM sound carrier is taken from the junction of C_{39} and the secondary winding of L_{19}, and is fed to the 6AU6 sound limiter grid. From this stage the 4.5-mc. signal of between three and about four volts goes to the grid of the 6BN6 sound limiter-discriminator.

The sound discriminator circuit used in the "Super K" chassis is one of the simplest ever designed. No discriminator transformer is required; the entire circuit depends for its operation on the 6BN6 tube. The tube is unconventional in element structure, operating on electron optics principles. Fig. 3 shows the element arrangement of this gated-beam tube.

Electrons from the cathode are formed into a beam by the grounded focus electrode and the positive accelerator. This beam is passed through the limiter grid when the latter is at zero or positive potential. However, when it is negative, it stops the beam which falls back on the accelerator. Since the limiter grid merely acts as a gate, passing or obstructing the beam formed by the focus and accelerator elements, the size of its positive potential is irrelevant. The same beam will be passed whether the voltage on the limiter grid is 1-volt positive or 10-volts positive, resulting in very effective limiting.

The electron beam leaving the limiter grid next passes through the second accelerator and screen and from there goes through the quadrature grid to the positive anode. The quadrature grid is tuned to the signal frequency.

When the limiter grid is positive (one-half of each cycle of the input signal), it passes the electron beam to the quadrature grid. The quadrature grid obtains its potential from the periodic variation in the space charge in front of it, which produces about 5 volts across its tuned circuit. This grid clips the leading portion from the half-cycle pulse and passes approximately a quarter-cycle pulse of current to the anode.

The phase displacement between the voltage on the quadrature grid and the electron beam is affected by the modulation of the signal frequency. This, in turn, affects the length of the anode current pulse. The d.c. voltage drop across the plate load resistor (which is bypassed for i.f.) is proportional to the length of this pulse, and therefore, to the original modulation of the input signal.

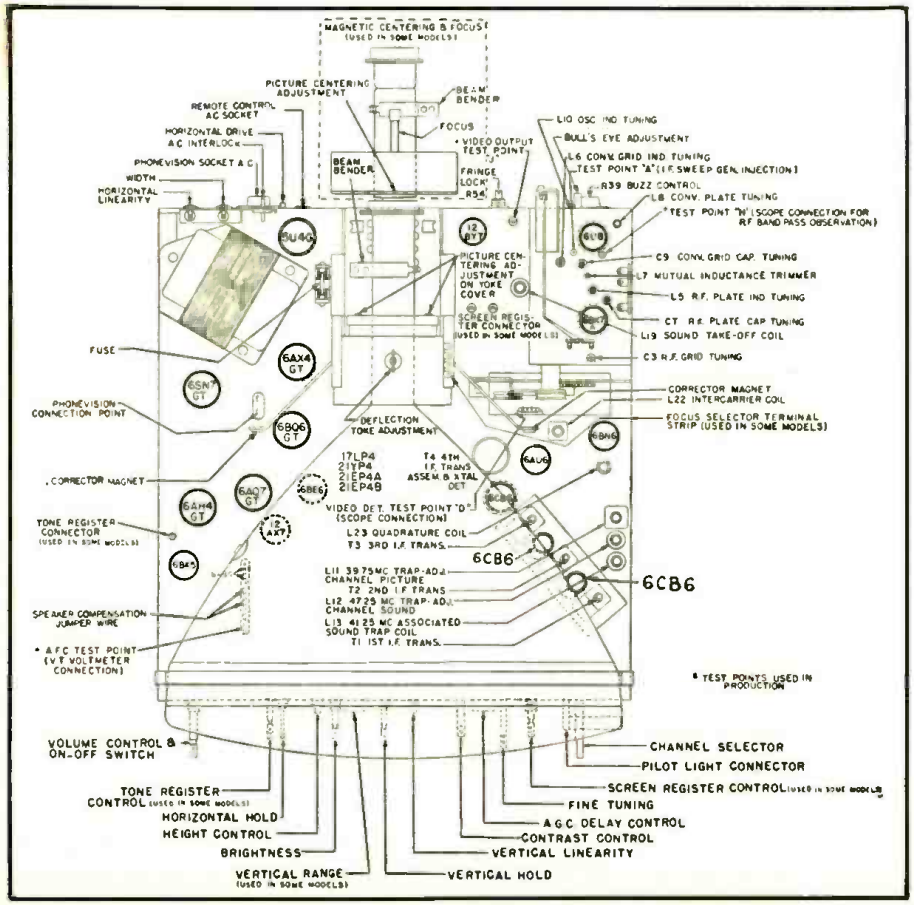
A 220,000 ohm resistor, R_{33}, and .047 μfd. condenser, C_{30}, in the circuit of the quadrature grid places a bias voltage on this grid to improve the noise immunity of the circuit. The variable resistor, R_{29}, sets the operating point of the 6BN6 to eliminate the 60-cycle vertical pulse from the sound.

The composite video signal at the grid of the video amplifier is fed to the first signal grid of the 6BE6 sync clipper. The sync pulses fed to this grid are negative in polarity, and the bias on the grid is so adjusted by means of R_{51}, the "Fringe Lock" control, that the sync tips do not cut off plate current in the tube. The current in the tube is normally controlled by a positive polarity composite video signal fed to the second signal grid from the output of the video amplifier. This voltage drives the 6BE6 into both plate saturation and cut-off. Operating bias of the tube is set by R_{55} and C_{52} from grid current drawn while signal voltage is applied, so that the sync pulse is clipped just above the black level. However, when a burst of noise appears in the composite video signal, the first signal grid is driven to cut-off, so that this noise does not appear in the output of the tube. Although the sync pulses may also be eliminated by this action, the oscillator continues on the flywheel effect, and will resync when the sync pulses reappear.

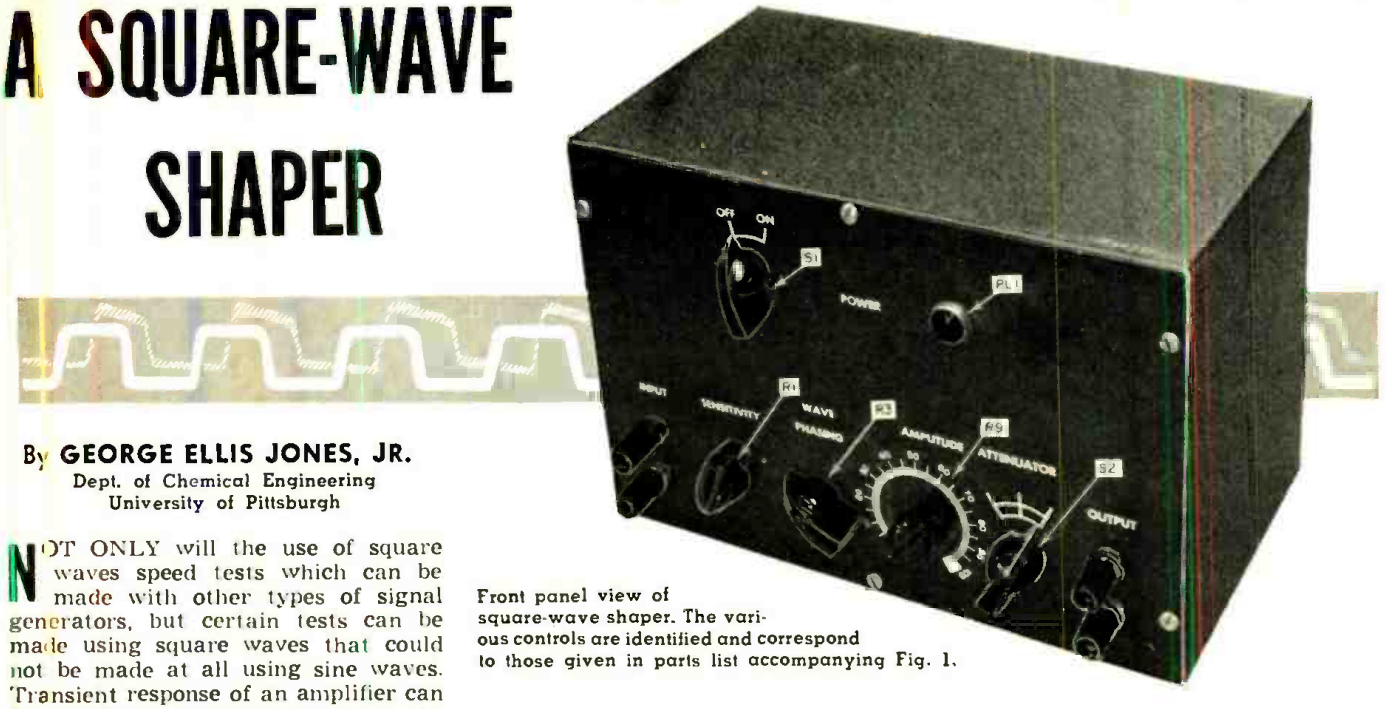
The sync pulses next go to the integrator and differentiator networks

(*Continued on page* 106)

Fig. 4. Representative chassis layout for the Zenith "L" series TV receivers. Note the alternative focus and centering method used in some models (dotted).



A SQUARE-WAVE SHAPER



Front panel view of square-wave shaper. The various controls are identified and correspond to those given in parts list accompanying Fig. 1.

By **GEORGE ELLIS JONES, JR.**
Dept. of Chemical Engineering
University of Pittsburgh

The design, construction, and operation of an audio test unit which can be used in conjunction with a sine-wave generator.

NOT ONLY will the use of square waves speed tests which can be made with other types of signal generators, but certain tests can be made using square waves that could not be made at all using sine waves. Transient response of an amplifier can be rapidly established by driving the amplifier with a square wave and observing its output with an oscilloscope. An additional use, not often discussed, is in the checking of tone control circuits. When the treble and bass controls are so adjusted that a 1000 cps square wave looks good and the best possible 100 and 10,000 cycle square waves are obtained, the tone controls are in their flat position.

The technician or experimenter who realizes the convenience of square-wave testing usually already has a sine-wave generator. The construction or purchase of the ordinary square-wave generator causes a duplication of parts and, generally, poorer performance than can be obtained by using a square-wave generator of the type described here. Most square-wave generators use a multivibrator circuit to develop a square wave of sorts which is then clipped and amplified. Frequency stability in such generators is notoriously bad. Furthermore the steep wavefronts are often slowed down and rounded off because the multivibrator circuit must suddenly charge or discharge the larger condensers necessary for timing the relatively long level sections of the square wave.

The unit which the author has designed amplifies and clips a sine wave input (derived from an external sine-wave generator) with one duo-triode stage. Further amplification and isolation is provided by a video-amplifier stage and a cathode-follower output stage. Fig. 1 is the schematic diagram of the unit. Waveforms appearing at various key points within the generator are shown in Fig. 2.

For those of us who generally work with class A amplifiers where the objective is to have the output waveform an enlarged version of the input waveform, complete and accurate in all detail, a stage-by-stage analysis of this generator should prove interesting. Here each stage is driven either to cut-off or to grid current, and some of the tubes are driven from the one extreme to the other.

The amplifier tube V_{1B} is driven at both its cathode and its grid by V_{1A} in such a way that the two drives augment each other. When the grid voltage of V_{1A} rises above some critical value (which is determined by the size of the cathode resistor, R_3) V_{1B} suddenly cuts off. When the V_{1A} grid voltage drops again, V_{1B} starts with equal rapidity to conduct again. Thus the sine-wave input (for all practical purposes) switches V_{1B} off

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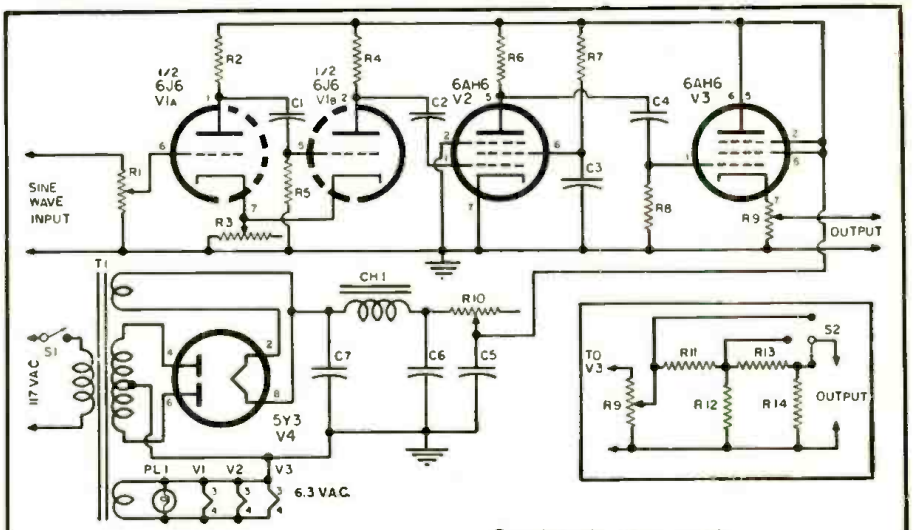
Fig. 1. Complete schematic diagram of the square-wave shaper built by the author.



R_1—50,000 ohm audio-taper pot.
R_2—47,000 ohm, ½ w. res.
R_3—5000 ohm wirewound pot.
R_4—6800 ohm, 1 w. res.
R_5, R_6—10 megohm, ½ w. res.
R_7—3300 ohm, 2 w. res.
R_8—5600 ohm, ½ w. res.
R_9—2000 ohm composition pot.
R_{10}—10,000 ohm, 10 w. wirewound adj. res.
R_{11}, R_{13}—10,000 ohm, ½ w. res.
R_{12}, R_{14}—1000 ohm, ½ w. res.
C_1—.02 μfd., 400 v. cond.
C_2—.1 μfd., 400 v. cond.
C_3—.002 μfd., 400 v. cond.
C_4—.25 μfd., 400 v. cond.
C_5—100 μfd., 250 v. elec. cond.
C_6, C_7—20 20 μfd., 450 v. elec. cond.
CH_1—10 hy. a.c.-d.c. choke
S_1—S.p.s.t. toggle sw.
S_2—S.p. 3-pos. selector sw.
T_1—Power trans. 325-0-325 v. @ 55 ma.; 5 v. @ 2 amps.; 6.3 v. @ 2 amps. (Stancor PM8407 or equiv.)
PL_1—6.3 v., 150 ma. pilot light
V_1—6J6 tube
V_2, V_3—6AH6 tube
V_4—5Y3 tube

SELENIUM DIODE APPLICATIONS

By
J. T. CATALDO
International Rectifier Corp.

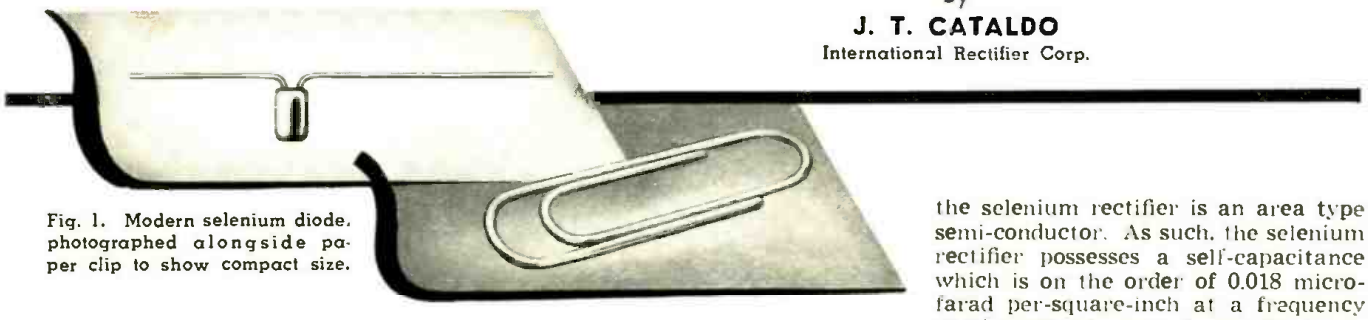


Fig. 1. Modern selenium diode, photographed alongside paper clip to show compact size.

The development of the selenium diode opens a whole new field of circuit design possibilities to the engineer.

THE development of the selenium diode offers the electronic design engineer a series of semi-conducting components heretofore not available. These units were developed, in part, to help fill the ever increasing demand for miniature diodes of the metallic family which was created with the advent of electronic computers and miniaturized equipment of all types. Germanium and silicon diodes were used almost exclusively in computers as well as in other electronic equipment such as hearing aids, electronic organs, bias supplies, sensitive d.c. relays, TV and radio receivers. Manufacturers have been sponsoring research and development activities since the first commercial production of selenium rectifiers. The development of the selenium diode, shown in Fig. 1, is the result of the progress made to date in the effort to miniaturize selenium rectifiers. The diode is photographed with a paper clip for comparison purposes.

Initial efforts to produce small rectifier cells were not very encouraging because the many intricate and complex production processes were not well understood. However, with the gradual and continued improvement and control of production techniques and processes, a few selenium rectifier manufacturers started producing miniature rectifier cells. These small cells were assembled into various types of enclosures. A few of the many types of rectifiers produced are shown in Fig. 3. These units, although exceedingly satisfactory for many applications, were limited insofar as their frequency response is concerned. Unlike the silicon or germanium diode, the selenium rectifier is an area type semi-conductor. As such, the selenium rectifier possesses a self-capacitance which is on the order of 0.018 microfarad per-square-inch at a frequency of 60 cycles-per-second. In Fig. 2 are plotted capacitance test data of an 0.250 inch diameter selenium rectifier cell in microfarads per-square-inch *versus* frequency. From this curve, the self-capacitance of an 0.250 inch diameter cell is calculated to be 500 $\mu\mu$fd. at 100 kc. and 900 $\mu\mu$fd. at 60 cycles. Since the capacitance of a selenium rectifier is a function of its area, it is obvious that reducing the area of the cell would, in turn, decrease the self-capacitance. Large scale production of smaller diameter cells was accomplished after continued research resulted in resolving the many difficulties previously encountered. Consequently, it is now possible to produce rectifier cells having an area of 0.003 square inch as compared to previous small cells having an area of 0.05 square inch. A decrease of capacitance of as much as 16 to 1 has been achieved by this reduction in rectifier cell size. The decrease of self-capacitance permits the use of these selenium diodes in circuits operating in a frequency range of 100 kc. to 200 kc. These research and development activities also resulted in operational improvements such as extreme stability and long life in high ambient temperatures and adverse environment conditions normally encountered in military applications. The resulting improvements are attributable to modifications made in several manufacturing processes and to the complete encapsulation of the rectifying element within a thermo-setting plastic.

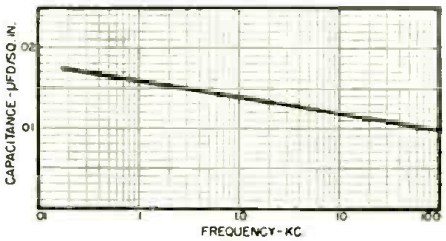


Fig. 2. Capacitance versus frequency curve.

Table 1. Specifications on the Series S, Series T, and Series U selenium diodes.

	1S1	2S1	1T1	2T1	1U1	2U1	3U1	4U1	5U1
Rated Forward Current	100 µa.	100 µa.	200 µa.	200 µa.	1.5ma.	1.5ma.	1.5ma.	1.5ma.	1.5ma.
Max. Applied Voltage (r.m.s.)	26 v.	52 v.	26 v.	52 v.	26 v.	52 v.	78 v.	104 v.	130 v.
Max. d.c. Output Voltage	20 v.	40 v.	20 v.	40 v.	20 v.	40 v.	60 v.	80 v.	100 v.
Peak Inverse Voltage	60 v.	120 v.	60 v.	120 v.	60 v.	120 v.	180 v.	240 v.	300 v.
Max. Surge Current (in ma.—1 sec.)	5	5	10	10	80	80	80	80	80
Voltage Dropat Full Load	1 v.	2 v.	1 v.	2 v.	1 v.	2 v.	3 v.	4 v.	5 v.
Max. r.m.s. Input Current	250 µa.		500 µa.		3.75 ma.				
Peak Rectified Current (in ma.)	1.3		2.6		20				
Reverse Current at Max. Applied Voltage	6 µa.		6 µa.		27 µa.				
Reverse Current at	— 10 v.	— 20 v.	— 10 v.	— 20 v.	— 10 v.	— 20 v.	— 30 v.	— 40 v.	— 50 v.
	.6 µa.		.6 µa.		2.4 µa.				
Shunt Capacity at Max. Frequency	57 µµfd.	29 µµfd.	57 µµfd.	29 µµfd.	140 µµfd.	70 µµfd.	50 µµfd.	35 µµfd.	25 µµfd.
Max. Frequency	200 kc.		200 kc.		100 kc.				
Ambient Temperature Range: —40 to 100 degrees C.									

Characteristics and Specifications

The present line of selenium diodes consists of three series: Series S, Series T, and Series U. The units are provided with pigtail leads to facilitate wiring into crowded chassis. Their small size (see Table 1 for dimensions) makes them ideal for use in electronic equipment where space is limited. They do not require any additional support because of their light weight.

The d.c. output current rating is 100 microamperes, 200 microamperes, and 1.5 milliamperes for the Series S, T, and U respectively. The Series S and T are produced for output voltages of 20 and 40 volts, while the

Series U is available for output voltages of 20, 40, 60, 80, and 100 volts at rated output current. Higher output voltages are attainable with these selenium diodes at reduced output current. Static forward and reverse characteristics for the three available series are shown in Fig. 6. The characteristics shown are for the Type 1S1, Type 1T1, and Type 1U1. However, these curves are also applicable to the other diodes if the forward voltage and reverse voltage scales are multiplied by 2, 3, 4, or 5. For example, the Type 5U1 would have a maximum forward voltage drop of 6.0 volts when it is delivering an output current of 1.5 milliamperes. The characteristics in Fig. 6 are the minimum acceptable quality level for these diodes. Units in production all have characteristics well within the limits shown in Fig. 6. In others words, lower forward voltage drop and lower reverse currents can be expected of selenium diodes from regular production runs. Examination of this figure will disclose that a minimum forward-to-reverse resistance ratio of 5000 to 1 is obtainable when the reverse voltage on the unit is not more than 20 volts for the single cell units. This ratio is also attainable with a reverse voltage of 100 volts on the Type 5U1.

Forward voltage drop *versus* ambient temperature characteristics for various loads on a basic bridge are shown in Fig. 4. The bridge consisted of four Type 1T1 selenium diodes, one in each arm. The input voltage or voltage drop across the bridge was recorded for loads of half-, one-, and four-times rated for ambient temperatures of 0 to 100° C. Since selenium has a negative-temperature coefficient, a lower voltage drop exists at elevated temperatures. It will also be noted that the slope of the curves decrease with decreasing load.

These selenium diodes are being used in many novel circuits. An interesting application is as a clamping diode in a telemetering circuit, shown in Fig. 5. The purpose of this circuit in the telemetering equipment is to convert a signal voltage of fixed phase with the reference voltage into a d.c. voltage of 0-5 volts that is proportional to the amplitude of the signal voltage. In operation, the rectifier SR_1 rectifies the a.c. voltage existing at the cathode of the tube, V_1. Since there is no control on the magnitude of the input signal, the output voltage can exceed 5 volts thereby causing malfunctioning of the telemetering circuit. To preclude this condition, a Type 1U1 selenium diode is incorporated into the circuit as a clamper. With a clamping potential of 4.3 volts, clamping occurs when the output reaches 5 volts. In Fig. 5, SR_1 is an *International Rectifier Corp.* #V1HM rectifier and SR_2 is a 1U1 type. The circuit was supplied by the *Raymond-Lindsey Co.* of Gardena, Calif.

There are many other applications for these units. For example, the diodes have been designed into hearing aids, electronic organs, and numerous electronic instruments. The circuits of these applications cannot be disclosed at this time, since their disclosure may jeopardize certain patentable features. The most popular usage for these diodes is to provide bias voltage in electronic equipment. Fig. 7 shows a typical application for providing fixed bias for the push-pull stage of an audio system. It is well to note that

(*Continued on page* 149)

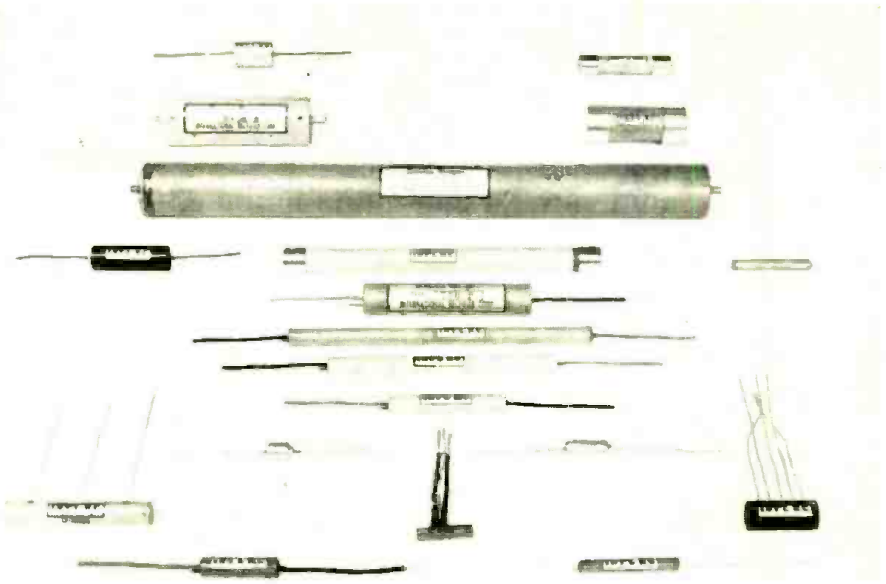


Fig. 3. Typical cartridge-type selenium rectifiers as made by International Rectifier.

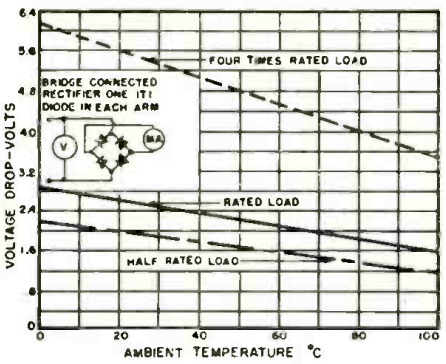


Fig. 4. Forward voltage drop vs ambient temperature characteristics for basic bridge.

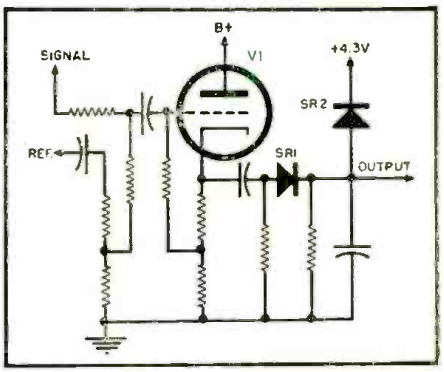
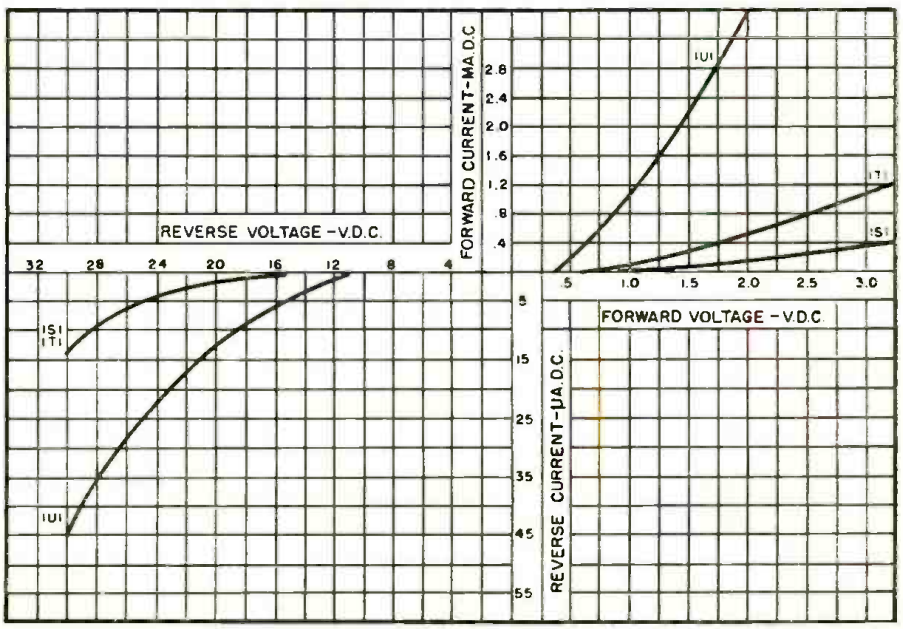


Fig. 5. Telemetering circuit showing selenium diode used for the clamping action.

Fig. 6. Static forward and reverse characteristics of Types 1S1, 1T1, and 1U1 diodes.



OBTAINING TRANSISTOR CHARACTERISTIC CURVES

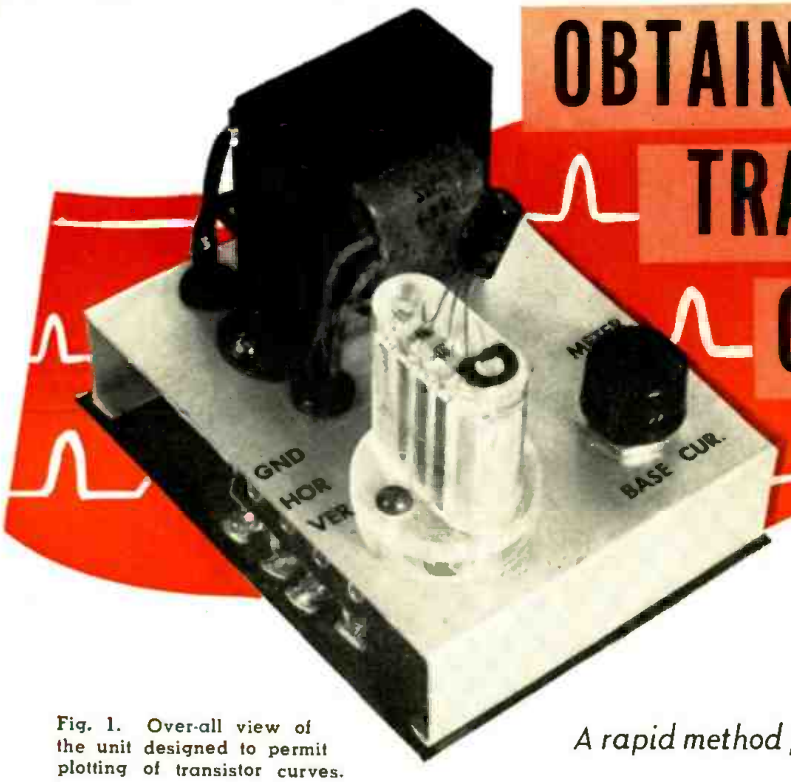


Fig. 1. Over-all view of the unit designed to permit plotting of transistor curves.

By

WARREN PHILBROOK

A rapid method for obtaining performance data on junction and point-contact transistors. "Breadboard" layout may be used.

THE usual technique for obtaining a characteristic curve for a vacuum tube, transistor, or crystal diode is to set up the basic experimental circuit in breadboard fashion, making provision for both fixed and variable voltage sources. Where more than one voltage source is required for the particular characteristic curve desired, it is general practice to fix all voltage sources but one, then to vary that voltage in small increments, noting any variations in current.

In the case of a transistor, for example, a fixed base current may be allowed to flow, with the collector voltage varied over a range and changes in collector current noted. A number of "check" points may be obtained and the resulting data tabulated.

After a series of measurements have been completed, the resulting data might be plotted on a conventional graph scale, giving a "collector voltage *vs* collector current characteristic curve" for the particular transistor checked, and for the specific base current. If several complete sets of measurements are made, with different base current values, the resulting series of graphs, plotted on the same scale, represent a "family" of characteristic curves.

As can be easily seen, considerable time might be required to obtain sufficient experimental data to plot even a small "family" of curves. Where a number of individual transistors are to be checked, obtaining the experimental data alone may well represent many man-hours — with still more time required to plot the curves.

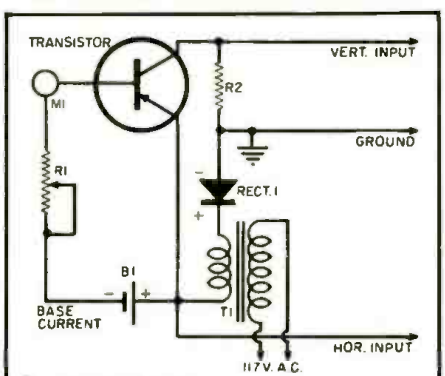
However, by using the small instrument illustrated in Fig. 1, it is possible to obtain an accurate characteristic curve in less than a minute's time, including the time required for "setting up" the equipment! With proper accessory equipment, a complete "family" of curves can be obtained in well under five minutes' time!

Circuit Description

The complete schematic diagram of the "transistor waveform tracer" is given in Fig. 2. The meter M_1 is external to the small chassis shown in Fig. 1 and is connected to it with the leads identified by the word "Meter" on the chassis.

In operation, B_1, a small penlight cell, supplies the desired base current for the transistor, with the exact amount of base current adjusted by means of series resistor, R_1, and indicated on the meter.

Fig. 2. Complete circuit diagram of unit for checking transistor characteristics.



R_1—50,000 ohm pot
R_2—100 ohm, ½ w res. (see text)
M_1—0-1 ma. or 0-500 μa. meter
B_1—1.5 volt penlight cell
T_1—6.3 v. @ 1 amp. fil. trans.
Rect. 1—25 ma. selenium rectifier

A pulsating d.c. voltage is applied between the emitter and collector terminals. This voltage is obtained by rectifying a 6.3 volt a.c. signal which is obtained, in turn, from the secondary of filament transformer T_1. A half-wave selenium rectifier, *Rect.*$_1$, is employed.

A small resistor, R_2, is connected in series with the collector terminal. The value chosen for this resistor (100 ohms) is low enough so as not to affect circuit operation. Since the voltage across any resistor is directly proportional to the current through it, observing the voltage waveform across R_2 gives an exact indication of the variations in collector current.

In practice, the pulsating voltage applied between the emitter and collector of the transistor is applied to the horizontal terminals of an oscilloscope. *This gives a horizontal sweep directly proportional to variations in collector voltage.*

The voltage across R_2 is applied to the vertical input terminals of the oscilloscope, *giving a vertical deflection directly proportional to the variations in collector current.*

The waveform of the pulsating voltage applied to the collector-emitter circuit is shown in Fig. 3, and can be observed by transferring the "Hor. Input" lead shown in Fig. 2 to the vertical input terminals of the scope and using the built-in linear sweep. *However, when obtaining characteristic curves, the built-in sweep of the scope is not used. Be*

sure that the horizontal amplifier is switched to "Hor. Input."

Typical characteristic curves obtained by using this technique are illustrated in Figs. 4A and 4B. Fig. 4A was obtained using a base current of 100 microamperes, while Fig. 4B represents the curve obtained with a base current of 20 microamperes.

Construction Hints

The average technician should have no difficulty in assembling the circuit illustrated in about two or three hours' time and most of this time will be expended in laying out and drilling the small chassis. Where "breadboard" type construction is used, the entire circuit can be assembled and wired in less than an hour's time.

Terminals are provided for making the oscilloscope connections and two leads are brought out for the panel meter which is used to indicate base current.

All other components, including the penlight cell, are mounted directly on the small chassis shown. The chassis used by the author is a standard *Bud* CB-1617 chassis, but any small chassis base is suitable.

The transistor socket used in the model shown is a special unit and is not generally available commercially. However, the prospective builder may use any one of several substitute methods: a standard subminiature tube socket, a terminal strip to which temporary soldered "lap" joints may be made, a screw-type terminal strip, or even permanently-mounted spring clips to which quick connections of the transistor leads may be made.

No special pains need be taken in wiring the unit. *However, if the transistor is to be soldered in position, care should be taken that the transistor leads are not overheated.*

Circuit Modifications

The model shown in the photographs and in the schematic diagram is designed to obtain characteristic curves when used with *Raytheon* junction transistors of the *p-n-p* type over fairly limited changes in collector voltage. Where greater changes in collector voltage are desired, simply substitute another transformer for T_1 which will provide a greater secondary voltage, for example, a 12.6 volt or a 25.2 volt transformer may well be used here.

If the engineer or experimenter wishes to obtain characteristic curves of the same type for *point-contact* transistors, the same basic circuit arrangement may be used, but with the necessary modifications in T_1, as mentioned previously.

Where junction transistors of the *n-p-n* type are used, reverse the connections to the battery, B_1, and to the selenium rectifier. This is necessary to insure that the proper voltages are applied to the transistor elements.

Although the circuit arrangement shown in Fig. 2 supplies collector current *vs* collector voltage characteristic curves, other types of curves may be easily obtained by making minor variations in the circuit connections. For example, the pulsating voltage might well be applied between base and emitter, with a fixed voltage applied between emitter and collector. Any number of variations are possible, depending on whether "grounded-base", "grounded-emitter", or "grounded-collector" circuits are employed and upon which voltages (or currents) are made the independent variable.

However, whenever changing to different circuits, make sure that the polarity of the voltage connections is correct for the type of transistor being checked and for the type of characteristic curves desired.

The oscilloscope and meter connections are apparent in the schematic diagram (Fig. 2). A typical experimental set-up is shown in Fig. 7.

Once the proper connections have been made and the transistor connected in the circuit (or inserted in its socket), R_1 is adjusted for the desired base current, as indicated on meter M_1. The "Vert. Gain" and "Hor. Gain" controls of the oscilloscope are adjusted until the desired image size is obtained.

The resulting characteristic curve (see Figs. 4A and 4B) is suitable for experimental study and school demonstration work. Where the curves obtained are to be used for engineering work, one or two additional steps are required in "setting up" for tests, however.

A transparent graph scale should be placed over the screen of the CRT and the "Vert. Gain" and "Hor. Gain" adjusted for a known amount of gain. In other words, the scope is "calibrated" so that the characteristic curve obtained may be actually checked in terms of milliamperes current and amount of applied voltage.

This calibration procedure is quite simple, and consists of applying a

(*Continued on page* 130)

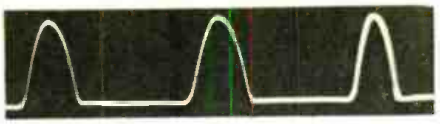


Fig. 3. Waveform of a pulsating voltage applied to the collector-emitter circuit.

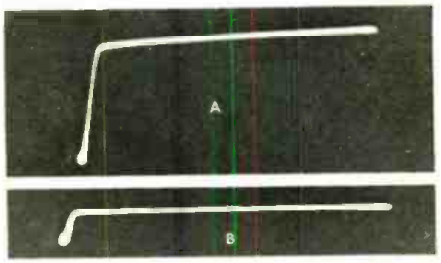


Fig. 4. Characteristic curves obtained with (A) base current of 100 microamperes, and (B) with base current of 20 microamperes.

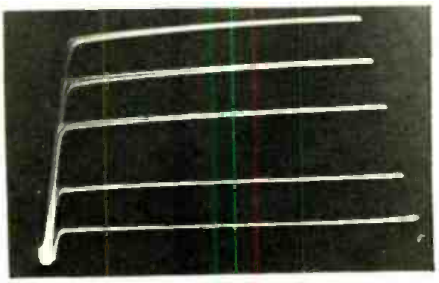


Fig. 5. Family of collector current vs collector voltage curves for Raytheon CK722 at base currents of 25, 50, 100, 150, and 200 microamperes respectively (bottom to top).

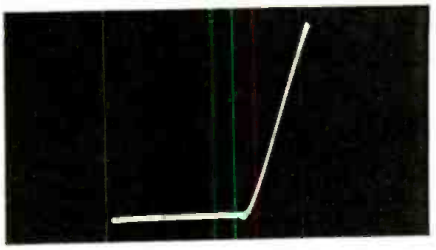


Fig. 6. Characteristic curve of a germanium diode which was tested with same circuit.

Fig. 7. An experimental test set-up using the oscilloscope and meter.

A TRANSISTORIZED AUDIO OSCILLATOR

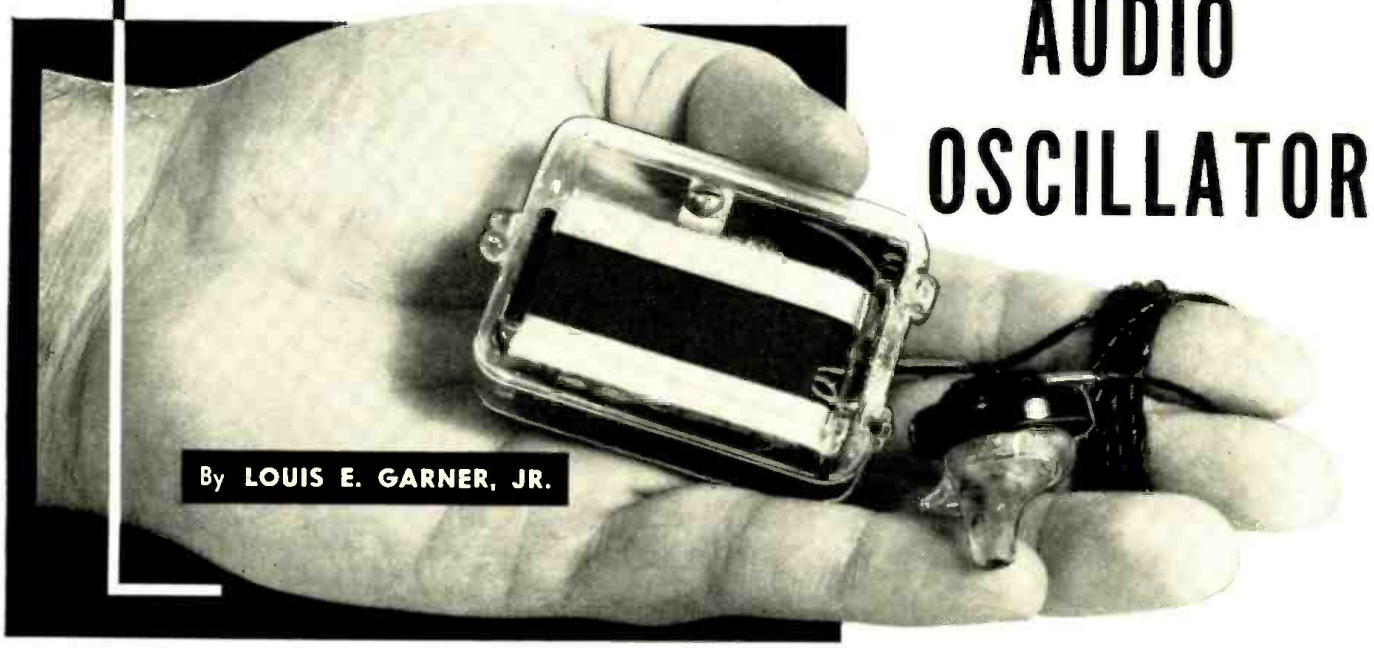


Fig. 1. "Light-powered" audio oscillator which is housed in tiny pill box.

By LOUIS E. GARNER, JR.

A miniature test unit which requires neither batteries nor power lines. It has several unique service applications.

MOST electronic and electrical devices have one circuit in common —the power supply. In some cases, the power supply consists of one or more batteries, and may include additional components such as a vibrator, transformer, rectifier, and filter components. In other cases, the equipment is "line-operated," and the power supply may include a power transformer, rectifier (whether a vacuum tube or "dry disc"), and filter components.

But the audio oscillator shown in Fig. 1 (together with its small earphone) is completely self-contained and requires neither batteries nor "line plug-in" for operation! *All that is required for operation is for a reasonable amount of light to fall on its face.* While not quite "something for nothing," it is a close approach.

The unit shown is not an expensive "laboratory device" but a practical piece of equipment that can be easily duplicated by almost any technician or experimenter.

Its design and construction has been made possible by utilizing two semiconductor devices—a self-generating selenium photocell and a *Raytheon* type CK722 junction transistor.

Circuit Description

The complete schematic diagram for the *light-powered oscillator* is given in Fig. 2, while an interior view of the unit is shown in Fig. 3.

Referring to the schematic diagram, the transistor collector is connected to the primary of a small "Sub-Ouncer" transformer, T_1. The return lead is connected to the "negative" terminal of the self-generating photocell, *PS*.

The transformer secondary winding is connected between the transistor emitter and, through coupling condenser C_1, to the transistor base. R_1 serves as a "base return" resistor and is connected to the negative terminal of the photocell.

An output signal is obtained through coupling condenser C_2 and applied to a standard crystal earphone, the lower lead of which connects directly to the transistor emitter. The "positive" terminal of the photocell is also connected to the transistor emitter.

In operation, light striking the photocell generates sufficient voltage to drive a small current through a low impedance load (the maximum current obtained with the photocell shown does not exceed a few hundred microamperes).

This current flows over two paths. Part of the current flows through the R_1 and base-emitter path, establishing the "bias current" for the transistor. Another part of the current flows through the primary of T_1 and the collector-emitter path.

As is readily apparent, the transistor itself is connected in a modified "tickler feedback" grounded-emitter oscillator circuit, with feedback obtained through the primary and secondary winding of T_1. Current variations in the primary winding cause a.c. variations in the secondary winding through magnetic coupling. The signal thus developed in the secondary is applied to the base-emitter circuit of the transistor, where amplification takes place, resulting in further variations in the primary current (since this is equal to the collector current).

The oscillation obtained continues as long as sufficient light falls on the photocell.

With the parts values shown, there is a certain amount of "blocking oscillator" action, with the result that the frequency of operation varies with large changes in the amplitude of light falling on the photocell (and hence with changes in the amount of generated current). When the model shown is held in sunlight and gradually turned so that greater amounts of light strike the photocell, the tone gradually increases in pitch, then suddenly changes over to a low frequency "buzz."

Good results can be obtained under incandescent lights, but when the unit is used under fluorescent lamps, the 60-cycle line buzz modulates the normal signal, with the result that a "buzz" is heard in the earphone.

Construction is fairly straightforward and no particular difficulty should be encountered by the skilled technician. However, a few special suggestions appear to be in order.

The author's model has been assembled and wired in a small plastic box (an old "pill box"). As is easily seen in the interior view, Fig. 3, the inside of the box is mostly "empty space." If a smaller plastic box had been available at the time of construction, the entire unit could have really been "miniaturized."

Either a larger or smaller case may be used by the builder, as he prefers. However, two points should be kept in mind when selecting the case—first, it should be large enough so that the photocell used can be easily mounted. Secondly, if the builder plans to mount the photocell inside the case (as the author did), the case should be of clear (transparent) plastic.

This brings up an important point—obtaining the photocell. All parts used in constructing the small unit are commonly available and can be obtained from the majority of wholesale electronics parts distributors—except the photocell. Two possible sources of supply are open to the experimenter, (*a*) he can salvage a unit from a discarded or used photographic exposure meter, and (*b*) he can watch for "surplus" sale ads, where these units are sometimes offered at low prices. (*Concord Radio*, of New York, recently offered similar photocells at less than one dollar each.)

Once the photocell has been obtained, the polarity of lead connections must be identified. If these connections are not already marked on the photocell, a 0-1 ma. or 0-500 microammeter should be connected to the photocell and the unit held under a reasonably strong light. By noting whether an "up-scale" or "down-scale" deflection is obtained, the lead polarity can be quickly determined.

In the unit used by the author, the rear surface was positive and two narrow strips on the front (or light-sensitive) surface formed the negative terminals.

When mounting the photocell, make sure that the light-sensitive surface faces in the proper direction. Also make sure that positive contact is made to the photocell terminals. This contact is preferably made through spring surfaces (phosphor bronze is good material to use for this). *No attempt should be made to solder directly to the photocell unless special terminals are provided for this on the unit itself.*

Although the transistor could be wired directly into the circuit, using its leads, it is suggested that a standard 5-pin subminiature tube socket be used instead, as shown in the model. This step is necessary because the short lead lengths used in subminiature wiring might result in the transistor being overheated during soldering.

However, if the builder does not have the proper socket available, and cannot easily obtain one, the transistor may be soldered into the circuit if special care is taken to hold each transistor lead during soldering with a pair of flat-nosed pliers (the pliers should be on the "transistor side" of the soldered joint).

Both the transistor socket (where used) and the "Sub-Ouncer" transformer may be mounted simply by cementing them to the plastic case, using either "Duco" cement or any general-purpose radio service cement.

Other parts are supported on their own leads.

Adjustment

Once the wiring is completed, the unit should be checked for operation by placing the earphone in the ear and holding the completed oscillator near a reasonably strong light source so that light falls directly on the photocell.

If oscillation is not obtained, try varying the size of R_1. If necessary, a 250,000 ohm potentiometer may be temporarily connected in place of this resistor and an adjustment made. The value is then checked and a fixed resistor of approximately the same value permanently connected in place.

Should it be impossible to obtain oscillation, even by varying the size of R_1, reverse the transformer secondary leads (the two black leads, Fig. 2) and again check for oscillation. If necessary, again try varying the size of R_1.

Where the last step does not permit oscillation to be obtained, it may indicate that the photocell is defective or "weak." Check this unit for operation by connecting a 0-1 ma. or a 0-500 microammeter across it and holding the unit under a strong light source; a current of at least 50 to 100 microamperes should be obtained, with as high as several hundred microamperes obtained from a really sensitive cell.

In an extreme case it may be necessary to try another transistor, but, in general, this should not prove necessary. The author tried this circuit with a number of different transistors (of the same type) and obtained satisfactory results in every case.

Applications

While the *light-powered audio oscillator*, as shown in the photographs, is basically an experimental "gadget," the unit does offer a number of practical applications. For example, by providing a hand-key in the emitter circuit, the unit could be used as an extremely compact and inexpensive-to-operate code-practice oscillator.

The unit could also be used by a blind person to determine if a room is lighted or dark. Since the tone pitch varies somewhat with light intensity, this would provide some indication as to the amount of light in a room and as to the light sources.

In addition to the applications of the audio oscillator, the use of "light-power" suggests many other possibilities. The author plans to eventually construct a small light-powered transmitter, a receiver, and possibly a small audio amplifier.

The reader can undoubtedly think of many additional applications of the light-powered audio oscillator, as well as other more general applications of light-powered "electronic" equipment.

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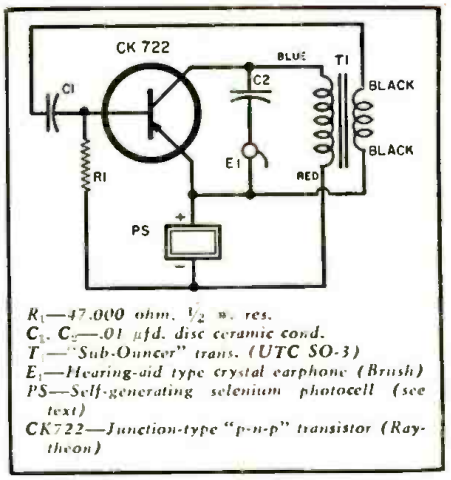
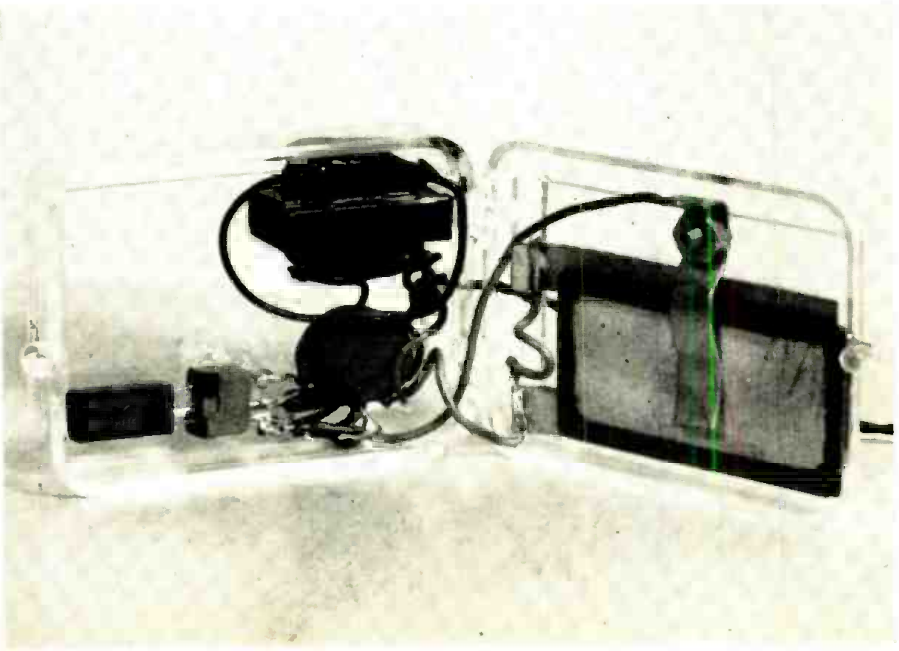


R_1—47,000 ohm, ½ w. res.
C_1, C_2—.01 µfd. disc ceramic cond.
T—"Sub-Ouncer" trans. (UTC SO-3)
E_1—Hearing-aid type crystal earphone (Brush)
PS—Self-generating selenium photocell (see text)
CK722—Junction-type "p-n-p" transistor (Raytheon)

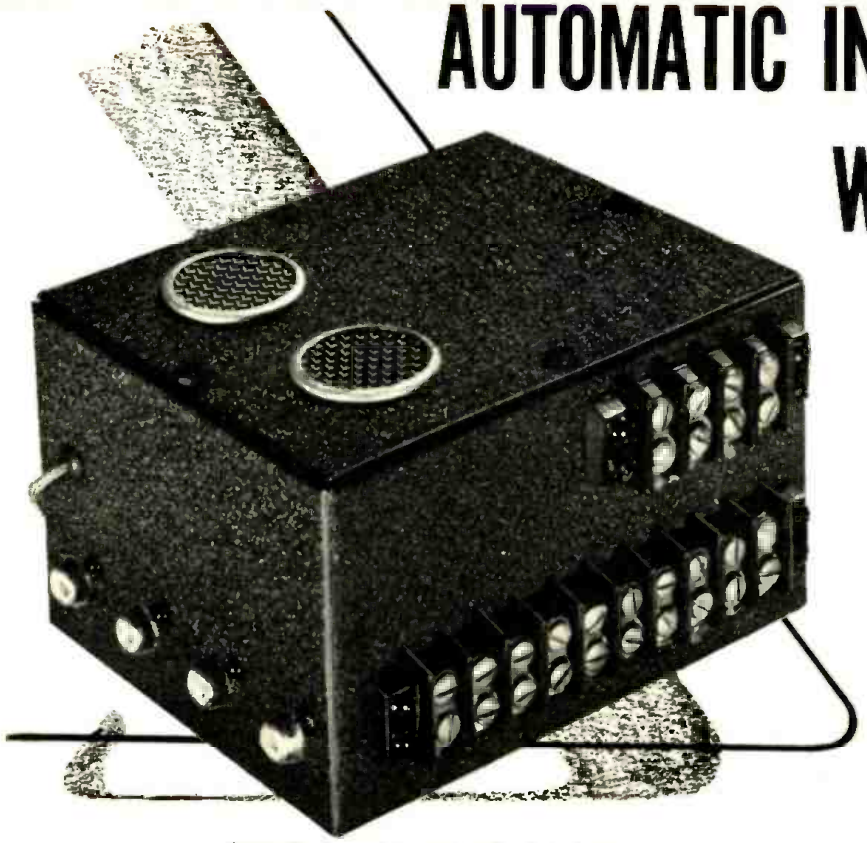
Fig. 2. Schematic of audio oscillator unit.

Fig. 3. Internal view. Unit can be constructed in even smaller cabinet if desired.



AUTOMATIC INPUT SWITCHING WITHOUT RELAYS

By **ALLAN M. FERRES**



Over-all view of control unit. It is housed in 3" x 4" x 5" steel utility can. See text.

Construction details on a novel input control circuit for switching in the desired source—tuner, phono, TV, etc.

"TOO many knobs" . . . and "I don't know how to work it" . . . "It's too complicated". If anyone in your family ever says these things about your radio/phonograph installation, then you are not getting full value from your investment in high-fidelity. Every member of the family should be able to enjoy it when they want to and so obtain from it the many hours of pleasure a really good system can furnish.

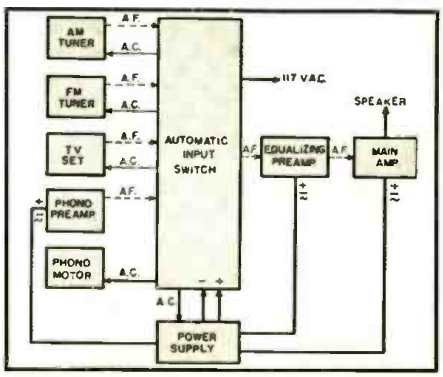
The "automatic input selector" can help you make the operation of your equipment easier. Here is how it was used in one fairly typical installation which was being re-designed with simplified operation in mind.

The equipment was installed in a deep-shelved bookcase built against one wall of the living room. The record player was placed on one open shelf a convenient forty-five inches from the floor, with the space below it containing the speaker and its housing. An AM tuner, an FM tuner, and the equalizing preamp were on another shelf of the same height.

Two open shelves below them were used for records and the bottom shelf was provided with doors to conceal the speaker crossover network, main amplifier, and power supply. Ten knobs and two switches were in daily use on the tuner/preamp shelf. All the controls except those for the AM and FM tuners were grouped together on the preamp/control panel, each control essential, but the seven knobs in a row discouraged all but the technically-minded members of the family. The knobs lined up this way: on the AM tuner—"on-off" and volume and a tuning knob. On the FM tuner—volume, "on-off", tuning knob. On the preamp/control panel—input selector, bass, treble, low-frequency turnover, high-frequency cut, volume, "on-off" switch, and pilot light.

To reduce the number of controls, two methods of attack were used. The first was to have one knob serve two functions wherever possible and the second was to place specialized controls on the unit with which it was used. An example of both methods was to combine the low-frequency turnover and the high-frequency cut adjustments, which were used only for records, on one six-position switch and mount it alongside the record player. All this entailed was to build the phono preamp on its own two by four chassis instead of combining it with the equalizing/control preamp, and mounting it under the motor board so that the equalizer switch would appear near the back of the pickup arm. From an experimental viewpoint, it had the advantage of being readily available for modifications without the need for putting any other equipment out of service while it was being worked on. From the family's point of view, its location made it obvious that it needed manipulation only when records were being played.

Fig. 1. How the various components in the home entertainment system are connected into the automatic input switching unit.



The AM and FM tuning knobs on the separate tuners defied changing, for even if a combination AM/FM tuner were used, a bandswitch would be needed which still meant two knobs here.

Bass and treble controls still had to be separate, but if the input to the equalizing preamp could be selected automatically when the desired music source was turned on, one more control could either be eliminated or moved to a less crowded spot. It would, of course, be possible to use the input selector to turn on each input source as required, but with the tuners and the record player arranged as they were, the former method resulted in more logical operation. If another input source, such as a TV set or tape recorder, were located at a distance from the main installation, the reason for choosing this method would be even more obvious. As the only unusual item in the simplified installation was the automatic input selector, it is described here. The general arrangement is shown in Fig. 1.

The automatic input selector could have been included in the equalizing preamp, but it was made up on a separate chassis to reduce the extent of crippling of the whole system when future modifications were in order. As a separate unit, it can be readily

added to existing installations with only minor changes in each input source. Relays could have been used to select the desired input which was to be fed into the rest of the system, but by using the cathode followers, the distance between the selector and the equalizing preamp could be greatly extended without loss of high-frequency response or increase in susceptibility to hum pickup without additional complications.

The circuit (Fig. 2) is simple enough. It consists of four triodes connected as cathode followers, having a common cathode load resistor. In this case, two dual triodes, 12AU7's, are used. In these tubes, the cathode which is connected to pin 3 is heated by the section of the heater included between pins 4 and 9 and the cathode connected to pin 8 is heated by the section between pins 5 and 9. Each input source, tuner, TV set, tape recorder, or phono preamp is connected to a separate grid circuit and when the heater of this section is turned on by the regular a.c. switch of the input source, the signal is passed on by the tube and appears across the common cathode load resistor. As only one triode heater is turned on at a time, the other input circuits are effectively disconnected from the rest of the circuit. In order to eliminate the heat that would be caused by having a series dropping resistor in the heater circuit, a condenser is used to reduce the line voltage to the 6.3 volts required by each triode section. This idea was gratefully lifted from Mr. Richard Graham's article "A Novel Capacitance Relay" in the December 1952 issue of RADIO & TELEVISION NEWS. If each source of input had had its own 6.3-volt heater supply, this 6.3 volts could have been used to operate its respective triode section, although one additional conductor would have been required between the source and the input selector unit.

In the unit built by the author, the parts were mounted in a three by four by five steel utility can as shown in the photographs. The two tube sockets and the filter condenser were mounted on a piece of aluminum approximately five by two and three-quarter inches, with a half-inch fold on the two and three-quarter-inch

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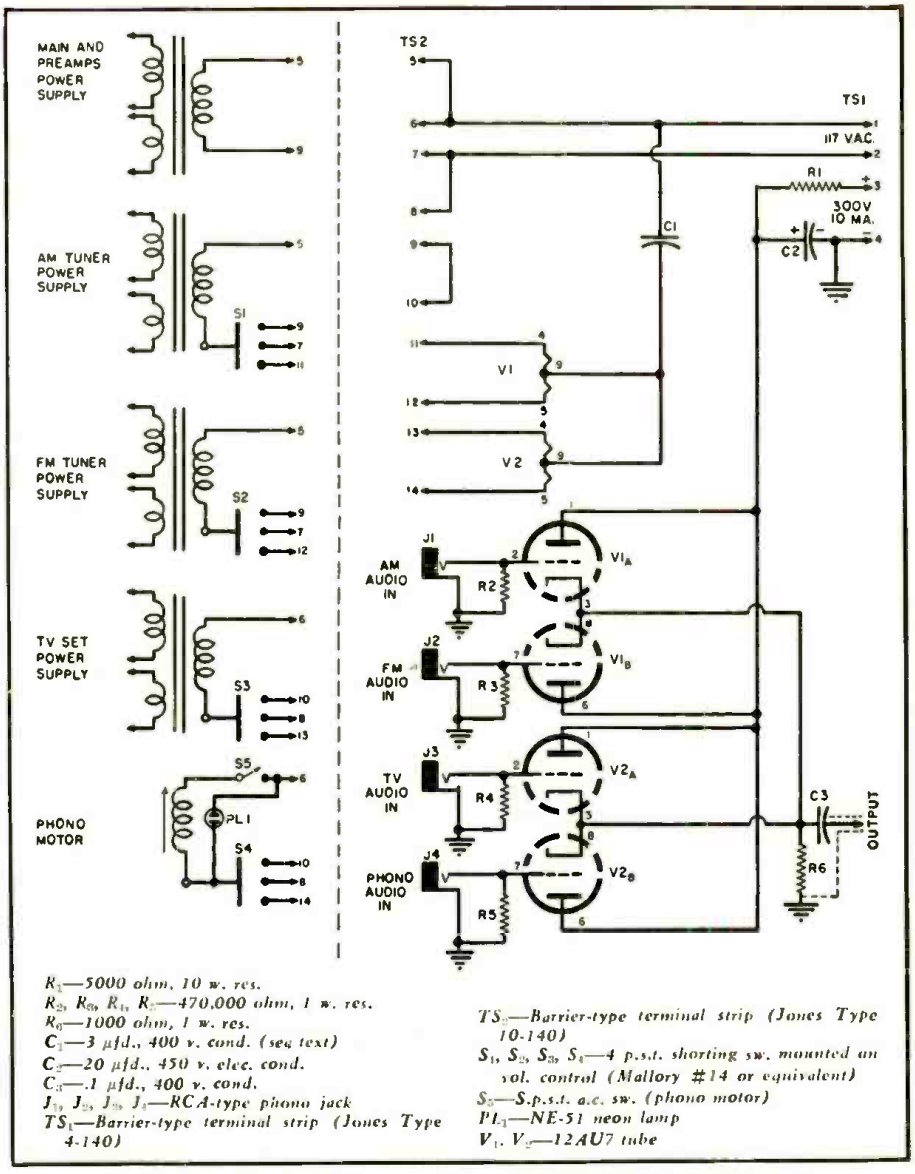
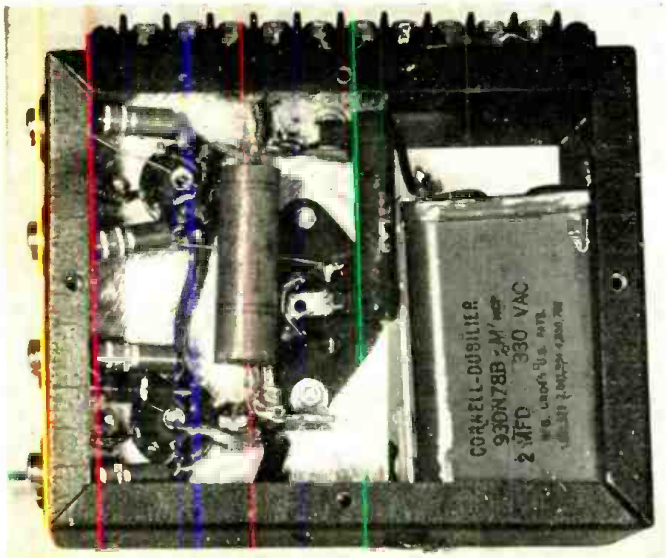


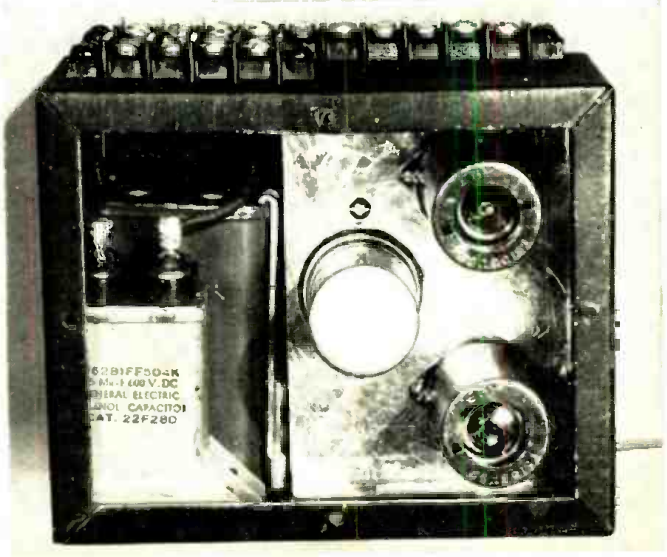
R_1—5000 ohm, 10 w. res.
R_2, R_3, R_4, R_5—470,000 ohm, 1 w. res.
R_6—1000 ohm, 1 w. res.
C_1—3 μfd., 400 v. cond. (see text)
C_2—20 μfd., 450 v. elec. cond.
C_3—.1 μfd., 400 v. cond.
J_1, J_2, J_3, J_4—RCA-type phono jack
TS_1—Barrier-type terminal strip (Jones Type 4-140)
TS_2—Barrier-type terminal strip (Jones Type 10-140)
S_1, S_2, S_3, S_4—4 p.s.t. shorting sw. mounted on vol. control (Mallory #14 or equivalent)
S_5—S.p.s.t. a.c. sw. (phono motor)
PL_1—NE-51 neon lamp
V_1, V_2—12AU7 tube

Fig. 2. Complete circuit diagram of the automatic input switching device.

Under chassis view. Few parts are required in the construction.



Top chassis view. Provision is made for proper heat dissipation.



A MULTI-BAND, CONSTANT IMPEDANCE ANTENNA

By **CALVIN R. GRAF, W5LFM**

A simple modified "dipole" antenna can be used on all bands related to the fundamental frequency in steps of 1, 2, 4, 8, 16, etc. by choosing the correct feed point.

IN AN ARTICLE in this magazine several years ago,[1] it was shown that a transmission line could be matched to an antenna so that the antenna would operate on two bands. However, further investigation of the impedance-*versus*-length chart of the antenna shows that it is possible to work on several bands as long as they are related harmonically in steps of 1, 2, 4, 8, etc.

It is possible to find a point on an antenna that will present the same impedance to the transmission line when operating on several different bands. Fig. 1, which is a logarithmic plot of impedance *versus* antenna length by bands, shows that there are many points on an antenna where the impedance is the same for different bands. Also, the points lie very near the 300-ohm line on the chart.

If point *X* in Fig. 1 is chosen, it can be seen that the fundamental of the antenna is not at the 300-ohm points. But if point *Y* is chosen, it includes the 300-ohm point of the fundamental and of all harmonics related in steps of 2, 4, 8, etc. Thus operation is possible not only on two bands, but on all bands that are related as indicated above. It becomes a simple matter of feeding a 300-ohm antenna with a 300-ohm line and this can be done on all bands without changing the feedpoint.

On its fundamental frequency, in our case 3.5 mc. (Fig. 2A), the antenna is fed off-center at one of the two 300-ohm points that exist on a half-wave dipole. This procedure is based on the assumption that the center radiation resistance of a half-wave dipole is approximately 70 ohms, rising to an approximate value of 4000 ohms at each end. Both values will vary somewhat, of course, depending upon the wire size and the proximity factors of the antenna.

When the antenna is operating on its second harmonic, 7 mc., and is a full wavelength long electrically (Fig. 2B), there exists a high impedance of 4000 ohms at the center instead of the usual 70 ohms. This 4000-ohm value will also be found at both ends of the wire. But, because of the position of the feedline, the antenna is still being energized at a 300-ohm point with a 300-ohm transmission line. Thus no standing waves result.

The same 300-ohm point is also used to feed the antenna on 14 and 28 mc., which are the fourth and eighth harmonics (Fig. 2C, 2D).

The 300-ohm transmission line can be any good-quality molded plastic or open-wire line.

We must now calculate the length of the antenna and the feeder tap point. The long wire formula $L = 492(N-.05)/f$ is used to determine antenna length. L is length in feet, f is frequency in mc. for the highest band to be used, and N is the number of half-waves for the highest band to be used.

While in Japan, the author constructed an antenna such as this to be used on all bands from 80 through 10 meters. A frequency of 28.4 mc. for f was chosen since it allows the antenna to be tapped at the correct distance for proper operation in both the phone and c.w. portions of 10 and 20 meters. Operation on 40 and 80 will be satisfactory because of the lesser importance of the tap position at the lower frequencies. N in this case be-

(*Continued on page* 104)

[1] Dreher, Karl: "A Two-Band Piece of Wire" RADIO & TELEVISION NEWS, February, 1950.

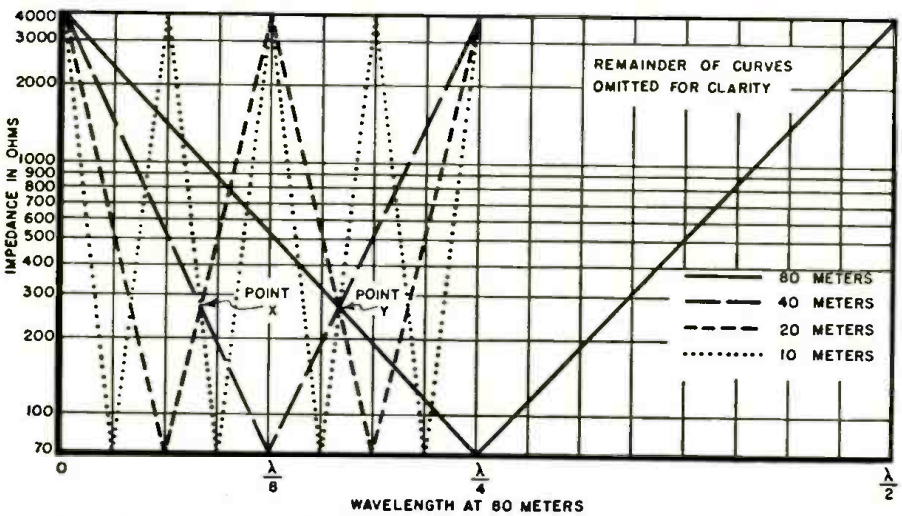


Fig. 1. Impedance vs wavelength for 80-meter antenna. See text on Points X and Y.

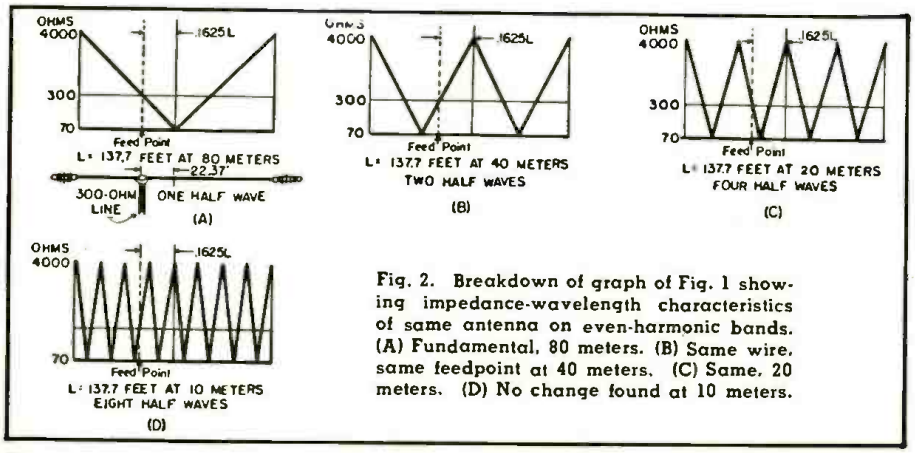
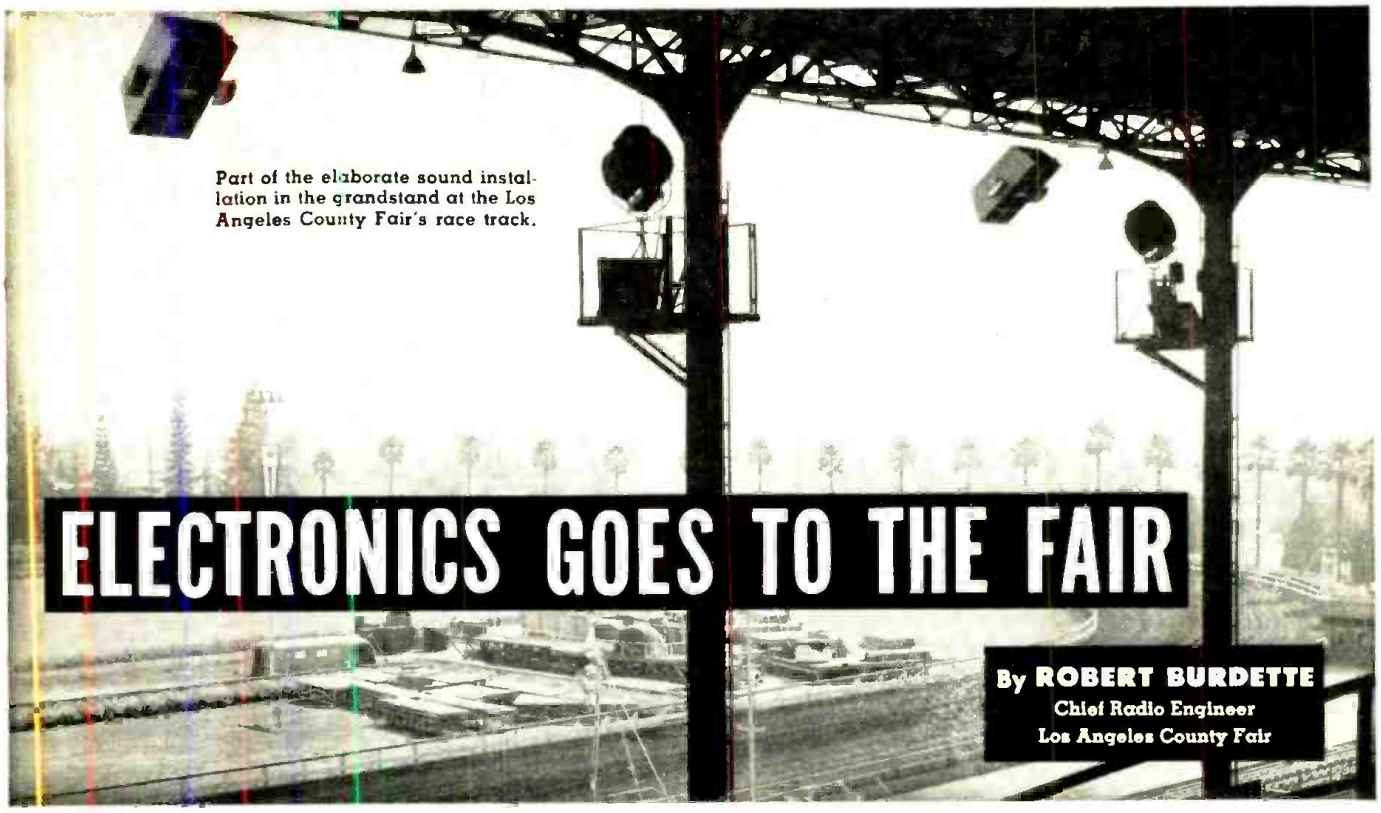


Fig. 2. Breakdown of graph of Fig. 1 showing impedance-wavelength characteristics of same antenna on even-harmonic bands. (A) Fundamental, 80 meters. (B) Same wire, same feedpoint at 40 meters. (C) Same, 20 meters. (D) No change found at 10 meters.



Part of the elaborate sound installation in the grandstand at the Los Angeles County Fair's race track.

ELECTRONICS GOES TO THE FAIR

By **ROBERT BURDETTE**
Chief Radio Engineer
Los Angeles County Fair

The sprawling grounds of the Los Angeles County Fair can shrink to backyard size because of an elaborate sound system which permits complete coverage.

IN OCTOBER, 1922 a popular young pharmacist, Mr. Jack C. Aflerbaugh of Pomona, California, conceived the idea of interesting a few of his fellow citizens in organizing an association, the purpose of which would be the exhibition of the products of the rich farm land and industries surrounding their thriving city.

Thus was born the Los Angeles County Fair, which has grown to be the largest in the world. From exhibits in tents spread over 40 acres of grain field, the Fair now covers 400 acres of ground with parking accommodations for 40,000 cars; one of the country's finest race tracks; and 200 permanent buildings housing exhibits brought from all over the world. More electricity is consumed daily at the Fair than is used by the entire city of Pomona, with its population of over 35,000 people.

Nineteen fifty-two, the twenty-fifth anniversary of the Fair, saw 1,068,000 people swarming through the grounds, consuming over 25 miles of hot dogs.

Protecting, guiding, and informing such a tremendous crowd involves public address and radio control problems of the first magnitude. The people must be able to hear clearly all sorts of material, from concerts in the grandstand (which seats 10,000 people) to the raucous calls of the Midway barkers.

Forty-two thousand individual exhibitors collect an estimated two miles of ribbons for prize-winning accomplishments in various fields including agriculture, livestock, fine arts and crafts, horticulture, domestic arts, and many others. Information regarding the activities must be gathered, edited, and broadcast by public address, radio, or telecast.

To accomplish this involves the simultaneous operation of over seventeen major public address systems, the broadcasting of over 600 radio programs of all types, and 75 hours of live telecasting, plus the release of many tape recordings for delayed broadcast.

This requires an enormous amount of electronic equipment, which must be set up, operated, and disassembled every year during the seventeen days the Fair is open.

Public address requirements may be divided into four classifications: the race-track installation, ground system, localized installations, and the mobile unit. The race-track installation consists of seven trumpet horns mounted in two clusters and directed to project sound across a 420 foot grandstand, which accommodates approximately 20,000 people. Two large baffle-type speakers are located directly in front of the grandstand to provide sound reinforcement for people standing at the edge of the track with two additional trumpet horns strategically mounted to cover the infield. Located in the center of the grandstand, upstairs rear, is a race announcer's microphone.

In front of the grandstand is a large stage equipped with seven microphones which is used for entertainment between races. Custom-built amplifiers furnish 150 watts of power. This installation is sponsored by the *General Petroleum Corporation*.

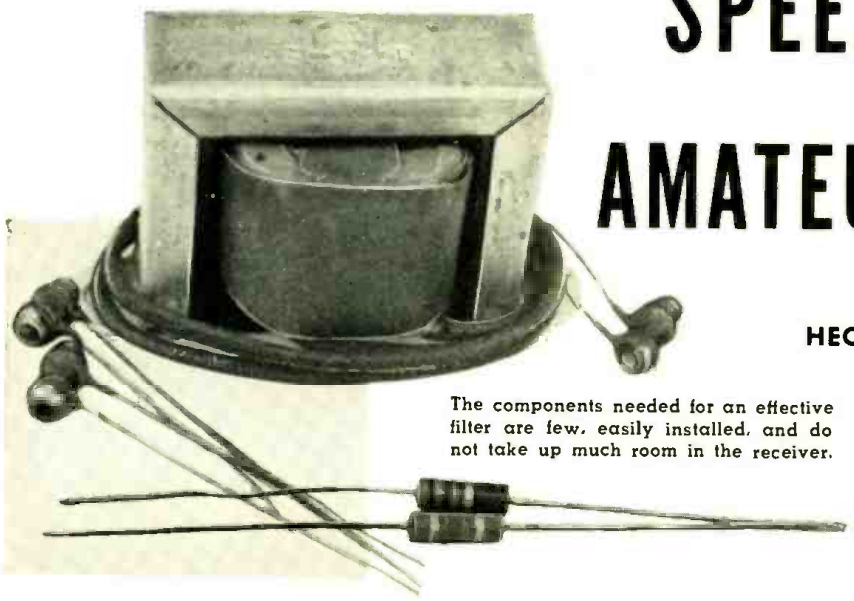
The ground system consists of speakers located throughout the grounds on towers approximately 60 feet in the air. These speakers are re-entrant-type trumpet horns with their amplifiers located in the Agriculture Building. Music, interspersed with public announcements, is continually originated at this point.

Custom-built amplifiers with 200 watts of power are located in the Agriculture Building. This system furnishes sound individually or simultaneously to the ground system and the speakers inside of the Agriculture Building, which is 400 feet wide, 800 feet long, with a 68 foot ceiling. Six *Jensen* "Hypex" chandelier-type speakers are used for sound projection. A stage, located at one end of this building, is equipped independently with its own amplification and baffle-type loudspeakers. This installation is also sponsored by the *General Petroleum Corporation*.

Localized installations are the main part of the public address operation with many units being operated simultaneously in approximately sixteen major locations. These installations cover the main auditorium, seating approximately 2000 persons, located in (*Continued on page* 183)

SPEECH FILTERS FOR AMATEUR RECEIVERS

By
HECTOR E. FRENCH, W1JKZ



The components needed for an effective filter are few, easily installed, and do not take up much room in the receiver.

Essential "intelligence" audio frequencies are emphasized and much interference rejected by a receiver speech filter.

WITH the amateur phone bands becoming more crowded each year, it is necessary to take advantage of every possible improvement in the entire communications link, from the microphone of the transmitter clear through to the speaker of the receiver. One of the easiest and most effective ways of improving this communications link is by using a speech filter.

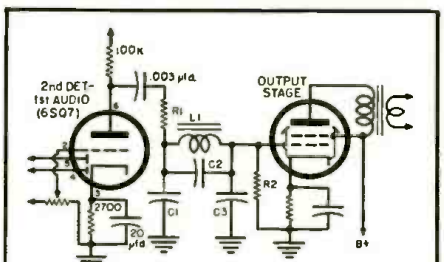
Already, many transmitters include a filter circuit in the modulator, designed to eliminate the frequencies which lie outside the basic communications range of speech. By eliminating these frequencies, all the modulation energy can be applied to the most useful speech frequencies, with a resulting increase in the effectiveness of the modulation. When a speech clipper is being used in the modulator to increase the apparent percentage of modulation, a speech filter is required in order to eliminate the higher-order harmonic components generated by the clipping action. Failure to use a filter would result in severe distortion and spurious sidebands.

However, there is often little or no attention paid to the audio characteristics of the receiver when trying to reduce interference. This portion of the communications link can also benefit by careful design, since the signal fed to the speaker by the audio stage may include high-frequency heterodynes, converter hiss, splatter from a neighboring overmodulated carrier, or random noise from the background noise level on the band. To make it even worse, these interfering components are usually present two or three at a time. Since the generally-accepted limits of the effective speech frequencies are roughly 300 and 3000 cycles, it is obvious that a filter which rejects the frequencies outside these limits will improve the communications ability of the receiver when interference is present.

This type of interference is frequently made more severe by the characteristics of the speaker and its enclosure, and even by the position in the room where the speaker is mounted. Any resonances in this system outside the speech range will artificially re-inforce these unwanted frequencies, and reduce the effective signal-to-noise ratio. When it is remembered that the human hearing mechanism is most sensitive to the frequencies above 3000 cycles, it is plain that any effort to control this characteristic is a step towards more effective operation.

One popular and simple approach towards controlling the audio characteristics of the amateur communications receiver is to incorporate a resistance-capacity tone control somewhere in the audio circuit. This is of some help in reducing the extremely high-pitched noise components, but the filtering action is usually too broad to be fully effective. With the tone control "full on," the important upper speech frequencies become attenuated so severely that the intelligibility is reduced by the tone control more than it would have been by the interference the tone control was designed to cure in the first place!

Fig. 1. Circuit of the filter. Numbered parts are the filter proper; labelled parts are typical or preferred receiver values.



R_1—33,000 ohm, ½ w. res.
R_2—82,000 ohm, ½ w. res.
C_1, C_2—380 μμfd. ceramic cond.
C_3—330 μμfd. ceramic cond.
L_1—4.5-5.3 hy. filter choke (Stancor C-1706)

The only simple way of achieving the necessary sharp cut-off at the limits of the speech frequency range is by using a properly designed filter which has both inductance and capacitance. Designing the filter itself is somewhat complicated, but the greater complications are those which arise after the design is completed and the practical considerations of using the filter appear.

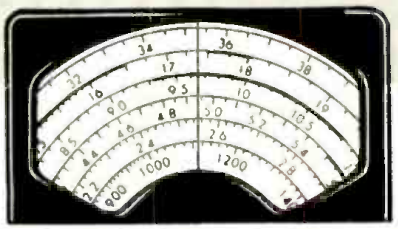
For example, there is the problem of size. A bandpass filter for the audio range can require more space than is available. Also, the electrical values required for the components almost always include some awkwardly impractical number of microfarads that must be "built up" by placing smaller values in parallel. It soon became evident that a conventional bandpass filter design was impractical, and this approach was discarded.

After calculation and experiment, it was found that the bandpass action could be obtained in two steps, by using a low-pass filter for the 3000-cycle cut-off, and by using the combination of a resistance-capacitance filter and an acoustic filter at the lower frequencies. Still further thought determined that for the greatest utility, the filter should be applicable to a receiver by merely inserting the circuit between the plate of a conventional "hi-*mu*" triode audio amplifier, such as the 6SQ7 triode section commonly used following the second detector, and the grid of the audio output stage which follows.

For convenience and economy, the filter was designed around the smallest and least expensive standard filter choke available. This turned out to be the *Stancor* No. C-1706, rated at 4.5 henrys at 50 milliamperes. By measurement, the inductance at zero current was found to be 5.3 henrys. By using this inductor with three

(*Continued on page* 124)

International SHORT-WAVE



Compiled by KENNETH R. BOORD

ANSON BOICE has resigned as editor of the "United 49'ers Radio Society" and Mrs. Boice (Julia) has resigned as secretary, due to press of other duties. Bill Peters (W3NIT), 413 Pershing Ave., Collingdale, Pa., first editor of this club, has taken over the editor's job, and Mrs. Mabele Broome has been appointed secretary. Until further notice, all inquiries concerning the club should be sent to the president, Edward Broome, Box 371, Medford, N. J. (Boice, Conn.)

The "Newark News Radio Club" held its annual Convention Aug. 9 at the Montgomery County Sportsmen's Club, Green Lane, Pa.; this organization recently observed its 25th anniversary.

* * *

Around the World

Anglo-Egyptian Sudan—Radio Omdurman, 7.655A, tuned 1250 when had news in Arabic, then vocal Arabic music. (Pearce, England) Lists *English* for Friday 1230-1300, Sunday, Wednesday 1115-1130, and frequency as 7.600. (Riggle, Ohio)

Angola—Radio Clube de Huila, 10.048A, Sa da Bandeira, is fairly strong in Britain from around 1330 to close at 1604; CWQRM bad at times. (*Monitor*, England) Luanda, 11.862, is good level in Sweden 1500-1600 closedown. (*GDX-aren*, Sweden)

Australia—VLC9, 9.615—replacing VLC11, 11.810—to Eastern North America 0700-0845 is sending a greatly improved signal; DX session Sun. 0830. (Fox, Va.; Smits, Minn., others) Smith, Mich., notes excellent signal around 2300 from VLA15, 15.200.

Austria—Blue Danube Network, 9.617, Salzburg, noted 0200 with music; 0400 with news summary from the AFN newsroom, Frankfurt (Germany). (Pearce, England)

Balearic Islands—Radio Menorca, 7.410A, Mahon, noted in Sweden 1700-1725 sign-off. (*Nattugglan*, Sweden)

Belgian Congo—OTC, 9.655, Leopoldville, noted with *English* session relayed from ORU, Brussels, Belgium, 2000-2200 closedown. (Kelting, N. Y., others)

Brazil—A station on 11.965A around 1830 identifies in Portuguese as "Radio Record," Sao Paulo. (Niblack, Ind.) ZYE32, 11.825, Recife, noted 1700 with call of "Radio Jornal do Commercio;" excellent level in Britain. ZYB8, 11.764.5, Sao Paulo, noted 1715 at good level. PSH, 10.224, Rio de Janeiro, heard relaying "Agencia Nacional" session at 1750, fair level. (Catch) ZYB9, 15.155, Sao Paulo, noted in Portuguese at fair level 2100. (Hardwick, N. Z.) ZYR57, 9.745, has Japanese session ending around 1830; best day to try for this is Monday when HCJB, Quito, Ecuador, is off the air. (Bellington, N. Y., others) PRL7, Rio de Janeiro, noted recently with *English* announcements between 2130-2200. (Roberts, Conn.) Heard lately to *past* 0000. (Richmond, N. Y.)

Bulgaria—Sofia noted with *English* 1500-1515, 1615-1645 on 6.07, 7.670A. (Pearce, England) Excellent on 9.700 to North America 2000-2030. (Kelting, N. Y.) And in *new* period 1800-1815. (Dexter, Iowa, others) Now lists *English* for North America on 9.700 at 1800-1815, 2000-2030. (Crowell, Pa.)

Canada—CHNX, 6.130, Halifax, N. S., good level 0900. (Morrison, R. I.)

Canary Islands—Tenerife, 7.633A, noted 1700 in Spanish. (Alonso, Spain)

Cape Verde Islands—CR4AA, Praia, sent QSL card and gave channels as 5.895, 7.13 (but is now *near* 7.40), 400-3000 watts, at 1500-1700. (Pearce, England)

Ceylon—Colombo, 6.006, noted 0730 with musical program and news. (Sanderson, Australia) Commercial Service noted on 17.82A at 0615-0715 in *English*. (Ishikawa, Japan)

Chile—CE1173 is wandering around 11.945AV lately; heard as early as 0730. (Stark, Texas; Niblack, Ind., others)

China—Radio Peking was *measured* 15.063A recently 2235 when was only fair level, a bit improved by 2247; in Chinese. (Ferguson, N. C.) Current schedule shows *English* at 0400-0430 on 6.100, 7.500, 9.040, 10.260, 11.690, 15.060, 15.170; 0830-0900, 11.690, 15.060; 2200-2230, 13.625 (*new*), 15.060. (Oskay, Scheiner, N. J.)

Czechoslovakia—"The Voice of Peace," Prague, 9.504, noted signing on in *English* 1400 with news, music; off 1423. (Pearce, England) Heard on this channel 2315 with news, music. (Sanderson, Australia)

Denmark—Copenhagen, 15.165, heard signing on 0900 in Danish after clock chimes, anthem, to India, Malaya; closed with anthem 0959 (*no English*); at 1000 had ship's bells, then opened program for Danish seamen. (Pearce, England) Heard opening 1130 on this channel in Danish to Near East. (Takemi, Japan) Heard in both transmissions on 9.52 to North America 2030-2130, 2200-2300. (Gay, Calif., others)

Ecuador—HCRC1, 4.930, Quito, is scheduled Mon.-Fri. 0630-0800, 1200-1400, 1900-2215; Sat. 0630-0800, 1200-1400, 1900-2300; Sun. 1100-1300, 1900-2300. (Pearce, England) HC5GB, 4.780, Riobamba, noted signing off 2300. (Cushen, N. Z.)

Egypt—Cairo's *new* 11.965 channel noted opening 1000 with clock striking "5 p.m." The 6.085 channel appears parallel. (Pearce, England) Has been *measured* on 11.966 around 2335. (Ferguson, N. C.) Very strong in Virginia

(*Continued on page* 150)

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.) The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

This neat short-wave Listening Post is that of Yo Ishikawa, JA1DS, Tokyo, Japan, who is both an amateur and a SWL. Yo uses a home-made 11-tube superhet which has one r.f., three i.f., and two a.f. stages. Antenna is 10 meters long, 8 meters high.

TV RECEIVER SENSITIVITY

By

JOHN RANKIN

The "SensiMeter," manufactured by Service Instruments Co., measures TV receiver sensitivity when used with a v.t.v.m.

Importance of sensitivity measurements in improving TV sets and selecting the best receiver for fringe area operation.

ALTHOUGH television design engineers have been making great progress in increasing receiver sensitivity, realizing that this important factor enables the fringe areas to be extended farther from the television stations, very little information is available to the service technician on this subject. The majority of receivers now manufactured have approximately twenty times the sensitivity of receivers manufactured in 1948. However, due to production tolerances, tube aging, and rough handling during shipping, many receivers reach their destinations with decreased sensitivity and, unless the receiver is actually checked, poor reception is often blamed on local conditions or the antenna.

Very few factories check the sensitivity of all receivers leaving the plant, although every effort is made to see that the average sensitivity is kept high. If a receiver with below normal sensitivity goes to a primary service area, the owner would not know the difference; but if the same receiver goes to a fringe area, it might mean a very poor picture.

In many fringe areas where television signals are subject to fading, it is impossible to tell if a receiver has been satisfactorily repaired unless the sensitivity is actually measured.

Design engineers determine sensitivity by connecting a generator to the receiver antenna terminals, measuring the d.c. voltage developed across the video detector load resistor. The generator is not modulated, and has an output attenuator calibrated in microvolts. The attenuator is adjusted to give 1-volt d.c. across the video detector load resistor. This value is used because, under actual operating conditions, if 1 volt d.c. is developed by the television signal a satisfactory picture will result. Some early receivers required an input as high as 500 microvolts to obtain 1 volt d.c. across the video detector load resistor. The receivers being produced today are capable of obtaining 1 volt with 20-microvolts input, with many even better.

The sensitivity figures mentioned are for Channel 2. This channel is used because the lower the channel, the higher the sensitivity, and unless one channel is used as a standard, the figures would become confusing. In modern receivers the sensitivity on Channel 2 is twice that of Channel 13, and the variation is almost linear on the other channels.

Sensitivity measurements help the service technician to improve reception in fringe areas. The following is an actual report on what can be done by measuring the sensitivity.

A receiver was checked and found to have a sensitivity of 100 microvolts. This was not good enough for fringe-area reception. The a.g.c. was a straight peak-operated diode type. Connecting the a.g.c. circuit through a changeover switch to operate from the negative voltage developed across the video detector load resistor, as shown in Fig. 1, brought the sensitivity of the set to 50 microvolts.

The "B+" was found to be low on the video i.f. amplifier tubes, so it was increased by shunting the feed resistors to the next higher "B+" source (an increase of 50 volts). This increased the sensitivity of the receiver to 25 microvolts.

The receiver used a *Standard Coil* tuner, so the 3900-ohm resistor across the r.f. grid coil was changed to 22,000 ohms, resulting in a sensitivity of 20 microvolts.

In a 20-microvolt signal area this receiver gave excellent results. Sometimes, however, it is necessary to obtain a greater increase in sensitivity. If the receiver uses 6AU6 tubes as i.f. amplifiers, it is often possible to rewire one socket and use a 6AG5, increasing the sensitivity to 10 or 15 microvolts.

Due to manufacturing tolerances, all receivers, even of the same make, will not show the same increase with each step. Some receivers, with the changes mentioned, will not go below 20 microvolts; but others will go to 5 microvolts without developing a peaked curve due to regeneration.

Rectifiers supplying "B+" are one of the worst offenders causing low sensitivity—r.f. amplifier tubes come next. These tubes may be changed while the sensitivity is being measured without re-alignment of the receiver generally being necessary. Germanium diodes can also contribute to low sensitivity and, if they are accessible, they should be tried next; otherwise, the i.f. amplifier tubes should be replaced and the i.f. stages re-aligned.

Increasing the sensitivity by these methods will often save the work involved in erecting stacked antennas, and will eliminate the need for a booster.

Since all u.h.f. signals are ultimately converted to a v.h.f. signal, and also since u.h.f. signals are usually much weaker than v.h.f., it is important to know the maximum receiver sensitivity on a low v.h.f. channel before poor reception is blamed on the converter or u.h.f. strips. Unless a check of this type is made, the service technician may spend much time on the antenna installation without much improvement in picture quality.

The "SensiMeter" is a generator designed expressly for measuring the sensitivity of television receivers. This unit has a unique attenuator which is

the most critical part of equipment of this type; a cross sectional diagram of the attenuator is shown in Fig. 2. The oscillator coil "A" is housed in a seamless metal bellows "B." When the bellows is opened or closed, the output coil "C" moves with it. The attenuation remains constant with variations in oscillator frequency, and is free from the usual difficulties associated with variable-resistance type attenuators. The attenuator also provides shielding and matching for the output circuit and even with the attenuator in the 5-microvolt setting, the cable may be grasped without any change in reading. The output impedance is 300 ohms at all settings of the attenuator, and the calibrations are extremely accurate. Also, the oscillator tube may be replaced without recalibrating the instrument.

To measure sensitivity with the "SensiMeter," the two clips on the output cable are connected to the receiver antenna terminals; the receiver channel selector is set to Channel 2, or if Channel 2 is operating in the area Channels 3 or 4. The meter on the front panel is then set to center scale to compensate for any variation in line voltage. A v.t.v.m. (or 20,000 ohms-per-volt meter) set on the low-voltage d.c. range is connected across the video detector load resistor, and the channel dial on the "SensiMeter" tuned for a peak on the v.t.v.m. The microvolt dial is then adjusted until the v.t.v.m. reads 1 volt. The figure on the microvolt dial at this setting is the sensitivity of the receiver. The scale of the microvolt dial is divided into three parts—"Very Sensitive Receiver," "Medium Sensitivity," and "Insensitive Receiver," to allow the operator to quickly determine the condition of the set.

Measuring sensitivity in this manner duplicates the receiver operating conditions in fringe areas where the pictures are mostly tuned with the video carrier on top of the curve. If it is required to know the receiver sensitivity under operating conditions in a primary area, the microvolt figure would be multiplied by 2, since the video carrier would be tuned to the 50% point of the receiver response curve.

While sensitivity is being measured, the channel dial on the "SensiMeter" should be turned slowly, watching the pointer of the v.t.v.m. If the receiver is properly aligned, the pointer will slowly rise and fall, tracing out the curve of the receiver, as shown in Fig. 3A.

Some receivers may show very good sensitivity, but the check described in the preceding paragraph may indicate a sharp peak, as shown in Fig. 3B.

This is often caused by regeneration. Most manufacturers recommend that battery bias be used during alignment, and after alignment the curve may look normal when viewed with a sweep generator and oscilloscope. However, when very little or no a.g.c. bias for the i.f. amplifiers is developed in fringe areas, regeneration may occur in the i.f. strip, resulting in large snow particles and poor sync. The regeneration can be caused by wrong lead dress in the i.f. amplifier strip, long leads on i.f. bypass condensers, or the use of tubes with too high a gain for the amount of shielding provided. Connecting the suppressor of 6AU6 tubes to the unbypassed cathode resistor instead of to ground is another common cause of regeneration.

Many manufacturers have test points for the video detector load accessible without removing the receiver from the cabinet, so it is possible to check the sensitivity of a receiver rapidly before it is sent to a fringe area. In this way a "hot" receiver may be selected for a difficult area.

A further use for the "SensiMeter" is to check the field strength of the television signal on Channels 2, 3, and 4. To do this, connect the antenna to a television receiver, short-circuit the a.g.c., and measure the voltage across the video detector load resistor. Then connect the "SensiMeter" to the receiver input. Adjust the microvolt dial until the voltage across the video detector load is the same as that produced previously by the signal coming down the antenna. The reading on the microvolt dial is the field strength. If this reading is 15 microvolts, then a receiver with a sensitivity of at least that amount must be used.

The preceding methods of measuring sensitivity do not include the video amplifier and picture tube which also play their parts in producing the picture. The video amplifier, whether it be one or two stages, must amplify the signal from the video detector load to a level which will operate the picture tube.

Two terminals on the right-hand side of the "SensiMeter" provide 1 volt peak-to-peak. This is connected across the video detector load resistor and if the video amplifier has adequate gain and if the picture tube is good, a black bar will appear on the screen.

Although it is not necessary, the actual gain of the video amplifier may be measured by connecting a peak-to-peak voltmeter between the picture tube cathode and grid. The reading in peak-to-peak volts is the gain of the video amplifier.

Although this article has stressed the importance of receiver sensitivity in fringe areas, sensitivity becomes very important in primary areas when receivers are installed in apartment buildings where outside antennas are not permitted. In such instances, many sales have been lost due to insensitive receivers. —30—

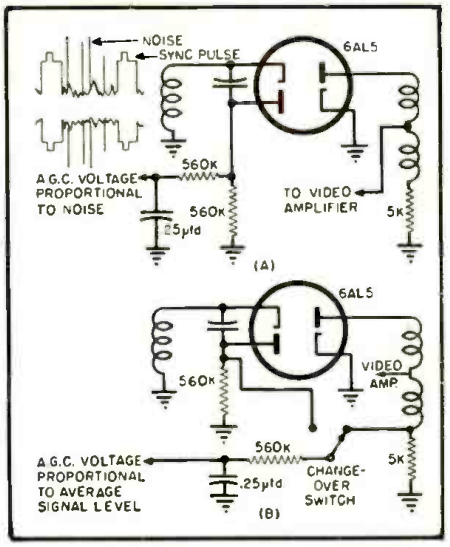


Fig. 1. (A) A diode a.g.c. system which develops a.g.c. voltage in proportion to the peak level of the received signal. In fringe areas where the noise peaks often exceed the level of the sync pulses, the noise pulses develop a.g.c. voltage which is too high. The addition of a local-distance switch shown in (B) avoids this situation.

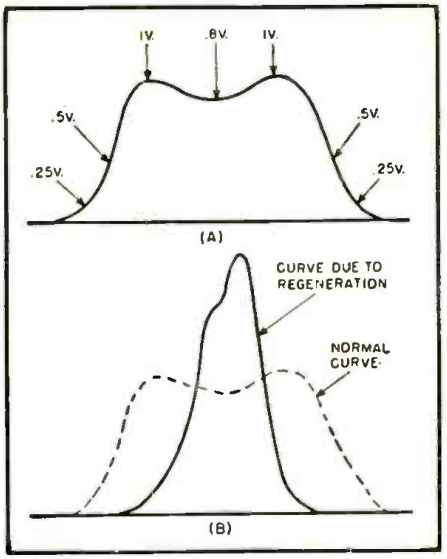
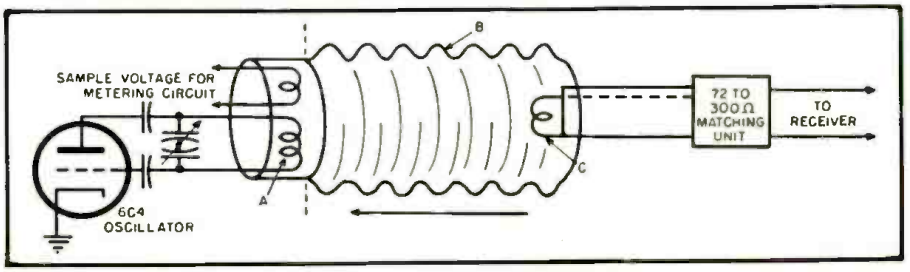


Fig. 3. (A) TV receiver response curve traced out from v.t.v.m. readings as channel dial of "SensiMeter" is tuned. (B) Faulty-type curve.

Fig. 2. Simplified schematic of the critical circuits of the "SensiMeter" showing the "bellows" attenuator, which gives constant output attenuation for all frequencies.



MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE

BARNEY'S DAY

A SMUG little smile was playing around Barney's mouth as he marched into the service shop and tossed the book he was carrying onto the service bench. Mac, his boss, eyed him out of the corner of his eye for a little while and then said, "All right; wipe the cat-that-ate-the-canary grin off your mug and out with it! What do you think you've got on me?"

"Oh it's nothing, really nothing at all," Barney said airily; "only it just so happens I was chewing the fat on 75 phone last night with a ham up in Connecticut and a friend of his by the name of Howard who was there with him in the shack. We got to talking about test instruments, and I sounded off on that business you were giving me a while back about how the 20,000 ohms-per-volt voltmeter loads a circuit less than a v.t.v.m. whenever you are measuring a voltage from about 500 volts up. Howard agreed this was so as long as you use the instruments without high voltage probes or if you use probes merely designed to extend the highest scale of either instrument to 30,000 volts.

"However, he pointed out that some v.t.v.m. manufacturers use a probe that increases the total resistance and all ranges of the v.t.v.m. by a ratio of 100 to 1. In theory, this would extend the top range to 100,000 volts or so, but of course you would never try to measure such a voltage. What you do, though, is switch to say a 300-volt scale and read up to 30,000 volts on it. Changing ranges of the v.t.v.m. has no effect on its fixed input resistance of 10 megohms, and so you can thus have a total meter-and-probe resistance of around 1000 megohms."

Mac mulled this over for a moment, and then a sheepish grin spread over his face. "And Howard is absolutely right!" he confessed. "I'm giving myself a big black mark for forgetting about those high-resistance probes. We were not giving the v.t.v.m. a very fair shake, were we?"

"*You* were not," Barney said with exaggerated emphasis on the pronoun. "Why a fellow could use a 10,000 to 1 probe and read the 3-volt scale and so get a resistance total of 100,000 megohms for measuring 30,000 volts!"

"Not in practice, he couldn't," Mac disagreed. "When you get past 1000 megohms of multiplier resistance, the resistance of the probe insulation would become a serious factor. Not to change a disagreeable subject, though, how did you manage to tear yourself away from your beloved comics long enough to try to read a book? What have you got there: *'Tom Swift and His Giant Cannon'* or *'The Return of Tarzan'?"*

"This book," Barney said with great dignity, "is *'Cybernetics'* by Professor Wiener."

"Whoberwhatics?" Mac asked with a puzzled frown.

"Cybernetics," Barney repeated, obviously enjoying his employer's bewilderment. "Surely you know what that is."

"This is certainly not my day." Mac said with a deep sigh. "Would you condescend to explain in as simple words as you can to an ignorant old man what cybernetics might be?"

"Well," Barney began with obvious relish, "cybernetics has been defined as the study of control and communication in the animal and the machine, but I like to think of it as a sort of correlation of the physical sciences of mathematics, statistics, and electronic engineering with the biological science of neurophysiology."

"You do?"

"Yes; but you might understand it better if I said it occupies a kind of middle ground between men and machines, and looks in two directions: on the one hand it is interested in building machines that will do some of the tasks of computing or controlling that now are usually done by human beings. At the same time it studies the problems and failures of such machines and so arrives at a better understanding of the nervous system of the human body by which such jobs are done."

"I get it now," Mac said. "You are talking about the brand-new science that builds electronic brains like the one we saw on television election night."

"The word is new but the science is not," Barney explained. "We had cybernetic machines long before we had vacuum tubes. The governor of a steam engine is a good example. This gadget tends to keep the speed of the engine constant under varying loads. It consists of two iron balls on pendulum rods attached to opposite sides of a rotating shaft driven by the engine. As the balls are swung out from the shaft by centrifugal force they work a valve that controls the amount of steam entering the engine. If the engine tries to speed up, the governor cuts down on its steam; if it tends to slow down, the governor admits more steam. This is a dandy example of the negative feedback principle that is of major importance in cybernetics."

Mac looked completely baffled. "Negative feedback in a non-electronic machine?" he questioned.

"Sure; feedback is merely a term applied to information fed back from a controlled mechanism to the controlling force to let it know how the action is progressing. In the case of the steam engine, the change in speed of the engine 'reports back' by causing the iron balls of the governor to change their position."

"But you said 'negative feedback.'"

"That's right. The use of the word 'negative' means that the feedback tends to buck whatever the system is already doing. If the engine speeds up, the governor slows it down, and *vice versa*. It is the same thing in an amplifier. 'Negative feedback' here simply means that we cause a portion of the output of the amplifier to oppose the input."

"Yes, I suppose it does," Mac muttered feebly. "You've been telling me about machines that act like men; what has cybernetics done in discovering how men act like machines?"

"A good question, and I'm glad you asked it," Barney said glibly. "Dr. Jose Delgado of the Yale Medical School recently thrust as many as forty tiny electrodes, only 1/200 of an inch in diameter, deep into the brain

(*Continued on page* 167)

Depend on Mallory
for
Approved Precision Quality

"...and BE SURE

the VIBRATORS are MALLORY!"

That's the best way to be sure your service jobs stay "sold". You can depend on Mallory Vibrators to give more years of service. Their precision quality is the answer to time-wasting call backs. These are just two of the reasons why 5 out of 6 service men prefer Mallory for all their service work.

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means less wear

High contact pressure . . .
means low resistance

Fast clean break . . .
means reduced arcing

The next time you order vibrators . . . be sure to ask for Mallory. You'll get better vibrators, available in a complete line, meeting original equipment specifications . . . yet they cost no more. You can be sure that every service job is done right the first time.

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WHAT'S *New in Radio*

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

CONSTANT CURRENT CONVERTER

Electronic Research Associates, Inc., Box 29, Caldwell, N. J. is now offering the Model CC-60 constant current converter for transistor applications.

The new instrument is designed to convert a standard power supply into a constant current generator for transistor and other applications where

constant current is required. The unit is connected externally in series with the standard supply and no rewiring or other modifications are necessary.

The design makes use of the high impedance of a pentode when operating above the knee of the I_b-E_b curve to present a constant impedance to the input voltage source. Thus, substantially constant current is maintained independent of a wide range of load variation. In addition, inverse current feedback is utilized which further increases the internal impedance and provides for long-term current stability.

The company will forward a data sheet on the Model CC-60 on request.

EVACUATED TRANSISTOR

CBS-Hytron of Danvers, Massachusetts has announced a new evacuated junction transistor.

Sealing each transistor in a vacuum is a further improvement on the original hermetic sealing of transistors, as announced recently by the company. The new process removes all polar molecules that in time might deposit themselves upon the junction boundary line, thus eliminating unwanted leakage of applied currents and the gradual breakdown of the units.

Additional information on the evacuated transistors is available on request.

HIGH-FIDELITY EQUIPMENT

Pilot Radio Corporation, 37-06 36th Street, Long Island City, N. Y. has announced the addition of several new units to its high-fidelity equipment line.

Among the new units now being marketed are the company's Models AF-723 and AF-824 FM-AM tuners, the Models AA-901 and AA-902 amplifiers, the Model PA-912 preamplifier, the Model CV-602 u.h.f. converter, the Model TV-524 24" television chassis, and the Model TV-527 27" television chassis.

A data sheet giving complete specifications on all of these units is available from the company on request.

RCA PORTABLE TAPE UNIT

The Engineering Products Department of *Radio Corporation of America*, Camden, New Jersey has unveiled a new portable tape recorder designed for the consumer market.

Packaged in an aviation luggage carrying case, the recorder weighs 25 pounds. Its over-all size is 14" x 12" x 9". The dual-speed machine can record or play back up to two hours and can rewind in approximately $2\frac{3}{4}$ minutes. It will accommodate all sizes of tape reels up to 7".

Push-button controls are used to operate the machine and tape threading may be accomplished in a matter of seconds. The unit also has a jack to permit easy attachment to phonographs, radio receivers, and p.a. systems.

The recorder is now available at *RCA* distributors, competitively priced.

REMOTE CONTROL UNIT

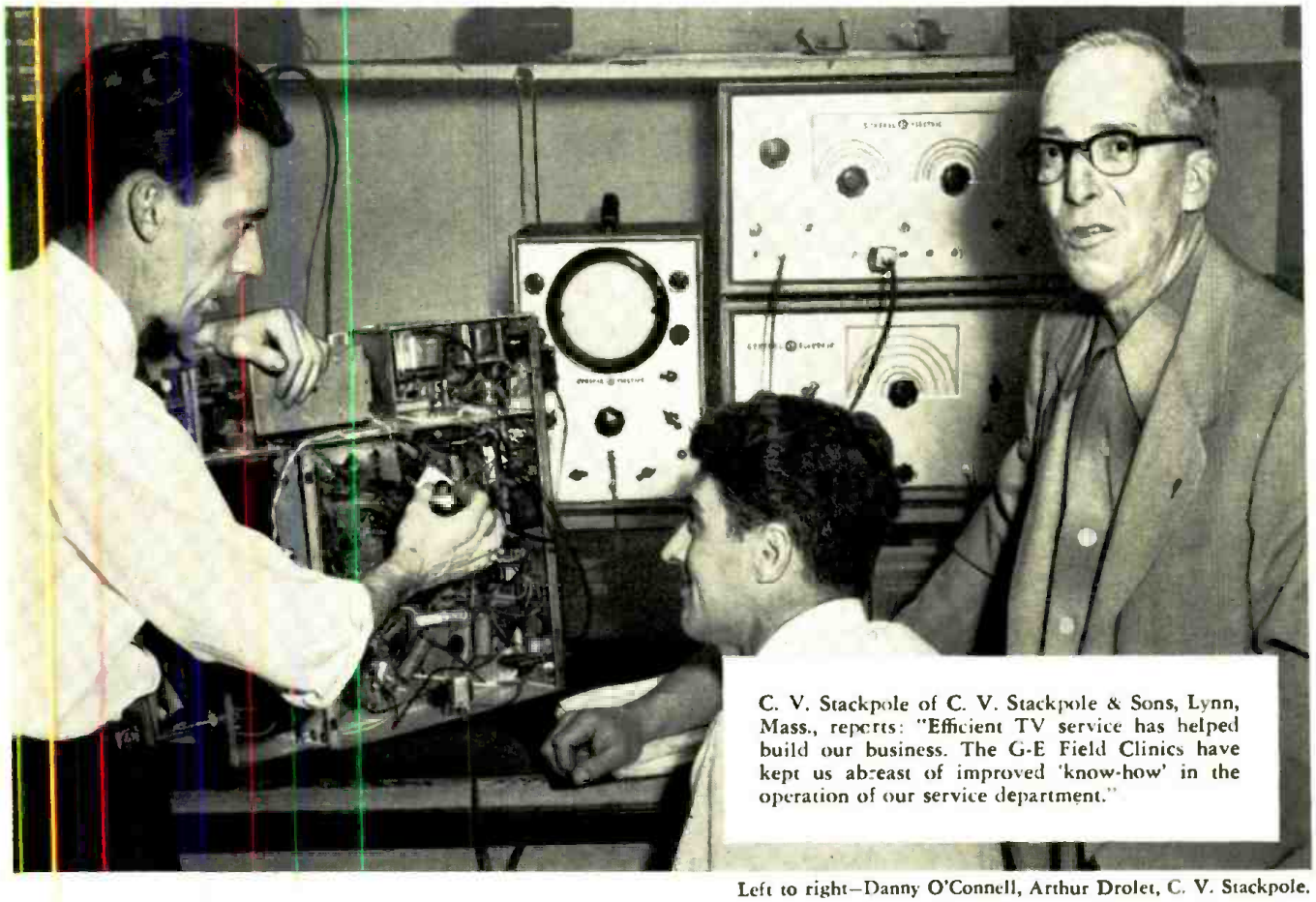
Rauland-Borg Corporation, 3515 West Addison Street, Chicago 18, Illinois has introduced a unique remote control unit which has been tradenamed "Libretto".

This remote control-preamp is fashioned in the form of a lavishly bound book in padded leatherette with metallic gold-finished backbone and sides.

The backbone lifts on a piano hinge giving access to convenient tuning controls. It can be operated in either horizontal or vertical position.

The "Libretto" is completely self-powered and capable of operating up to several hundred feet from the amplifier. The unit measures $8\frac{3}{4}$" x 11"

G-E FIELD CLINICS SHOW WAY TO INCREASED EFFICIENCY IN TV SERVICE



C. V. Stackpole of C. V. Stackpole & Sons, Lynn, Mass., reports: "Efficient TV service has helped build our business. The G-E Field Clinics have kept us abreast of improved 'know-how' in the operation of our service department."

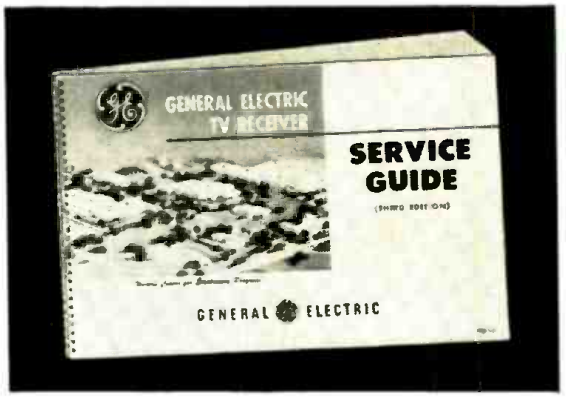
Left to right—Danny O'Connell, Arthur Drolet, C. V. Stackpole.

General Electric Field Engineers are holding Clinics throughout the Country—Open to all TV Servicemen—Without Charge

● An efficient service department is a vital factor in building a profitable television business. Like C. V. Stackpole, you'll find it well worth your while to attend one of the G-E Field Clinics. G-E engineers demonstrate simple ways to diagnose and correct TV troubles with special emphasis on UHF. They will show you how to install and adjust the various kinds of UHF antennas and tuners—and answer your questions on all phases of TV service.

Ask the Service Manager at your G-E TV distributor to sign you up for the next G-E Field Clinic in your area.

General Electric Company, Radio & TV Department, Syracuse, N. Y.



● The Third Edition of the G-E TV Receiver Service Guide has just been released. Order your copies today through your General Electric TV Distributor.

You can put your confidence in—

GENERAL ELECTRIC

x 2" and uses three 12AX7 tubes. It comes complete with a 7 foot power cord and 7 foot connector cable and plug. It incorporates five controls: crossover, roll-off, volume, bass tone, and treble tone.

The company will forward a data sheet on request.

NEW V-M CHANGERS

V-M Corporation of Benton Harbor, Michigan is now offering a high-fidelity record changer, the Model 935HF, to the trade.

The new unit features an exclusive die-cast aluminum tone arm which is rigid and resonance-free to eliminate tonal distortion, two plug-in tone arm

heads (less cartridges), a laminated turntable with precision-formed concentricity and heavy flocking, a four-pole four-coil motor which is said to eliminate the source of electronic hum and rumble during operation, and a muting switch for absolute quiet during the change cycle.

A brochure on this changer is available from the company on request.

SERVICE TESTER

Electronic Measurements Corporation, 280 Lafayette Street, New York, N. Y. has announced the addition of a new tube-battery-ohm-capacity tester to its line of test equipment.

The Model 207 features a large, easy-to-read, 7½" meter for counter use. It is a durable instrument that gives direct readings for all tubes through the standard emission method of testing. Four-position, lever-type switches are used and it is housed in a hand-rubbed portable oak carrying case with removable hinge cover. The counter model is the 207C while the portable case unit has been designated as the 207P.

BOGEN AUDIO EQUIPMENT

David Bogen Company, Inc. of 29 Ninth Avenue, New York 14, New York has added an FM-AM radio receiver and an FM-AM radio tuner to its line.

The 10-tube radio receiver has been designated as the Model RR500. It provides both AM and FM reception, has an output of 10 watts at 3 percent distortion, and furnishes separate bass and treble tone correctors. The FM circuit features a triode r.f. amplifier and triode mixer for minimum noise and a balanced ratio detector. Sensitivity is 7 microvolts input for 30 db quieting and the frequency response is ± 2 db from 30 to 18,000 cps. Frequency response on AM is ± 3 db from 40 to 4000 cps.

TRAIN *FASTER* — TRAIN *BETTER* — TRAIN *EASIER*

IN 10 MONTHS — OR LESS — FOR

RADIO-TELEVISION

Our 21st Year Training Men for Greater Incomes and Security in Radio-Television

I SEND YOU 18 BIG KITS

of Radio Television parts and equipment. Much of your training will be actual construction and experimentation . . . the kind of truly PRACTICAL instruction that prepares you for your Radio-Television career.

Frank L. Sprayberry
President
Sprayberry Academy of Radio

NEW! NO OBLIGATION PLAN

You Have No Monthly Payment Contract to Sign
Pay For Your Training as You Earn and Learn

You can get into Radio-Television, today's fastest growing big money opportunity field, in *months* instead of years! My completely new "package unit" training plan prepares you in as little as 10 months or even less! *No monthly payment contract to sign—thus NO RISK to you!* This is America's finest, most complete, practical training—gets you ready to handle any practical job in the booming Radio-Television industry. Start your own profitable Radio-Television shop . . . or accept a good paying job. I have trained hundreds of successful Radio-Television technicians during the past 21 years—and stand ready to train you, even if you have no previous experience! Mail coupon and get all the facts—FREE!

Valuable Equipment Included With Training

The new Sprayberry "package" plan includes many big kits of genuine, professional Radio-Television equipment. You perform over 300 demonstrations, experiments and construction projects. You build a powerful 6-tube 2-band radio set, multi-range test meter, signal generator, signal tracer, many other projects. All equipment and lessons are *yours to keep* . . . you have practically everything you need to set up your own profitable Radio-Television service shop.

Earn Extra Money While You Learn!

All your 10 months of training is IN YOUR HOME in spare hours. Keep on with your present job and income while learning. With each training "package" unit, you receive extra plans and "Business Builder" ideas for spare time Radio-Television jobs. New television stations everywhere, open vast new opportunities for trained Radio-Television Technicians—and those in training. If you expect to be in the armed forces later, there is no better preparation than practical Sprayberry Radio-Television training.

YOU BUILD the Television set and the powerful superhet radio receiver shown above. IN ADDITION to the other test units shown here (many are not shown because of lack of space). All equipment I send you is YOURS TO KEEP.

Approved for Veterans under the G. I. Bill

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Dept. 25-A, Chicago 6, Ill.

MAIL COUPON TODAY! NO OBLIGATION

I invite you to get all the facts—

FREE TO YOU 3 BIG RADIO-TELEVISION BOOKS

I want you to have ALL the facts about my new 10-MONTH Radio-Television Training—without cost! Rush coupon for my three big Radio-Television books: "How to Make Money in Radio-Television." PLUS my new illustrated Television Bulletin PLUS an actual sample Sprayberry Lesson—ALL FREE. No obligation and no salesman will call. Mail coupon NOW!

SPRAYBERRY ACADEMY OF RADIO, Dept. 25-A
111 North Canal St., Chicago 6, Ill.

Please rush to me all information on your 10-MONTH Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me. Be sure to include 3 books FREE.

Name..... Age.....

Address.....

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

The tuner is known as the Model R300 and features separate bass and treble controls, automatic frequency control, and compensated preamp for use with magnetic pickups.

WEBCOR PHONOGRAPH

Webster-Chicago Corporation of Chicago, Illinois has recently introduced a high-quality, table-model phonograph which has been tradenamed "Musicale."

According to the company, this new unit provides uniform audio response from 50 to 12,500 cps. It incorporates a 5-tube amplifier which includes a preamplifier for the *G-E* reluctance pickup with which the phonograph is

equipped. A loudness control is used to improve tonal quality at low levels.

The set uses three separate speakers, one 4-inch unit to handle the higher frequencies and two 6-inch speakers. The 4-inch speaker is mounted in the front of the case while the others are mounted on the sides. With this arrangement the high frequencies are still audible even when the listener moves at an angle from the speaker.

The "Musicale" is currently available in blonde korina and in mahogany finishes.

AMATEUR DESK SIGN

Hawkins Distributing Co., Paquatuck Terrace, East Moriches, New York is now offering a new amateur desk sign which features a sturdy, crystal-clear, plexiglas base and red or black polystyrene injection-molded letters 1⅜" high.

The new sign is durable and may be washed in lukewarm water with mild soap when it becomes soiled.

A quantity price is available to radio clubs ordering lots of three or more. An order blank, giving full details on these units, will be forwarded on request.

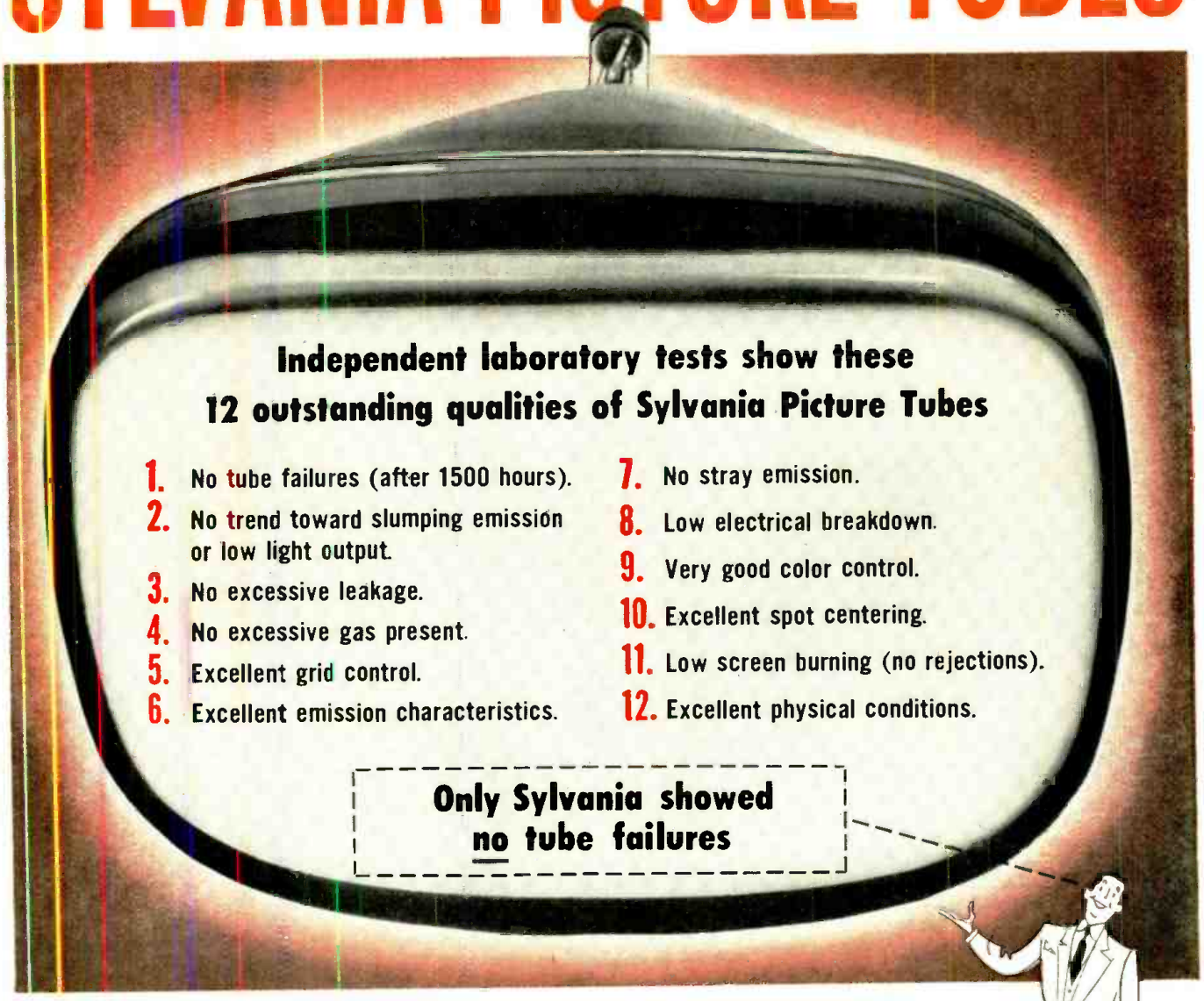
SMALLEST PERSONAL PORTABLE

Emerson Radio and Phonograph Corporation of 111 Eighth Avenue, New York 11, New York has just introduced what is said to be the world's smallest personal portable receiver, the "Pocket Radio".

Catalogued as the Model 747, the unit weighs less than 1 pound and measures 6 inches in width and 1¼ inches in depth. It is small enough to

(*Continued on page* 110)

12 reasons why it pays to replace with SYLVANIA PICTURE TUBES



Independent laboratory tests show these 12 outstanding qualities of Sylvania Picture Tubes

1. No tube failures (after 1500 hours).
2. No trend toward slumping emission or low light output.
3. No excessive leakage.
4. No excessive gas present.
5. Excellent grid control.
6. Excellent emission characteristics.
7. No stray emission.
8. Low electrical breakdown.
9. Very good color control.
10. Excellent spot centering.
11. Low screen burning (no rejections).
12. Excellent physical conditions.

Only Sylvania showed no tube failures

Here is proof that Sylvania Picture Tubes are *first* in long life and *finest* in all around performance of all tubes tested.

The above record was established in comparison tests of the tubes of 9 different manufacturers. All tests were conducted under identical conditions by an outside testing agency.

Set owners everywhere are being told again and again about Sylvania's superiority on the big, nation-wide TV show "Beat the Clock."

The Picture Tube for Reliable Replacement

Of course, the name Sylvania has always stood for highest quality. Now, more than ever before, Sylvania Picture Tubes mean better business for jobbers and service-dealers alike. If you would like the full story of these recent tests to show your customers how Sylvania Picture Tubes won over all others tested, simply mail the coupon now.

Send for this report

Sylvania Electric Products Inc.
Dept. 3R-2109, 1740 Broadway, N.Y. 19, N.Y.

Please send me the official report of the tests made on Sylvania Picture Tubes in competition with other makes.

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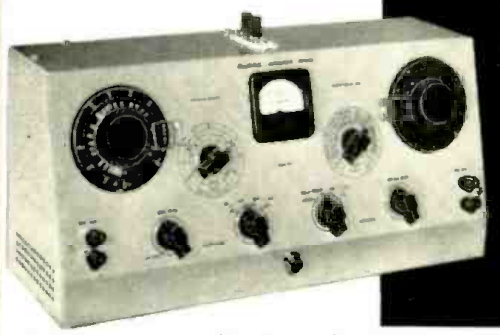
In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg. St. Catherine St., Montreal, P. Q.

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.

NEW 5" *Heathkit*

OSCILLOSCOPE KIT

MODEL O-9

$59.50

SHIPPING WT. 28 LBS.

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

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 50,000 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 5 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

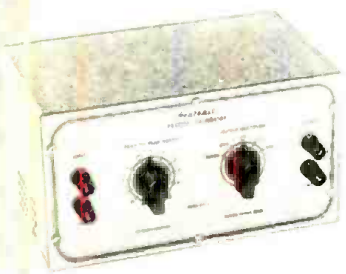
SHIP. WT. 1 LB.

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

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. 336

$4.50

SHIP. WT. 2 LBS.

Heathkit PEAK-TO-PEAK PROBE KIT

No. 338-B

$5.50

SHIP. WT. 2 LBS.

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

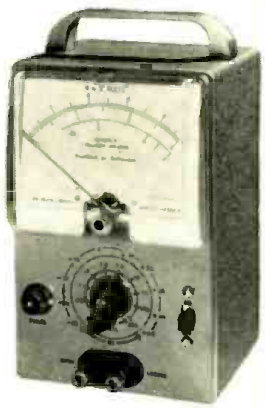
SHIP. WT. 2 LBS.

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 microompere 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 compacr 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*

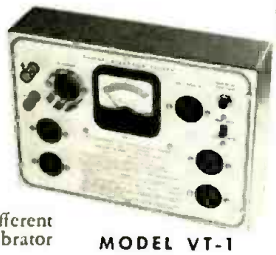
- Either 6 or 12 volt operation
- Continuously variable voltage output
- Constant ammeter and voltmeter monitoring
- Automatic overload relay — self-resetting
- Two 10,000 mf condensers
- New 18 disc split type heavy duty rectifier unit
- Fuse protection

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 vibrarors 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 interruprer and self rectifier types of vibrators. Five different sockers 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.

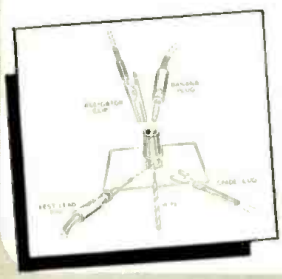
NEW *Heathkit* VARIABLE VOLTAGE ISOLATION TRANSFORMER KIT

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.

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

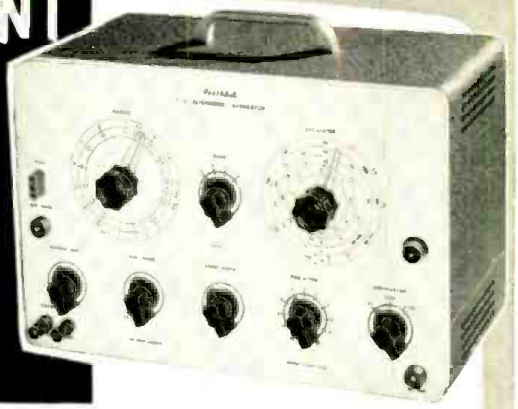
NEW *Heathkit*

TV ALIGNMENT GENERATOR KIT

MODEL TS-3

$44.50

SHIPPING WEIGHT
18 POUNDS



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 generarors. A new, automatic amplitude control circuit maintains the output level flat ro ± 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 generaror 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.

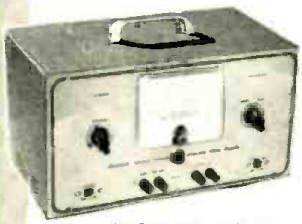
No. 355
Ship. Wt. 1 Lb.
$4.50

Heathkit TV PICTURE TUBE

TEST ADAPTER

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

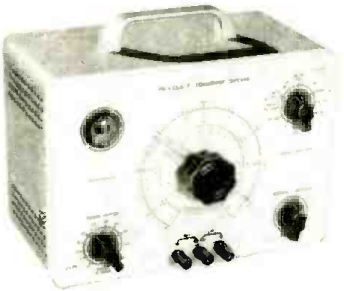
MODEL RS-1

$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*

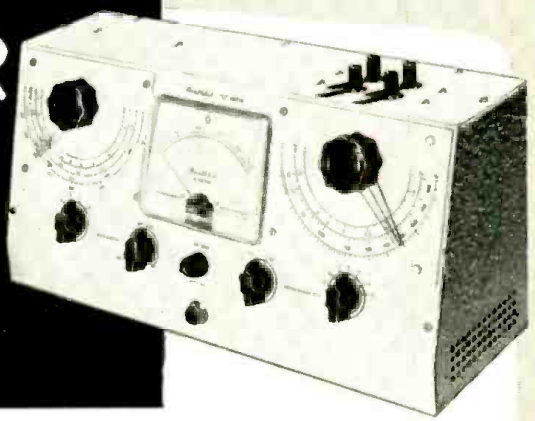
- First popular priced Q Meter
- Reads Q directly on calibrated scale
- Oscillator supplies RF frequencies of 150 kc to 18 mc
- Calibrate capacitor with range of 40 mmf to 450 mmf with vernier of ± 3 mmf
- Measures Q of condensers, RF resistance, and distributed capacity of coils
- Many applications 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

MODEL AG-8

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.

$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 circuitry 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

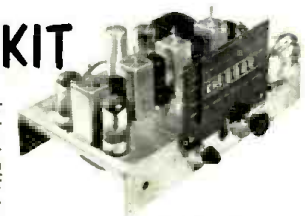
MODEL BR-2
$17.50 SHIP. WT. 11 LBS.

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.

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SIMPLE SOUND EFFECTS FOR HOME MOVIE MAKERS

By **JACK DARR**
Ouachita Radio Shop

For fun or as a money-making sideline, these sound effects can be set up using readily-available household equipment.

A WHOLE new market for wire or tape recorders can be opened up around your home town if you'll get out and round up some of the local "home-movie" bugs. The home-type wire or tape recorders, referred to hereafter as "recorders," to save time, can be used to make real professional-sounding sound-tracks and sound effects. Any of these are easily made at home, with a little practice. Special sound effects, shots, automobile or airplane engines, trains, or anything, can be "dubbed in," by using two or more recorders.

Recording of sound, dialogue, etc., simultaneously, as the pictures are being shot is easy; the sound can later be transferred to another tape. This could be done on occasions such as banquets, speeches, athletic events, etc., which could not be repeated. To make dramatic scenes, such as in a play, the actors can say the lines; after the film has been developed and edited, it can be run off, while the characters say the lines for the final sound track. "Bridge" music and special effects may be put on at this time. Of course, for a simple indoor or outdoor scene where the action is stationary, this wouldn't be necessary; the main value of this method lies in shots where the sound would be very difficult to record; moving cars, etc. This can be used to make scenes such as the common ones found in Western pictures; the hero and heroine, with supporting characters, are riding over the plains, singing happily to the accompaniment of a full orchestra, apparently riding in an invisible stage-coach! Shoot the picture from the back of a car, while the actors pretend to be singing; then, with the orchestra and chorus, dub in the sound later. Horses' hoofs, etc., may be dubbed in from another sound track. The popular "cartoons" are all made in this way, as a matter of fact.

Some hilarious comedy effects are possible with this method; loud "bongs" when someone is hit over the head, horn-squawks when somebody gets a punch in the nose, tearing cloth as an actor bends over, and of course, the well-known "Boinnnnggggg!" when man sees beautiful gal. There are a million possibilities, and still more will occur to the "producer" as he goes along.

The first requirement is at least one recorder and a couple of tapes. Two or three would be much better, as this will permit dubbing and mixing sound effects, background music, bridges, (the music which is used during a fade between scenes) and other special effects. This is done with a simple mixing harness. (See Fig. 1A.) If the recorder in use has only one input, a mixer made up of standard volume controls and jacks will do very well. (See Fig. 1B.) When using this hookup, a few test runs will give you the proper level settings for each particular sound effect. One very convenient feature of magnetic recordings is their "erasability." If a scene isn't just right the first time, it can be erased and repeated until perfect.

Just for instance, a love scene is being recorded. The microphone, which is connected to the "Mike" input of the "final" recorder (Rec. 1) picks up the voices of the actors. Recorder No. 2 is playing soft background music into the #2 input of the mixer. If other sound effects are necessary, for instance a car driving up outside, they may be added by another unit connected to the #3 input of the mixer. The output of the mixer is fed to the "High Level" input of Recorder #1. Monitoring of the final recorder may be done by attaching headphones to the output of the amplifier. Some machines have this connection available, and it may easily be installed, if not. Using this method requires at least two operators for the sound

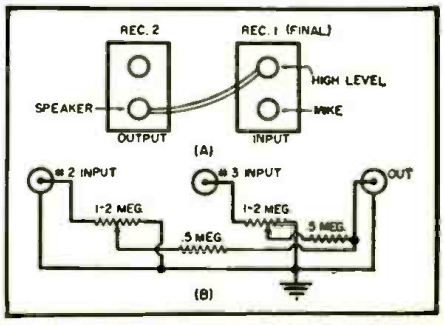
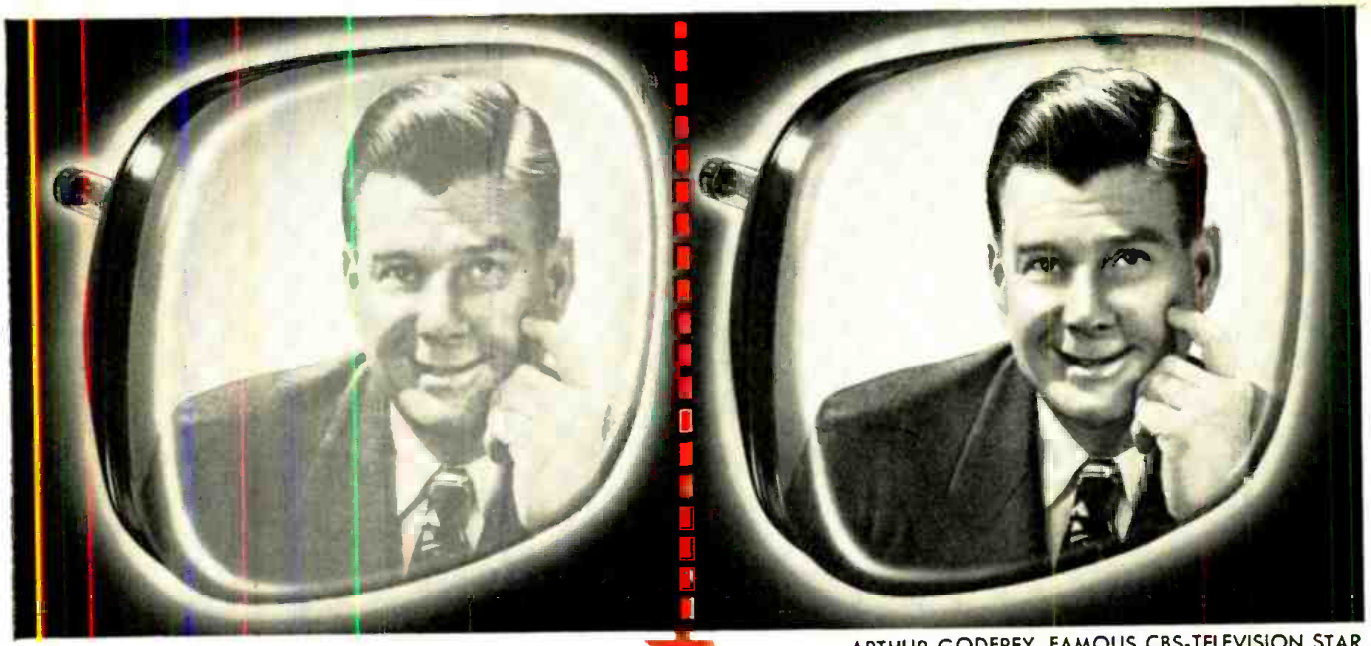


Fig. 1. (A) Simple connection harness for two recorders. (B) Unit for mixing outputs of two recorders into input of final machine. The resistance values are not critical.

You can see the difference...



ARTHUR GODFREY, FAMOUS CBS-TELEVISION STAR

NOW CBS-HYTRON MIRROR-BACK BIG-SCREEN TUBES

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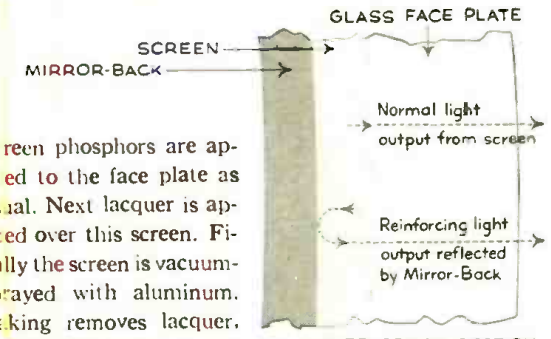
HOW MIRROR-BACK TUBES ARE MADE



MAGNIFIED CROSS-SECTION

Screen phosphors are applied to the face plate as usual. Next lacquer is applied over this screen. Finally the screen is vacuum-sprayed with aluminum. Baking removes lacquer, leaving the brilliant Mirror-Back coating. Mirror-Back reflects light that would otherwise be lost to the rear of the screen. Boosts light output. Brightens picture.

ADVANTAGES OF CBS-HYTRON MIRROR-BACK TUBES

1. Stepped-up light output.
2. Brighter picture.
3. Greater contrast.
4. Reduced strain on component parts.
5. Full effective screen potential maintained by metallic contact between anode and screen.
6. Longer life . . . drain on cathode materially reduced.

Leading TV set makers demand maximum brightness from their large-screen sets — without strain on component parts. For them, CBS-Hytron introduced its Mirror-Back 27EP4 and 24TP4 (both spherical, electromagnetic types). Mirror-like effect of their aluminum-backed screens reinforces light output. Gives brighter, sharper pictures.

You, too, will want CBS-Hytron Mirror-Back big-screen tubes for replacement. In 27- and 24-inch sizes, they are a must. Take a tip from leading TV set makers. Try the CBS-Hytron 27EP4 and 24TP4. See the difference for yourself. Let your customer see it too. Order performance-tested Mirror-Back tubes from your CBS-Hytron distributor.

New . . . FREE CBS-HYTRON TRANSISTOR MANUAL Just what you have been looking for: A down-to-earth, complete, 8-page introduction to transistors. In three parts: 1. Theory. 2. Data. 3. Application. CBS-Hytron Transistor Manual is profusely illustrated. Contains nine basic transistor applications. Explains by vacuum-tube analogy both point-contact and junction transistor operation . . . conduction by "holes" . . . P-N-P and N-P-N transistors . . . advantages and limitations of transistors.

An easy-to-take introduction to how transistors work . . . their characteristics . . . and how to apply them, this CBS-Hytron Transistor Manual is also *free*. Get it from your CBS-Hytron distributor. Or write direct today.

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Manufacturers of Receiving Tubes Since 1921

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RECEIVING . . . TRANSMITTING . . . SPECIAL-PURPOSE AND TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS

equipment, but around a project of this nature, there is usually a surplus of eager personnel, so that will be no trouble.

The basic hookup for this arrangement is not as complicated as it looks. Actually it is rather simple; Recorder No. 1 is making the final sound track: it is picking up the dialogue, and also the sound effects fed into it from the mixer. Background sounds are fed into the mixer by the other two recorders, on "playback," of course, and the resultant combination is all recorded upon the final tape. Monitoring is essential, so that the levels of different sounds may be adjusted to give the correct proportions. It is best to make a couple of "dry-runs" in order to check this.

Home-Made Sound Effects

There is no end to the possibilities of making home-made, realistic sound effects. We'll list a few, and your imagination can supply the rest.

Pistol shots: Slap a flat plastic or leather cushion with a flat stick, like a yardstick.

Machine-gun: Same cushion; make a "flapper" out of a tricycle wheel, etc., by fastening several pieces of leather to the rim, then spinning the wheel, so that the flappers strike the cushion.

Ricochets: Slap cushion and whistle.

Automobile effects: Take the mike or recorder out to the curb; while an accomplice starts, stops, slams door, etc., on the family car, record sounds needed. Hint: leave blanks of several seconds between each sound effect. These are necessary for rapid "cueing."

Train sounds: Take the recorder down to friend's house near tracks, or to depot.

Airplane sounds: Try a piece of medium-stiff cardboard and a small electric fan. Vacuum cleaner and a stiff plastic brush can make some interesting sounds, also electric razors.

Marching men: Make several small blocks of wood, like pieces of broomstick, about six inches long; drill hole through one end. String them on stiff wire, in two rows. Tap them on table, in cadence.

Door slamming, opening: Open and slam door. (Don't laugh; this is about the only way to get a realistic door slam sound!)

Rain: Large sheet of tin, about 12 x 24 inches; pour coarse sand or dried peas, as it is held in a slanting position.

Hail: Same; use larger peas.

Thunder: Bass drum or tympani, if obtainable; if not, use piece of tin mentioned before. Hang it by one edge, and shake gently. (This is the old "thunder-sheet" used in theaters for years. The bigger the piece of tin, the better the effect.)

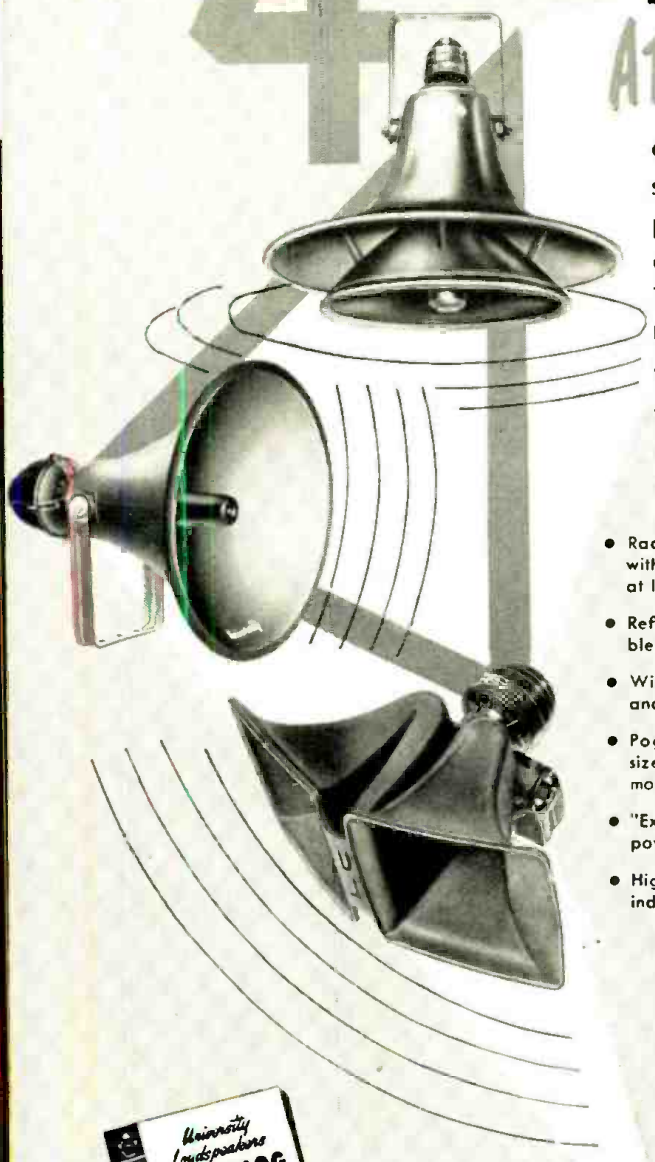
Fire, wood burning: Crush cellophane in hands close to mike.

Wooden house or the like falling down: Break strawberry box or other pieces of very thin wood in hands close to mike.

there are 4 points to a triangle...

THE POINT OF APPLICATION

determines the type of loudspeaker best capable of providing optimum performance at lowest possible cost. There are over 50 different University models to choose from... each designed to serve most efficiently and economically in its intended application.



- Radial type projectors and paging speakers with 360° dispersion for maximum coverage at lowest cost and ease of installation.
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- Wide-angle and bi-directional types, marine and submergence models for heavy industry.
- Poging and "talk-back" speakers in numerous sizes, power and frequency characteristics and mounting arrangements.
- "Explosion-proof", blastproof, and even superpower types from 100 to 720 watts capacity.
- High fidelity, full-frequency response types for indoor and outdoor use.

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University

UNIVERSITY LOUDSPEAKERS • INC.
80 SOUTH KENSICO AVENUE, WHITE PLAINS, N. Y.

Phone ringing: Get accomplice to call you, then record actual ring, picking up of phone, "Hello" etc. Telephone company is just a bit touchy about recording of actual conversations. To get effect, record other half of conversation on one recorder; connect output to actual telephone receiver; then play this and record whole thing.

Kiss: Recording of actual sound is more fun, but if performer is bashful, kiss back of your own hand close to mike. Comedy kiss, with loud "plop," made by putting forefinger in mouth, closing lips, then pulling out rapidly.

Footsteps: Surprisingly good footsteps may be made by putting mike on hard-topped table, then "walking" your fingers up to and past it. Variation in timbre of sound may be made by putting handkerchief on table.

Echo effects: Record the desired voice, etc., then go to a building with a long, hard-surfaced hall, while it is empty. Courthouse, school building, factory, etc. Set up one recorder at each end of hall; play sound loud enough to echo, record on other machine. For extra echoes, play back recording just made, and re-record.

(A peculiar effect may be made by making a recording of a voice, copying it, then playing both into the final recorder, so that one is just a fraction of a second out of phase; experiment with it.)

These are only a few of the hundreds of possible sound effects; the number is limited only by your imagination. Crickets or frogs chirping at night, for instance, can probably be picked up just outside your house, any summer night, unless you live in a very large city; in this case you'll have to go to the park or zoo. The zoo should furnish some wonderful sounds, if you can get them! Old auto-horns of the bulb-type are an indispensable adjunct of the sound man, as are cowbells, siren whistles, police whistles, wood blocks, and gongs. An old auto brake drum makes a wonderful gong.

As we've said repeatedly, there is no limit to the effects you can make, or the fun you can have with a setup like this, and if you're a radioman, you can make some good money selling the equipment. Have fun!

—30—

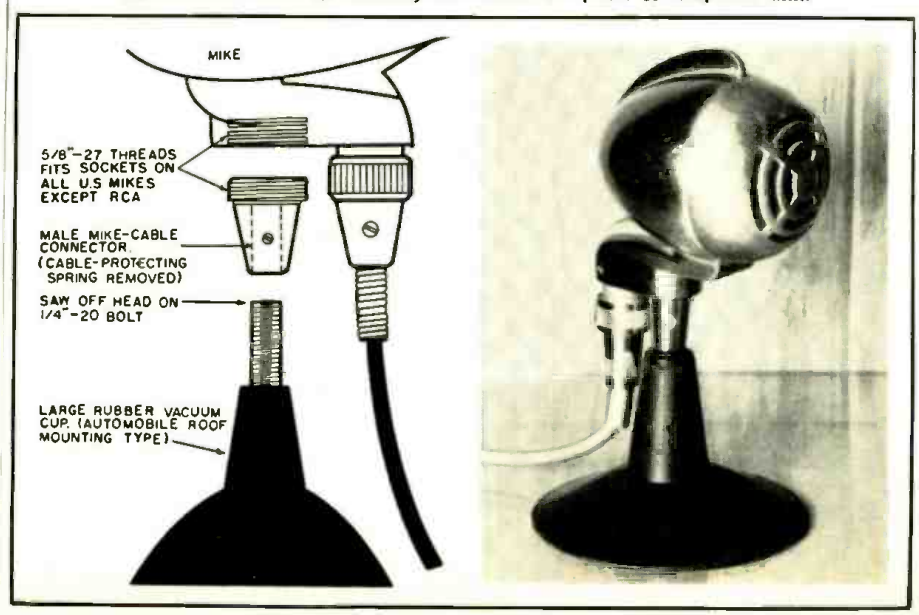
NOVEL DESK-STAND FOR MICROPHONE

By ARTHUR TRAUFFER

THIS novel, economical, and easily built desk-stand for microphones, was specially designed for those who use their mikes on glass-topped desks, or on other smooth or polished surfaces. Besides acting as a soft shock-absorbing base for the mike, this stand allows the mike to be "stuck" to the desk top so it cannot slide around or be knocked off the top of the desk.

Buy a large rubber vacuum cup with a ¼"-20 bolt in it; these are used for holding luggage racks on the tops of automobiles and sell for about 23c at auto supply stores. Also buy a male microphone-cable-connector; these sell for about 21c net at most radio supply houses. Twist the bolt securely into the neck of the vacuum cup and then saw off the head of the bolt. Remove the cord-protecting spring in the cable connector, and twist the connector into the socket in the bottom of the mike. Now slip the connector over the bolt in the vacuum cup and tighten the set-screw in the connector. The opening in the connector is a little large for the bolt, so if you wish, you can wrap a couple of turns of friction tape around the bolt to increase its diameter before slipping on the connector. As shown in the photo, the writer placed a rubber faucet washer between the top of the cup and the connector; this improved the appearance of the unit somewhat. This desk stand is not recommended for use with microphones much larger than the Turner Model-CD shown in the photograph. However, the modern trend is towards smaller and lighter microphones. —30—

Mechanical details for building desk-stand and photo of completed unit.



BUILDING INEXPENSIVE DECADE BOXES

By RICHARD FRIEDMAN

WHILE seeking an economical method for making home-made decade resistance and capitance boxes, I hit upon the scheme to be described.

The chief advantages of these techniques are that only four resistors or condensers are required for each decade box and that stock selector or push-button switches may be used.

A sample decade box is shown in Fig. 1B. It covers the range of 1000 to 9000 ohms. Similar decades can be made up to cover other ranges such as 10 to 90

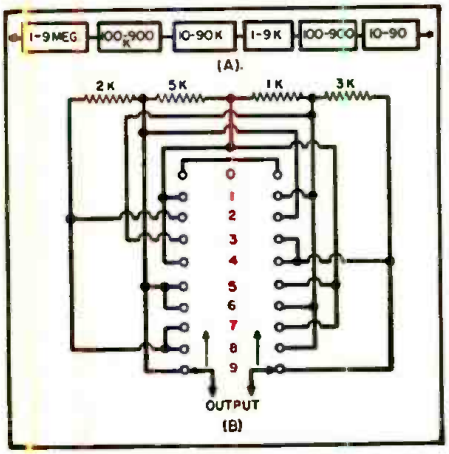


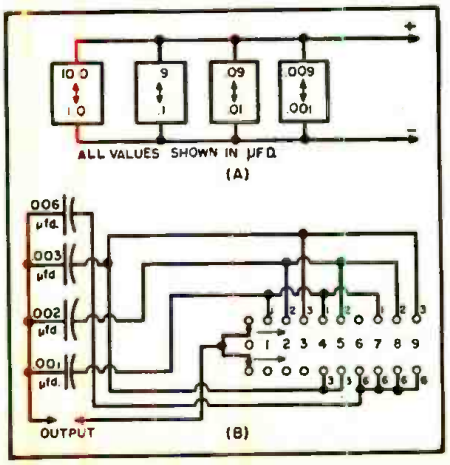
Fig. 1. (A) Method for connecting resistors and (B) a sample resistance decade circuit.

ohms; 100 to 900 ohms, etc. Any number of these units can be made up and connected in series, as shown in Fig. 1A, to give a greater range.

Connect condenser decades in parallel as shown in Fig. 2A. A sample decade is shown in Fig. 2B. It is recommended that the values of the condensers used be selected with the aid of a bridge. Incidentally, if electrolytics are employed be sure to observe polarity so that they are not reversed during the switching operation.

—30—

Fig. 2. (A) How condensers should be connected. (B) One usable circuit arrangement.



Multi-Band Antenna

(Continued from page 72)

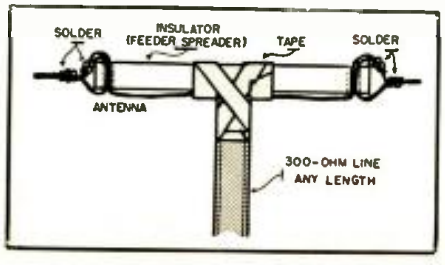
comes 8 because if the antenna is a half-wave at 80 meters, it will be two half-waves at 40, four at 20, and eight at 10 meters. Since a half-wave at 80 meters is over 130 feet, we know approximately what the exact length should be.

The length of the antenna is equal to 492 (8—.05)/28.4 which is 137.7 feet. The antenna is fed at a point 16.25% of its length either side of the center. That is to say, the two 300-ohm points on a half-wave will be found to be .1625 of its total length either side of center. The mid-point of the antenna is at 68.85 feet and either of the desired 300-ohm points is found 22.37 feet from the center. That is, 137.7 × .1625 = 22.37 feet. The wire is cut, an insulator inserted, and the 300-ohm line attached as with a center-fed dipole. A short, straight-sided feeder spreader is the best mechanical type of insulator for this application. The lead-in should run at a sharp right angle to the insulator so that no fanning effect can take place, as shown in Fig. 3.

As the feeders tie in at a rather low voltage point insulation is not too important. All excess line should be removed so as to reduce standing waves that may arise if the excess line is allowed to coil on the floor or wall. (Standing waves will exist in such an instance between the mismatched coiled section and the transmitter because of the discontinuity of characteristic impedance.) The line can then be attached to any link-coupled final tank circuit and will operate with virtually no standing waves.

It should be remembered that a transmission line which matches an antenna perfectly will reflect only a resistive load into the final tank circuit. When the loading is varied from minimum to maximum, the final tuning condenser does not have to be varied to tune out any reactance that would ordinarily be reflected into the tank circuit by an improperly matched line. This method was used and it was impossible to find a further dip of the final plate current when varying the loading on bands from 80 through 10 meters.

Fig. 3. The 300-ohm feedline is attached to the multi-band antenna without "fanning," which would upset the impedance relationship. Insulator is a ceramic feeder spreader. The horizontal pieces of feeder, taped to the spreader, become part of the antenna.



Loading will vary with precipitation, as do all antennas and lines made of molded plastic, because of the increased line capacitance per unit length.

The antenna can be a half-wave on any band and will operate on any higher band harmonically related to the fundamental in steps of 2, 4, 8, etc. If it is a half-wave at 80 meters, 40, or 20, it will not operate satisfactorily on 15 meters because the feedline now ties in at a high impedance point and standing waves will result.

The antenna requires approximately one half-hour to construct and is especially useful for contests or "field days" because the antenna connections do not have to be touched when changing bands.

If the final amplifier does not load enough with a two- or three-turn link, wind a separate pick-up link, increasing the number of turns until the antenna loads to the proper value.

Even though the antenna is fed off-center, the difference in line current is not measurable with a meter inserted in each line.

One important thing to bear in mind is that the feedpoint must be determined for the highest-frequency band to be used as this is where the impedance curve varies most rapidly for any variation of feedpoint location.

The radiation patterns of this antenna are identical to those of any long-wire antenna and signal reports have shown the pattern to be quite sharp on the higher frequencies. —30—

ROCKY MOUNTAIN MEET

ESTES PARK in the Rocky Mountains was the scene of the 1953 Convention of the Rocky Mountain Division of the ARRL recently.

The Denver Radio Club this year sponsored the meetings which drew local communicators, scientific personnel, and interested amateurs from widely separated points to share in an annual exchange of technical information. Visitors from both coasts and as far away as the Isthmus of Panama and the Johnson Islands were in attendance.

A diversified program, both technical and social, was provided for the edification of conventioneers.

—30—

PAGING OLD-TIMERS

WE ARE pleased to report that the item "Wireless Ops of Old" which appeared in the July issue (page 127) has elicited a favorable response from our readers.

Records from the West Coast disclose the names of several "Old Timers" we would like to locate: Art Baxter, George Baxter, C. H. Bowers, G. S. Corpe, E. W. Lovejoy, B. C. MacDonald, C. R. Parker, Felix Schadesack, and P. J. Townsend.

These men were prominent commercial operators about 1912, and we would like to know their present status. If some career highlights can be obtained on these Old Timers, we would like to print a thumb-nail sketch of such and thus honor these "Pioneers of the Pacific." Let's hear from you men!

—30—

GET DEPENDABLE PERFORMANCE IN TV TEST EQUIPMENT!

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Model ST-4A

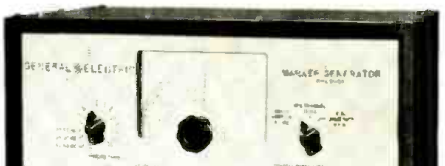
COMBINED use of these G-E units takes guesswork out of test measurements With good linearity and amplitude characteristics G-E equipment eliminates misleading results from distorted patterns. Your technicians will handle more work...handle it more efficiently...add to your profits and your reputation!

Sweep Generator ST-4A. Outstanding in performance and varied in application. Adjustable linear sweep that is all-electronic...no moving mechanical parts. Covers all broadcast TV channels. Good attenuation and extremely low leakage plus continuously variable center frequency.

Marker Generator ST-5A. Marks all the critical frequencies on a pass band as well as having continuous coverage. Designed to give fast manipulation with crystal controlled accuracy for outstanding performance. Features separate crystal on each TV channel with simultaneous picture, audio and trap markers on both channel and intermediate frequencies.

Oscilloscope ST-2A. Reports from thousands indicate this scope does the job they need in TV circuit work. Used in conjunction with the G-E Sweep and Marker you have an unbeatable combination. Special features include wide frequency response plus DC amplifier to adapt the equipment to other applications.

Balanced Output Adaptor ST-8A. Converts single-ended Sweep Generator output to balanced output for 300 ohm television receiver work.



Model ST-5A

Model ST-2A

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Electronics Park, Syracuse, N. Y.
Please send me complete specifications on G-E TV Test Equipment.

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COMPANY.....
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1954 Zenith TV Sets

(*Continued from page 62*)

where they are separated for the vertical and horizontal sweep circuits.

A 6AQ7GT duo-diode-triode is used in a conventional a.f.c. circuit for the horizontal oscillator. The duo-diode section compares the phase of the horizontal output pulse with the sync pulse, and furnishes the triode control section with a d.c. voltage proportional to the phase difference. A change in phase between the two compared waveforms changes the d.c. voltage to the triode section of the 6AQ7GT, and this changes the latter's internal resistance. Since this triode section is connected in series with condenser C_{55}, across the horizontal oscillator tank coil, a change in the triode's plate-to-cathode resistance will change the oscillator's frequency. If the internal resistance of the triode section is increased, the value of C_{55} is, in effect, reduced, and the oscillator frequency increases, and *vice versa*.

Condenser C_{56} and resistor R_{64} at the grid of V_{10B} form an anti-hunt circuit which reduces the overswing which exists when a correcting voltage is applied to a control circuit.

The horizontal oscillator is a conventional *Hartley* circuit using one-half of a 6SN7GT. The oscillator applies a positive pulse to the second section of the 6SN7GT, the horizontal discharge tube, initiating the production of the saw-tooth waveform applied to the horizontal output tube, a 6BQ6GT. A conventional high-voltage circuit, using an autotransformer, develops the high voltage for the picture tube as well as the horizontal deflection voltage for the yoke coils.

A.G.C. Circuit

The a.g.c. amplifier is of the "gated" type, in which the a.g.c. voltage developed is proportional to the amplitude of the transmitted sync pulses, and not to the average of the composite video and sync.

The tube used is one-half of a 12AX7 (the other half is used as the vertical oscillator). Fixed bias is applied to the cathode by connecting it to a voltage divider network consisting of R_{63}, R_{60}, and R_{59}. The resistor R_{63} is adjustable so that the cathode may be operated at the proper value for "gating" of the 12AX7 on the sync pulses only, and not on the pedestal. The grid is held at a fixed potential by means of another voltage divider network which consists of R_{71} and R_{62}. R_{62} connects to the 12BY7 video amplifier plate circuit and to "B+" through the video amplifier plate load resistors. This network also supplies the grid with the composite video and sync signal. However, as mentioned before, only the sync pulses cause conduction in the 12AX7 since the pedestal and video are below the grid cut-off potential point. The sync pulses at the 12AX7 grid are in the positive

direction, with respect to ground.

The 12AX7 plate load resistor, R_{51}, is returned to the cathode and its voltage divider. A 15,750-cycle pulse, approximately 100 volts in peak value, is taken from the grid of the horizontal discharge tube and applied to the 12AX7 plate through C_{11}. If the horizontal oscillator is operating at 15,750 cps, and is in phase with the transmitted horizontal sync pulse, the oscillator pulse will be applied to the 12AX7 plate at the same instant that the sync pulse is applied to its grid. The plate will be driven in a positive direction and the tube will conduct down through R_{51}. Since the plate is conducting heavily at this time, the potential will swing in the direction of ground. This negative excursion will be applied through R_{50} to C_{19} and C_{20}, and through R_{36} to C_{31}. These condensers will accumulate a negative charge. The time constant of the a.g.c. filter is comparatively long and, since the charging process repeats each time a horizontal sync pulse appears at the 12AX7 grid, the average voltage on the a.g.c. line, with respect to ground, will be negative. The degree of conduction in the 12AX7 is determined by the amplitude of the positive sync pulse applied to its grid, therefore, the negative a.g.c. voltage will vary in proportion to the sync pulse amplitude which, in turn, is proportional to the strength of the signal being received.

In a weak signal area, very little a.g.c. voltage will be developed since the sync pulse applied to the 12AX7 grid will be low in amplitude, and will not drive the tube into heavy conduction. Consequently, the gain of the r.f. and i.f. amplifiers will increase. When the signal is very weak, the 12AX7 plate, being returned through R_{51} to cathode and through R_{19} to "B+", will swing in a positive direction and the a.g.c voltage, with respect to ground, may actually be of a positive polarity. The 6BK7A r.f. amplifier grid, however, is returned to the a.g.c. line through a 2.2-megohm resistor (R_{36}) and, due to contact potential, will be maintained slightly negative even though the a.g.c. line may be positive. The 6CB6 first i.f. amplifier has some bias applied to its cathode (the cathode is returned to ground through a 56 ohm and two 220 ohm resistors, R_{11} and R_{22}), and the a.g.c. voltage is permitted to swing positive by this amount. This arrangement is designed to provide a good noise figure both on very weak and moderately weak signals. When the signal level increases to the point where the a.g.c. voltage passes through zero, the noise figure of the r.f. amplifier is no longer important, and the 6BK7A is then rapidly cut off by a further increase of a.g.c. voltage in a negative direction. This type of a.g.c. circuit is known as a "double delayed" a.g.c. system.

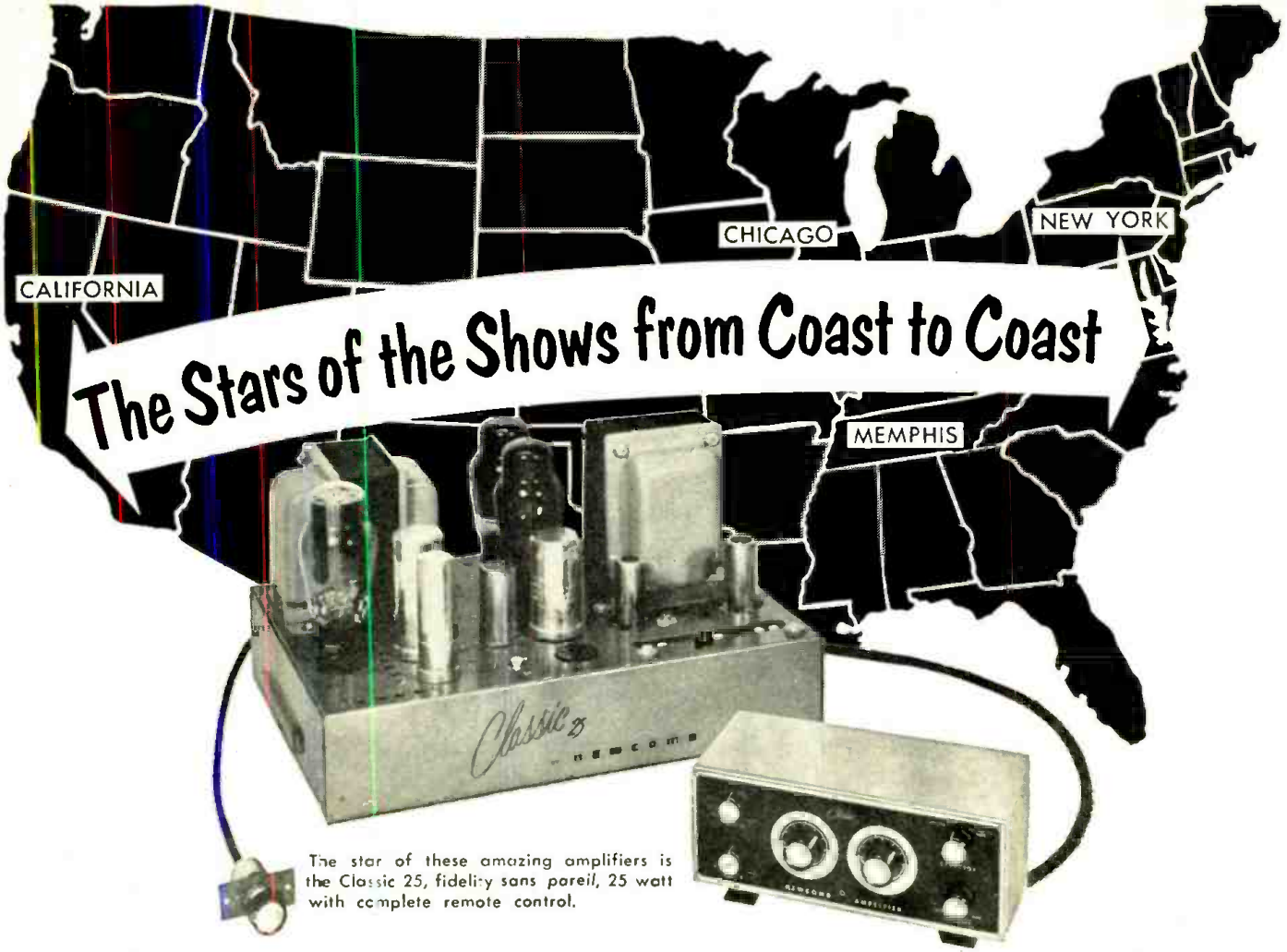
Some television technicians experience great difficulty in locating trouble in gated a.g.c. circuits. Much of this confusion is caused by the fact that defects in some other circuit will be indicated as an apparent fault in the a.g.c. As an example of what might happen, a receiver overloads on a strong local signal and the a.g.c. delay control has little or no effect. The technician undoubtedly would try a new 12AX7 tube before proceeding further. If this did not eliminate the trouble, it is possible that the defect could be located in the i.f. strip, the crystal diode detector, the video amplifier, the horizontal oscillator, or the a.g.c. circuit itself. If the overloading is severe, the picture probably would be negative; the sync would be compressed and possibly inverted. An oscilloscope examination of the diode output would be of little value except to confirm this.

Probably the best procedure for servicing gated a.g.c. systems would be as follows: first, make certain that the 12AX7 a.g.c. amplifier, the 12BY7 video amplifier, and the 6CB6 first i.f. amplifier tubes are good. The second step would be to disable the a.g.c. by applying from –3 to –6 volts to the a.g.c. line. This fixed voltage can be supplied by a small "C" battery, the positive terminal of which should be connected to chassis (ground). The application of the fixed bias should stabilize the circuit, at least to the extent where intelligent measurements can be made. It should be possible to stabilize the sweep oscillator. If the vertical stabilizes but the horizontal does not, it probably indicates some fault in the horizontal oscillator circuit. As described before, the plate voltage pulse for the 12AX7 is taken from the grid of the horizontal discharge tube. If this pulse is low in amplitude, the a.g.c. tube plate will not be driven sufficiently positive and very little a.g.c. voltage will be developed. If trouble in this circuit is suspected, the peak voltage value of the pulse at either the horizontal discharge tube grid or the a.g.c. tube plate may be measured and compared against the value shown on Fig. 1. If there is much difference in the pulse amplitude measured at pin 1 of the 6SN7 and pin 6 of the 12AX7, condenser C_{41} may be open. If the a.g.c. line is positive with respect to ground, or if the circuit continues to overload with the battery bias connected, C_{15}, in series with the coaxial line from the tuner to the i.f. input, may be leaky or shorted. If the peak value of the composite sync signal at pin 7 of the 12AX7 is low, the defect may be in the video amplifier, but is more likely to be a defective crystal diode.

Alignment

The alignment procedure for the video i.f. and sound circuits of the *Zenith* "Super K" chassis is given in Table 1.

When aligning the sound circuits, the signal to the receiver must be below the limiting level of the 6BN6. A "hiss" will accompany the sound



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Everywhere they are shown these new amplifiers by Newcomb create a positive sensation. Everyone has a good word for them. Acclaimed at the shows and fairs in New York, Chicago, Memphis and California for their noticeably better sound, unique new features and unbelievable values in every price group. Thousands who have seen them make enthusiastic comments like this:

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when the signal is below this level. To obtain this signal condition, a step attenuator should be used. Also, be certain to prevent leakage by using short leads between the attenuator and antenna terminals on the receiver. Use approximately six feet of 300-ohm shielded line between the antenna transmission line and the attenuator. The shield from the transmission line should be connected to the attenuator, and the attenuator itself grounded to the TV chassis. —30—

What's New in Radio

(*Continued from page 84*)

fit into a woman's purse like a compact or be tucked into a man's breast

pocket. It is smaller than a miniature camera and can be held comfortably in the palm of the hand.

The circuit uses subminiature parts throughout and is powered by self-contained batteries. The set has a full-vision dial with large easy-to-read numbers, automatic volume control, and a full-volume "super speaker".

SERVICE TOOL

Aviation Service Supply Co., Stapleton Field, Denver, Colorado has introduced a new precision-made nut and screw starter to aid technicians in starting small nuts as well as screws in difficult, hard-to-reach places.

Designed for use in the radio, electronic, communication, and instrument fields, the tool has a special lever mechanism in the handle which controls the movable blades and adjusts them for gripping all standard sizes of small nuts and screws.

The unit has a pair of movable blades projecting from a sleeve attached to the handle. As these blades are pushed into the sleeve, the mechanism inside the handle causes them

to rotate inward thus forming a "V" shaped end, which grips the screw head and maintains the necessary tension to hold it until the screw is started.

It is available in six different sizes to accommodate nuts and screws from #6 to ¼" nut and from a #4 to a #10 screw. Special sizes are available on a custom basis.

GERMANIUM DIODES

A new line of germanium diodes featuring vacuum tight, moisture-resistant seals as well as good mechanical stability is now being offered by *Bomac Laboratories, Inc.* of Salem Road, Beverly, Mass.

According to the company, the use of a ceramic case insures stable electrical characteristics and complete isolation from adjacent circuitry. The diodes consist of a small, low-loss ceramic case into which two end caps are threaded. Metallization of the case surfaces allows vacuum tight ceramic-metal seals to be made. The specially-treated germanium pellet and tungsten whisker are precisely adjusted for optimum performance by use of force-fitting, knurled, nickel pins.

The use of nickel terminal pins and flexible, tinned leads permits the unit to be either clipped into spring holders or soldered directly for circuit applications.

The Semi-Conductor Department of the company will provide complete information on request.

"LAVALIER" MIKE

Electro-Voice, Inc. of Buchanan, Michigan has introduced a small-sized lavalier-type dynamic microphone designed for chest, desk, or hand use in public address work.

The Model 647 offers full-range *E-V* dynamic microphone quality, rugged-

ness, and performance characteristics for indoor and outdoor use, according to the company. Frequency response is from 60 to 13,000 cps, specially compensated for chest resonance. Slightly rising characteristic is specifically calculated to provide crisp, clear pick-up and reproduction when used against the chest. Output level is −57 db.

For further information, write for Bulletin 201.

PARTS KITS

Carl Cordover & Co., 100 Warren St., New York 7, New York has introduced five new parts kits for service technicians, amateurs, laboratory men, dealers, experimenters, and engineers.

The line includes one resistor and four condenser kits. All assortments are selected to include the most-often used sizes for replacement work. The resistor kit (RK-100) contains 100 resistors; the ceramic condenser kit

MORE for your Kit Dollar!

All Collins Tuner Kits are complete with punched chassis, tubes and all other necessary materials. Sub-assemblies; tuning units, IF amplifier, etc. wired, tested and aligned. Join thousands of satisfied Collins users . . . order today!

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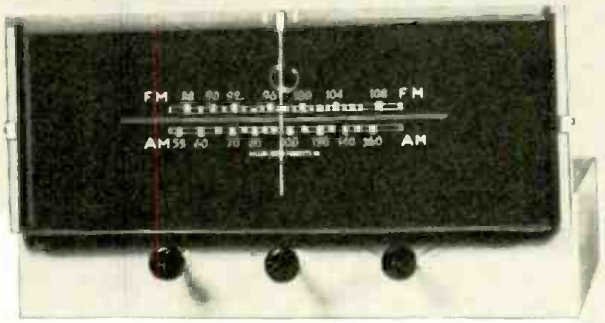
COLLINS AUDIO PRODUCTS CO. is in no way affiliated with Collins Radio Co.

FM/AM Tuner Kit

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.

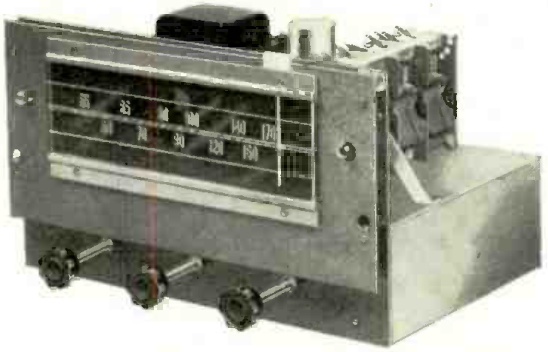
$77.50



AM Tuner Kit

A twin for the FM-11! A wide-band T.R.F. high fidelity AM tuner kit with special features. A new Collins design for those who desire the very finest AM performance. Tuning range: 530 KC to 1650 KC; Bandpass: 20 KC Distortion: less than 2%; Frequency response to 10,000 cycles; whistle filter; R.F. circuits wired and aligned. You mount the power supply and dial and it's ready to go. Operates into any high fidelity pre-amplifier control unit or standard single chassis amplifier. No tone controls. Six tubes. Shipping weight 14 lbs.

$59.50

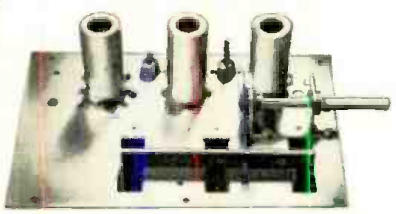


FM Tuner Kit

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.

$55

Selected Basic Components For Special Applications



FMF-3 Tuning Unit **$15.25**

FMF-3

The best tar 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" x 4½". 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**

IF-6

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%. Drawn 40 mo. @ 220 volts. Chassis plate dimensions: 11-5/16" x 2½". Shipping weight: 3 lbs.

AM-4 Tuning Unit **$24.50**

AM-4

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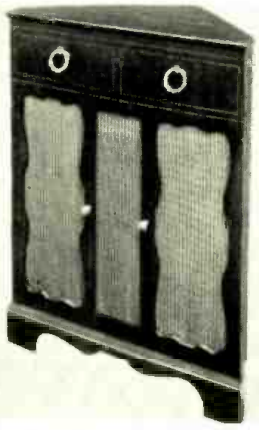
(CK-35) has 35 ceramic units; kit MK-50 contains 50 mica condensers; kit TK-25 offers 25 molded tubular condensers in various capacities; and LV-10 contains an assortment of 10 low-voltage electrolytics.

For further information, contact the company direct.

UNIVERSITY ENCLOSURE

University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y. has recently introduced a line of high fidelity corner enclosures for 12" speakers.

The enclosures combine authentic furniture styling with quality sound



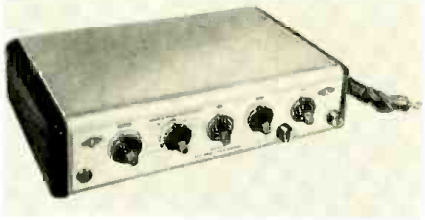
reproduction and are available in modern, traditional, or provincial furniture styles. The cabinets are available in a variety of wood finishes. Enclosure dimensions are 37" high, 28" wide, and 15" deep.

Although especially designed to house the company's Model 6201 coaxial speaker, the Model 6200 extended range, or the wide-range "Diffusicone-12", the "Musicorner" can serve as the enclosure for most 12" speakers. Simplified integral construction of both the interior and exterior makes for easy installation.

SELF-POWERED PREAMP

Brook Electronics, Inc., 34 DeHart Place, Elizabeth, N. J. is currently offering a self-powered preamp, the Model 7.

The unit is finished in gold-alumilite enhanced with highly polished walnut end blocks. All of the features of the company's Model 4B have been retained in the new unit with the addition of a built-in power supply. Hum



level is said to be extremely low, well below the thermal noise of the tubes.

Other features include a record playback characteristic control which permits a theoretically exact match of the recording characteristics so

that the tonal balance of bass, middle, and high frequencies will be correct. This control has nine positions to match the better-known makes of records.

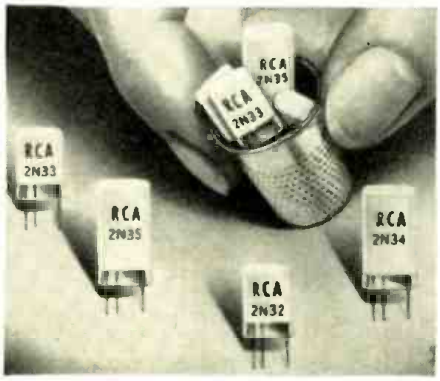
Over-all frequency response is within 1 db from 15 to 30,000 cycles.

A data sheet covering the Model 7 is available on request.

RCA TRANSISTORS

The Tube Department of *Radio Corporation of America* has announced the commercial availability of four types of transistors.

Two point-contact and two junction



types are now in production. The *RCA*-2N32 is a point-contact type for large signal applications. The *RCA*-2N33 is a point-contact type for use as an oscillator up to 50 mc. The 2N34 and 2N35 are junction types, *p-n-p* and *n-p-n* respectively. Both are designed for low-power, audio frequency applications.

Further information on these four units is available from the company's tube distributors.

POWER BOOSTER

Kuar Engineering Corp., Middlefield Road, Palo Alto, California has announced a new power booster which is said to increase the power output of any 10-watt mobile radiotelephone transmitter six times.

The booster is inserted between the low power transmitter and antenna.

The power desired is selected by a switch on the dashboard and the booster is activated when the microphone button is pushed. Because the unit is "instant heating", added power is not drawn from the battery until the mike button is pushed.

The unit may be used with any make of radiotelephone operating in the 152-174 mc. band. It is said to increase the effective range of the equipment considerably while conforming to the FCC good engineering requirements by using maximum power for such transmissions only when needed. —30—

Electronic Counter

(*Continued from page* 45)

is four. Since 2^4 equals 16 it means that the counter circuit shown can count up to sixteen. (The zero count also represents a number.) With a decimal system eight tubes would be required for a count of sixteen. This points out the advantages of the binary system, less tubes are required for an over-all count. The visual binary count is shown diagrammatically in Fig. 10. Each vertical row represents the four neon lamps. The different columns show the count from one to fifteen (and also zero).

One of the prime advantages of electronic counters is high-speed operation. The prototype described in this article can perform at a maximum rate of about 100,000 counts-per-second. However since the tally limit is sixteen the master sum could not be

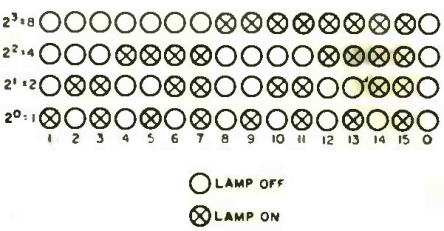


Fig. 10. Indicated count in binary system. Each vertical row represents four lamps on counter panel. When all lamps are extinguished the reading is zero.

indicated at this rate. In addition, the pickup switch could not function at this rate. Other types of counters have been developed which can perform efficiently up to 10,000,000 counts-per-second. For this purpose special unitized decade counters are used which stop at a forced count of ten. With this arrangement, identical prototypes are cross-connected for counting and indicating in the decimal system. One prototype is used for units, another for tens, another for hundreds, another for thousands, and so on. It is only necessary to connect the output of each subassembly in the input of the next higher decade and thereby build up to any degree required. These units also employ the basic four-stage circuit described in this article.

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Blume, R. J.: "Predetermined Counter for Process Control," Electronics, February Counters," Electronics, March 1948.

Sharpless, T. K.: "High-Speed N-Scale" 1948.

—30—

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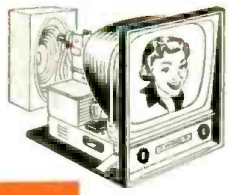

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Square-Wave Shaper

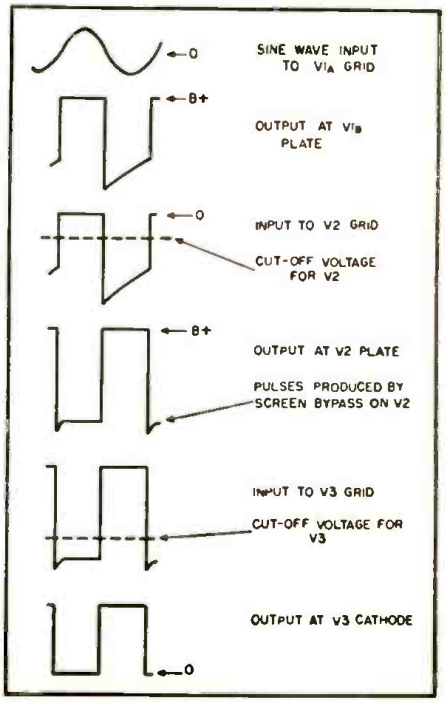
(*Continued from page 63*)

and on. This sine-wave input should be between seven and ten volts.

The video amplifier stage, V_2, rests at zero bias. *No grid coupling resistor is used.* Leakage through the coupling condenser, C_2, keeps the grid from drifting negative, and grid current in V_2 will prevent the grid from drifting positive. When this grid is driven by V_{1B} through the coupling condenser, C_2, rectification occurs and the grid of V_2 is driven between zero bias and a large negative voltage. Only a fraction of this grid voltage is needed to drive V_2 from zero bias to cut-off. The screen of V_2 is lightly bypassed so that its plate responds more rapidly to the sudden rise and fall in the grid drive. This bypassing of the screen produces a little pip on the negative section of the square wave appearing at the plate of V_2. No similar pip appears on the positive half since the positive segment results from the cut-off of both plate and screen current. The output of V_2 is coupled into the grid of V_3 by the ordinary method. This final stage, in addition to providing a low impedance output, eliminates the unwanted pip present on the negative segment of the output voltage from V_2. Since V_3 is a self-biased cathode follower (the entire voltage across its cathode load resistor providing bias voltage) and since the drive to its grid is large, it is cut off by the negative section of its drive.

At very low frequencies the positive segment of the output waveform tends to drift down slightly instead of remaining flat. This decay is caused by the discharge of coupling condenser, C_2, through the grid resistor, R_2. To

Fig. 2. Waveforms at various key points.



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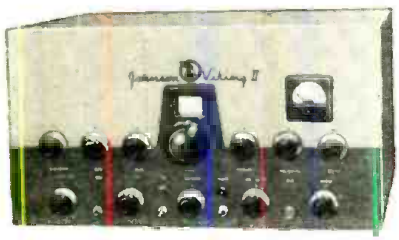

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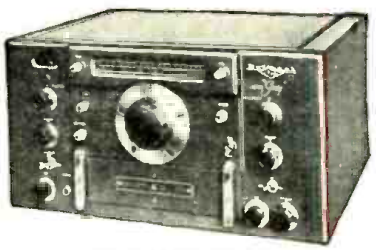

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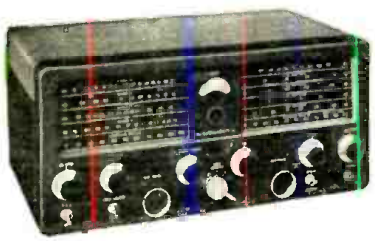

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compensate for this droop the screen and plate loads for V_2 have been selected to be, in combination, smaller than the cathode load for V_3. As a result the decrease in current when V_2 is cut off is not entirely offset by the simultaneous increase in current through V_3 when it starts to conduct. The net decrease in current causes the supply voltage to rise as the filter condenser, C_5, takes on more charge. This increase in supply voltage bucks out most of the deterioration of the output waveform. This design expedient seems somewhat more economical than using all push-pull, direct-coupled circuits.

When constructing the unit the three variable resistors should be considered front panel controls. Potentiometer R_1 may be used to adjust the amplitude of the sine-wave input. The variable cathode resistor, R_3, adjusts the relative length of the positive and negative pulses. Amplitude of the output signal is controlled by R_9.

The addition of a switch and four resistors after R_9 will give step-wise attenuation with R_9 serving as a vernier. The inset in Fig. 1 shows such an arrangement in detail. This addition is well worthwhile, since it is thus much easier to control very low output levels. Furthermore, on the second and third switch positions (—20 db and —40 db) the output impedance is substantially independent of the setting of R_9. Since these positions give maximum outputs of about 5 and 0.5 volts peak-to-peak, they will be the positions most often used. Having a constant output impedance is more than just a convenience when testing with pulse type signals. Unless the output impedance is constant the waveform shape will change as its amplitude is varied.

Should a different power transformer be used, R_{10} should be adjusted to give a supply voltage (at the plate of V_3) of between 100 and 150 volts. About 20 milliamperes of current will be drawn with a 150 volt supply. Generally speaking the higher supply voltage will give a larger output signal but will require a larger sine-wave drive. The author's unit with a 160 volt supply requires 7 volts of drive.

Without a sine-wave generator this unit as it stands is not of much use. However, if you do have a sine-wave generator, the device here described will provide an excellent square wave over the entire frequency range of your sine-wave generator. —30—

LONG ISLAND HAMFEST

THE Federation of Long Island Radio Clubs will hold its 17th annual Hamfest and Dance on Friday evening, Oct. 9, at Lost Battalion Hall, 93-29 Queens Boulevard, Elmhurst, N. Y. The program will begin at 8.00 p.m. and will include activities for amateurs with special interests (DX, v.h.f., traffic, etc), entertainment and favors for the ladies. Tickets are available from J. N. Jablin, W2QPQ, 147-14 Charter Road, Jamaica 35, N. Y. —30—

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Within the Industry

(*Continued from page 26*)

TRONICS, division of **CORN ELECTRIC COMPANY** in Stamford, Conn. . . . **K. W. JOHNSON & CO., INC.** has been formed in Dayton, Ohio to engineer, design, test, and manufacture complete shock and vibration systems for industry and military purposes. K. W. Johnson, formerly chief engineer of the Mechanical Section of the Components and Systems Laboratory at Wright Field, heads the new firm which has headquarters at 1805 Webster Street in Dayton . . . **FEDERAL CHEMICALS CORPORATION**, 210 Wythe Avenue, Brooklyn, New York has been formed to supply the plastisol and organisol fields . . . **INTERNATIONAL RESISTANCE COMPANY** of Philadelphia has purchased **GORMAN MANUFACTURING CORPORATION** of Los Angeles. The California firm will continue to manufacture its line of encapsulated wire-wound resistors . . . **THE DAN J. CONNOR CO.** has incorporated as **DANCO CORPORATION**. The firm which represents many well-known electronics firms will continue to maintain its offices at 1346 Suburban Station Bldg., Philadelphia 3, Pa. . . . A new electronics supply house which will operate under the name of **"HEADQUARTERS"** has been opened in Austin, Texas. Lyle Hamner, manager of the new firm, has been in the radio field for over thirty years.

* * *

LAWRENCE J. CERVONE has been promoted to the post of general sales manager of *Gates Radio Company* of Quincy, Illinois.

He was formerly head of the company's New York office and has been with the firm since 1947. He was previously associated with both *Westinghouse* and *RCA*. He served in the Navy during World War II. He replaces the late Fred O. Grimwood who passed away in 1952.

John M. Haerle, head of the defense contracts department for the company, will head the New York office which is located at 51 East 42nd Street.

* * *

T. R. MATHEWS has been named assistant general sales manager of the *Raytheon* Television and Radio Division at the Chicago headquarters. He was formerly eastern regional sales manager for the firm . . . *Sylvania Electric Products Inc.* has named **E. FINLEY CARTER** vice-president and technical director of the firm and **HOWARD L. RICHARDSON** as vice-president in charge of engineering operations . . . **HARRY SCHECTER** is the new general manager of *CBS-Columbia Distributors, Inc.*, the New York factory branch handling the distribution of the company's radio and television receivers in the Metropolitan area . . . **STANLEY L. ABRAMS**, director of purchases for *Emerson Radio and Phonograph Corporation*, has been promoted to the post of director of the material division of the firm . . . *General Electric Company* has created three sub-departments within its tube department and has appointed general managers for each. **ROBERT O. BULLARD** will head the industrial and transmitting tube sub-department; the receiving tube sub-department will be handled by **L. BERKLEY DAVIS** while the cathode-ray sub-department will have **ROBERT E. LEE** as its manager . . . **PERCY L. SCHOENEN**, former president of *Olympic Radio & Television, Inc.* of Long Island City, passed away suddenly at his New York City home. He was 61. He retired as president of the firm in April of this year after having been associated with the company since its founding in 1935 . . . **J. HARVEY PICKET** is the new chief engineer for the Capacitor Division of *Aerovox Corporation*. He has been with the firm's Canadian subsidiary since 1935.

* * *

HARRY E. McCULLOUGH has been named general sales manager for television and radio of the *Crosley Division* of *Avco Manufacturing Corp.* He succeeds E. W. Gaughan who has been transferred to the staff of W. A. Blees.

Mr. McCullough has been associated with the firm since 1948, taking over as Cincinnati regional manager in early 1949. He has served successively as Cleveland regional manager and then as assistant to Mr. Blees, from which position he was promoted to product sales manager of radio and television and, later, sales manager for radio and television.

* * *

RTMA has announced that TV set production for the first five months of this year topped all previous January-May periods on record.

During the first 21 weeks 3,309,757 TV sets and 6,102,711 radios were manufactured as against 1,957,083 and 4,469,432 TV and radio sets, respectively, produced during the same period in 1952.

* * *

DR. W. R. G. BAKER, vice-president and general manager of *General Electric Company's* Electronics Division, is the recipient of the 1953 Medal of Honor awarded annually by the Radio-Television Manufacturers Association to the person making the most outstanding contribution to the nation's radio-television-electronics industry.

A leader in the electronics industry for more than 30 years, Dr. Baker is chairman of the National Television Systems Committee which worked out the FCC-approved standards for the present black-and-white television system and is currently developing standards for a compatible color television system. —30—

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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 $117.30. 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.

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1A7GT	.59	6BC5	.59	6U8	.79	12Q7GT	.59
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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	12ABGT	.69	35B5	.59
3S4	.59	6CD6G	1.49	12AT6	.49	35C5	.59
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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
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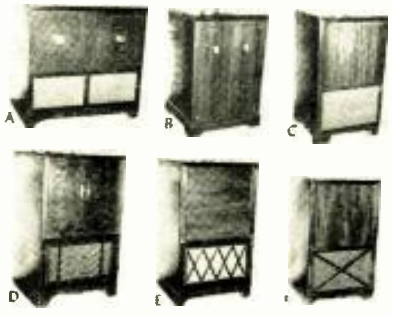
ESPEY DEAL (1), $99.95

Espey 7-C chassis complete with 12" coaxial PM speaker CU-14Y and VM-950 G.E. 3-speed changer equipped with a G.E. turnabout variable reluctance cartridge. A better home music system than ordinarily available. Espey Deal #1. Sale price **$99.95.** With 15" coaxial PM speaker P-15C8 instead of CU-14Y, **$10.00** extra.

ESPEY DEAL (2), $118.95

Espey 7-C chassis complete with 12" coaxial PM speaker CU-14Y and the English Garrard 3-speed changer equipped with a G.E. variable reluctance turnabout cartridge. Our best home music system. Espey Deal #2. Sale price **$118.95.** With 15" coaxial PM speaker P-15C8 instead of CU-14Y, **$10.00** extra.



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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, 14¾" high and 19" deep. Suitable for most 17" TV chassis. Left hand compartment is 14¾" wide, 14¾" 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, 35¼" high, 20¾" wide and 20" deep. Has blank panel. TV chassis area 20¼" wide, 10" high and 17" deep. Speaker baffle cut for an 8" speaker but there is room for a old 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.**

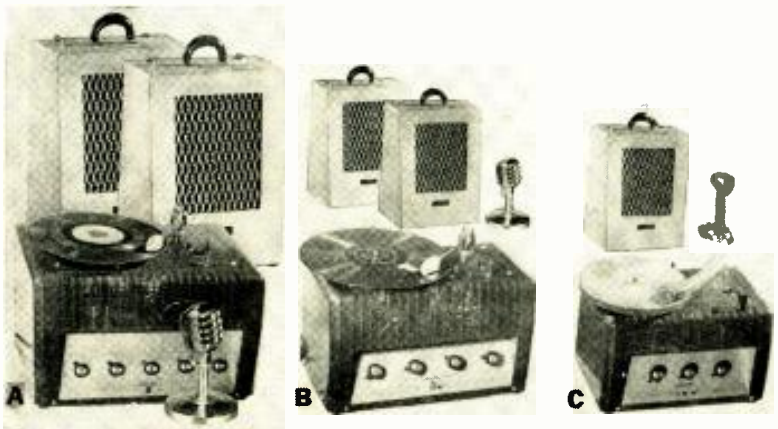
(D) 21" ¾ DOOR MAHOGANY T.V. CABINET **$39.95**
Stock No. AH-56 mahogany television cabinet with doors, 41" high, 25" wide and 21" deep. Has blank panel. Will hold 17", 20" or 21" TV chassis. However, be sure to watch your measurements so that you have room enough for whatever you intend putting in the cabinet. Chassis area is 20¼" wide, 19¾" high and 18¾" 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, 20¾" wide and 20" deep. TV chassis area is 17½" 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



$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 latch and is large enough to give good speaker baffling. Each case is 21 x 16 x 14 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 sits 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-50X, 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.

McGEE OFFERS YOU TERRIFIC VALUES IN T. V. BOOSTERS—AMP'S AND KITS

STANDARD COIL SUPER CASCODE TUNER $19.95
UHF STRIPS $7.50 EXTRA

The Cascode Circuit of the Standard 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 Pentode tuner. Other advances include: easy conversion to UHF reception by interchange of channel inductors; increased sensitivity for TV sets in fringe areas; elimination of booster use; and a high profit item for the serviceman as a replacement unit sale. Brand new factory TV-2000 TV tuner, compl. with tubes 6BK7 or 6BQ7 and a 6J6. Shaft length 3¼". Scoop UHF (specify channel) strips supplied in pairs for above cascode tuner. $7.50 per set.

FRINGE AREA TV RECEPTION IS BETTER WITH OUR McMURDO SILVER TV BOOSTER
$10.95—TWO FOR $20.00

Read the article on pages 52 and 53 of the December "Radio & TV News." You will see how a booster like 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, $10.95 each or two for $20.00.

14-Inch Conversion Kit WITH G.E. TUBE $25.95

14-inch conversion kit: You get a 14-inch black face, 1 year guarantee G.E. 14CP4 picture tube, 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. 14CC-G. Sale price, $25.95.

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 chassis 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 20MP4, 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.

SPEAKER AND BAFFLE SALE

8" SPEAKER AND BAFFLE $4.95

Stock No. 818. Tan leatherette covered, plywood slant type wall baffle; plus an 8" Oxford, 2.15 oz. Alnico 5 magnet PM speaker. A real hot McGee special for only $4.95 each, or $4.70 each in lots of 3 or more.

10" SPEAKER AND BAFFLE $6.50

Stock No. CA-10. Tan leatherette covered plywood slant type wall baffle; plus 10" Alnico V PM speaker. Only a few hundred to sell at $6.50 each, or $6.25 each in lots of 3 or more.

12" SPEAKER AND BAFFLE $7.95

Stock No. CA-12. Tan leatherette covered plywood slant type wall baffle; plus a 12" Alnico V magnet PM speaker. A terrific McGee value for only $7.95 each, or $7.50 each in lots of 3 or more.

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-A5.) 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 MIM-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.

1000 INTERCOM SUB-STATIONS TO SELL AT $3.95 EACH

Chrome plated, with call back switch for a 3-wire intercom master. Size 7½"x6"x2" 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, 11½ 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.

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 6Ω 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. 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.

McGEE'S $62.50 LIST 15" COAXIAL SPEAKER, $23.95

New 1953 Model—21 Oz. Alnico V Magnet—5" Tweeter

This is the finest 15" coaxial PM speaker value that we have ever offered. New 1953 production of a famous manufacturer of fine speakers. The 15" speaker has a 21¼ 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 ribbed 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-15HS, 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 1953 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 5 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. C0-14Y. Sale price $12.95 each; 2 for $25.00.

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"x12⅝". Shipping weight 14 lbs. Stock No. 700-GE. Scoop price, $22.95.

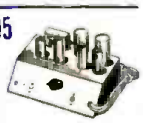
GI 3-speed changer same as above, but with Webster flip-over twin needle cartridge. Stock No. GI-700. Sale Price, $21.95 each.

COMPLETE RADIO, TELEVISION AND AMPLIFIER KITS AT McGEE

3-WAY PORTABLE KIT $15.95

New 1952 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, 5½x5¾x8". Receives broadcast 550 to 1650 KC. 4 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, baby listener and home entertainment. A complete kit of parts including tubes, Kit Model DE-6R. Net price, $7.95. DE-6RWT, wired and tested. Net price, $9.95. Crystal mike and desk stand, $4.95 extra. Concealed microphone unit, only 1" in diameter and ¼" thick. Specify hidden mike when ordering. Stock No. T-001. Net, $3.95 extra.

8-Tube Hi-Fi Amplifier Kit $29.95

A complete kit, including tubes: 3-7F8, 2-12AX7, 2-triode plus rectifier diagram and phones. 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

McGEE'S 1953 CATALOGUE

56 PAGES OF BARGAINS—EVERYTHING FOR THE TELEVISION AND RADIO SERVICE MAN. UP TO DATE UHF TELEVISION MATERIAL. WRITE FOR YOUR COPY TODAY.

10-TUBE RADIO KIT $29.95

10 tube broadcast radio chassis kit, complete with tubes: 2-6BK7, 1-6AT6, 3-6BN7, 1-6BL7, 2-6V6 plus 5Y3 rectifier, diagram and instructions. 3 gang superhet with 8" slide rule dial. Chassis size, 12½"x10"x8½" high. Features push-pull 6V6 high fidelity audio. Output matches 3 to 8 ohm voice coil speakers. Inputs for G.E. variable reluctance or crystal phono pickup and crystal mike. Heavy duty power transformer. Model HK-R10 kit less speaker, shipping weight 18 lbs. Net $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-30. 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" 17BR4A, $17.95. 20HP4, $25.00.

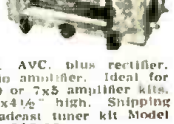
6-TUBE 2-BAND KIT $14.95

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. Complete kit with tubes: 12SK7, 12K8, 12SK7, 12SQ7, 50L6 and 35Z5, diagram and instructions. Factory quality. Cabinet size 13"x6¾"x6½". 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 $12.95



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., 6AB6 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, 9½x4x4½" high. Shipping weight, 7 lbs. Broadcast tuner kit Model BT-38X. Net price, $12.95.

McGEE RADIO COMPANY

Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER
1422 GRAND AVE., KANSAS CITY, MISSOURI

Speech Filters

(*Continued from page 74*)

tiny ceramic condensers which are also inexpensive and readily available, a complete low-pass filter section can be made which takes up a negligible amount of space inside a receiver. The photograph shows how small the filter and its terminating resistances actually are; a man's fountain pen is of telegraph-pole size by comparison.

To obtain the sharpest possible cut-off, an *m*-derived filter section was used. While this type of filter can give a much sharper cut-off than could be obtained with a more familiar design, it is done at the expense of a different type of attenuation curve as the frequency is raised. Unlike the more familiar circuits, an *m*-derived section does not have an ever-increasing attenuation as the frequency is raised, but instead has a point just above the cut-off frequency at which the attenuation is extremely high, and then has somewhat less attenuation as the frequency is raised still further. In some applications, this "leak-through" of the extremely high frequencies could be very undesirable. In this case, however, there should be no difficulties, because of the frequencies involved. With an *m*-derived filter cutting off at 3000 cycles, the response of all but the highest-fidelity loudspeakers will have dropped off before the attenuation of the filter starts to deteriorate at the high frequencies.

The final filter circuit is shown in Fig. 1, as it appears in a conventional receiver, complete with the 82,000 ohm terminating resistance at the input and output of the filter. The load or output termination is shown in the diagram at the grid of the output stage. The source impedance is furnished by the plate resistance of the 6SQ7, the 100,000 ohm load resistance of the 6SQ7, and the 33,000 ohms in series with the filter, which combined make up an effective 82,000-ohm source impedance.

The high-frequency end of the response curve shown in Fig. 2 represents the measured response of this filter section in the circuit shown. It is evident that the high-frequency cut-off is extremely sharp, much sharper than could ever be obtained with a conventional resistance - capacitance tone control circuit. Its effectiveness is indicated by the speed with which a c.w. note drops out completely as its audio tone passes the upper limits of the filter. In addition, the tone control circuit of the receiver was found to have become completely worthless, for the filter does the job so much more effectively that advancing the control to cut down any remaining high-frequency interference will instead reduce the intelligibility of the speech before any useful noise reduction is obtained.

In this design, the low frequencies

below the speech range were attenuated in three different ways.

First, the coupling condenser at the plate of the 6SQ7 is operating in a circuit whose impedance at low frequencies is twice the impedance required by the filter, or 164,000 ohms. With a value of .003 μfd., the response of the complete circuit between the 6SQ7 plate and the following grid starts to drop off below the lower limit of speech frequencies at six decibels-per-octave.

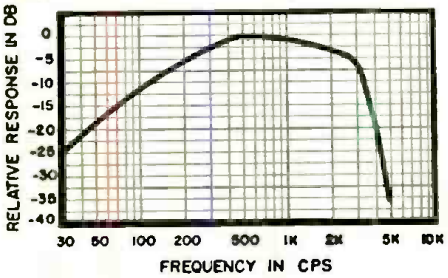
Second, a simple acoustic filtering process was used to increase still further this low frequency attenuation. The loudspeaker was removed from its cabinet and mounted in the exact center of a square baffle a few inches less than three feet on a side, and the baffle mounted out in the open, away from any adjoining wall. With this size baffle, the distance from the front of the speaker cone to the back of the speaker cone averages a half wavelength somewhere between 250 and 300 cycles, and introduces another attenuation of six decibels-per-octave which is effectively added to the similar attenuation introduced by the coupling condenser in the filter circuit. This simple acoustic filtering is valid for any size of speaker, providing the speaker is not so small that its fundamental free air resonance is up in the speech range of frequencies.

The third source of low-frequency attenuation is furnished by the human hearing mechanism itself. At the usual levels of reproduction, the ear becomes progressively less sensitive as the frequency is lowered. This particular attenuation, however, depends on so many other variables that it is difficult, if not impossible, to express precisely. Therefore, the response curve of Fig. 2 shows only the effects of the electrical filtering.

With this filter circuit, and with the speaker mounted in the center of the square baffle, the speech response takes on an added crispness which is very pleasing.

A final added benefit was obtained which was not expected. The tone control no longer performs any useful function, since the filter does the job automatically, and with much more precision. Guesswork and "fiddling" are eliminated. The operator can now be sure that if the speech can be brought out of the QRM by any process of audio filtering, he will hear it. —30—

Fig. 2. Response curve of the receiver speech filter. Note sharp drop at 3000 cps.



Technical BOOKS

"ELEMENTS OF ELECTRICITY" by William H. Timbie. Published by *John Wiley & Sons, Inc.*, New York. 624 pages. Price $5.50. Fourth Edition.

Any person who has ever taken a radio or electricity course without encountering Prof. Timbie's "Elements of Electricity" is a rare exception indeed. This revised edition of a work which has been known to several generations of students is a welcome addition to the literature.

Like the previous editions of this book, the material is presented at an elementary level and provides the student with the fundamentals so necessary to a thorough understanding of the subject.

Beginning with an exposition of Ohm's Law, the text progresses naturally and logically through electrical power and energy, wire, the measurement of resistance, magnets and magnetism, the magnetic circuit, the generator, operation of d.c. generators, electric motors, batteries and electrochemical action, the simplification of circuits, inductance, capacitance, alternating currents, electronics and electron tubes, and electrostatic behavior. Nine tables are presented in the appendix to give the reader all of the supplementary data required in his studies.

Students seeking an authoritative and readable text on the subject of electricity would do well to investigate this up-to-date work by one of the country's leading engineers.

* * *

"BRITISH RADIO COMPONENTS" compiled and published by *Radio & Electronic Component Manufacturers Federation*. Available from The Radio Industry Council, 11 Garrick St., London W. C. 2, England. 210 pages. Price 1 shilling.

This publication is the official catalogue and buyer's guide issued by the Radio Components Show held recently in London. It is intended to be used as a reference and handbook to the radio components available from various British firms.

The catalogue is thoroughly indexed and includes, in addition to technical data on the parts, two articles, one on the show and the other on the ever-increasing use of electronic components.

Since well over 400,000 English pounds' worth of British components were exported to the United States in 1952, the value of this handbook to American users is obvious.

* * *

"PRINCIPLES AND PRACTICES OF TELECASTING OPERATIONS" by Harold E. Ennes. Published by *Howard W. Sams & Co., Inc.*, Indianapolis. 600 pages. Publication date October 1, 1953.

Well-known to readers of this publication, Mr. Ennes covers all phases of telecasting operations from networks and remote links through monitors, cameras, control rooms, studio transmitters, and even production planning.

The publication will be non-technical in that no knowledge of advanced theory or mathematics is required for an understanding of the text material. It is suitable for all personnel connected with the technical production of video and audio program material from camera, mike, or projector through the transmitter. Students will also find it of value.

Department 107 of the publisher, 2201 East 46th Street, Indianapolis 5, Ind., will supply full details on this book upon request.

* * *

"ELECTRONIC CIRCUITRY FOR INSTRUMENTS AND EQUIPMENT" by Milton H. Aronson. Published by *Instruments Publishing Co.*, 921 Ridge Ave., Pittsburgh 12, Pa. 305 pages. Price $4.00.

The material appearing in this valuable home-study text originally ran serially in the magazine "*Instruments*" and contains a wealth of pertinent data in non-mathematical, concise style.

The text is divided into fifteen chapters which cover fundamentals, vacuum tubes, gas-filled tubes, rectification and power supplies, amplifier circuits, solid-state amplifiers, oscillator circuits, signal-shaping circuits, electrical and electronic test equipment, r.f. communication and television, scientific and industrial instruments, and military electronics.

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The booklet shows how to prepare a balance sheet of varying degrees of elaborateness to meet the requirements of various sized businesses. How such a balance sheet is to be used in doing business is explained in some detail.

The second part of the booklet explains the profit and loss statement, how it is prepared, and how it is to be used in conducting a successful servicing operation.

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Edward H. Guilford
Executive Vice President

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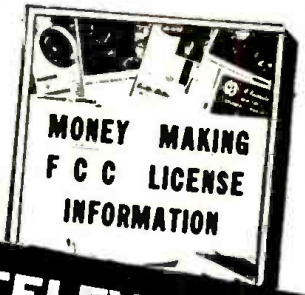

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Name.....

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Paste on two cent postcard or send air mail.

Input Switching

(*Continued from page 71*)

sides. The series heater condenser was made up of a 2 μfd. and two .5 μfd. condensers in parallel due to their being on hand, though, of course, any parallel combination of condensers totalling 3 μfd. can be used. They should be rated at 400 volts d.c.. If more than four inputs are required, as many additional triode sections as needed can be added to the assembly without any change in the cathode or filter resistors as only one section is drawing current at any one time. If an odd number of inputs is required, the odd triode may be a type 6C4, which is similar to one section of the type 12AU7.

A ventilating plug was mounted in the cover over each tube and rubber feet were attached to the bottom of the case by tapping the holes intended for the self-tapping screws that hold on the bottom plate. A one-quarter inch roundhead machine screw was passed through the hole in the rubber feet and this screw used to secure both the feet and the bottom plate. If the usual wiring precautions of keeping the grid circuits far away from the heater wiring are taken, no hum troubles will be encountered. The heater leads and the output lead were shielded as an additional hum prevention. It will be found that reversing the a.c. plug in the wall outlet will affect the hum level, so the connection which gives least hum should, of course, be used. Plate voltage was obtained from the main amplifier power supply. The insertion loss of this coupling unit is about 4 db when working into a 500,000 ohm load, little enough so that it can be easily compensated for by the spare gain usually available in home radio systems.

As the output impedance is low, the shielded cable between the unit and the following amplifier can be any length normally required in home installations, up to perhaps a hundred feet or so.

One point often misunderstood is that although the output impedance of a cathode follower may be in the neighborhood of 500 ohms, the load offered to the follower by the next amplifier can be the customary 500,000 ohms. It does not have to match the output impedance of the follower any more than it would have to match the output of any voltage amplifier.

A 4-pole, single throw shorting switch was mounted on the back of the FM tuner volume control and the a.c. toggle switch was removed. On the AM tuner, the original single-pole, single-throw switch on the volume control was replaced by a single-throw unit. These two tuners could now be operated simply by turning up the volume control, the way radio sets have been turned on during

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4 D.C. CURRENT RANGES: 0-1.5/15/150 MA. 0-1.5 Amps.
2 RESISTANCE RANGES: 0-500 Ohms. 0-1 Megohm.

Model 770 is an accurate pocket-size V.O.M. Measures only 3⅛"x 5⅞"x2¼".

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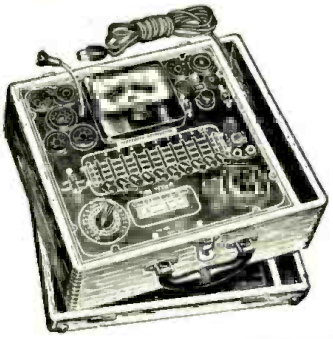
The Model 770 comes complete with self-contained batteries, test leads and all operating instructions.

Superior's New Model TV-11

TUBE TESTER



• 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. • Uses no 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. • Phono jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose external connections.

Operates on 105-130 Volt 60 Cycles A.C. Hand-rubbed oak cabinet complete with portable cover .....

$47.50 NET

Superior's New Model 670-A

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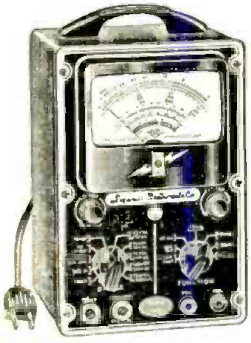

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A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Quality 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
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Comes housed in rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 6¼"x9½"x4½".

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• Tubes used: 1—6BE6 as R. F. Oscillator, mixer and amplifier, 1—6BE6 as Audio Oscillator, 1—6H6 as Power Rectifier. The Model 660-A comes complete with coaxial cable test lead and instructions ..... NET

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the years preceding high fidelity in the home. The dial lights on each tuner served to indicate that the system is on. This made the pilot light on the equalizing preamp unnecessary, thus eliminating one more part on what had been the central control panel.

A volume control, with its switch, and a pilot light were mounted alongside the phono preamp equalizer control, completing this part of the job.

A new panel of quarter-inch plywood, painted to match the shelves of the bookcase, and cut out for the two tuner dials and their tuning and volume control knobs, was mounted in front of the tuners. The former central control panel which had been reduced to holding only the bass and treble controls was installed between the two tuners so that the symmetry was preserved.

Another installation was made which also employed this automatic switching circuit. In this one it was found to be more convenient to mount just the double-pole, single-throw switches on each of the input sources, a tape recorder, TV set, FM tuner, and a record player, and use only one volume control mounted between the bass and treble knobs.

You will find, as the author has, that the time and effort expended on simplifying the operation of your home radio/phonograph installation will be amply repaid by the additional use of the equipment made by the family, thus giving you a better return on your investment. —30—

Transistor Curves

(*Continued from page* 67)

known a.c. voltage to the "Vert. Input" and "Hor. Input" terminals of the scope and adjusting the "Vert. Gain" and "Hor. Gain" controls, respectively, for a given deflection.

As an example, an a.c. voltage having a peak-to-peak amplitude of six volts could be applied to the "Hor. Input" terminals of the scope and the "Hor. Gain" control adjusted for a deflection of 3 inches. The horizontal sensitivity then becomes 2 volts/inch.

If an a.c. voltage having a peak-to-peak amplitude of 0.6 volt is applied to the "Vert. Input" terminals of the scope and the "Vert. Gain" control adjusted for a deflection of 3 inches, the vertical sensitivity is then 0.2 volt/inch.

Once the "Hor. Gain" and "Vert. Gain" controls have been set in this manner, no changes should be made in their settings while a particular characteristic curve (or group of curves) is obtained.

The characteristic curves obtained with the scope controls preset as described may be compared in terms of actual collector current and voltage, and, when recorded, are sufficiently accurate for many types of engineer-

ing measurements and calculations.

As an example, assuming the scope controls preset using the values given before, let us suppose that a curve having a peak amplitude of 1 inch and a width of 3 inches is obtained. The peak vertical input voltage is 0.2 volt. Since this represents the drop across a 100-ohm resistor (R_2, Fig. 2), the peak collector current is 2 milliamperes. The peak collector voltage is 6 volts.

The graph scale permits the collector current for any given collector voltage to be determined in a similar manner.

Recording the Curves

In many cases, the characteristic curve displayed on an oscilloscope screen is of little value unless a record is made of it. Two methods may be used.

A simple tracing of the curve may be made, using either plain or graph paper.

A better technique, however, is to photograph the scope pattern. If desired, the graph scale may be photographed also, so that the transistor characteristic curve appears superimposed on a graph scale in the final photograph.

One technique that has been used to accomplish this is to "de-focus" the oscilloscope beam so that the entire CRT screen glows behind the graph scale. An exposure is made of this. The beam is then refocused and the desired pattern obtained. Another exposure, on the same film, is made of the final curve, thus superimposing the characteristic curve on the previously photographed graph scale—a deliberate double exposure!

A complete family of characteristic curves may be obtained very easily by means of the "multiple exposure" technique. Before taking the first photograph, a small piece of tape is affixed to the CRT screen to serve as a "zero" point so that a series of curves may be properly "lined up."

The first curve is then photographed, after being lined up with the small piece of tape, using the vertical and horizontal centering controls.

Base current is then adjusted to a new value and the new curve lined up properly, again using the vertical and horizontal centering controls—*the "Gain" controls should not be touched, however.* Another exposure, on the same piece of film, is then made.

This process is repeated until the desired "family" of curves is obtained. A typical "family", photographed using this technique, is shown in Fig. 5. These are collector current vs collector voltage curves for a *Raytheon* type CK722 junction transistor at base currents of 25, 50, 100, 150, and 200 microamperes, respectively (from bottom to top).

(*Note:* For those photographers who may be interested in repeating this technique, the following information may be of value. A 2½x3¼ *Speed Graphic* camera was used, lens setting

*f*4.5, shutter speed 1/25 second, "Super XX Pan-Chromatic" filmpack. Room lights were turned off while making the series of "quintuple" exposures.)

Other Applications

As mentioned previously, this technique may be extended to obtain characteristic curves other than collector current *vs* collector voltage simply by rearranging the pulsating d.c. and steady d.c. supplies, and by changing the scope connections.

There is still another possible application of the unit shown, however. It may be used to obtain characteristic curves of germanium diodes with equal facility. In fact, the author obtained the characteristic curve of a type 1N34 crystal diode simply by "plugging" it into the transistor socket so that its cathode lead was connected in place of the transistor's collector lead, and so that the "plate" lead was connected in place of the emitter lead. The characteristic curve obtained is shown in Fig. 6. —30—

Electronic Break-in

(*Continued from page* 55)

Since most receivers have relay terminals on the back which are in series with the r.f. and i.f. tube screen girds, V_3 can be connected directly across the terminals provided, of course, that the correct polarity is observed. This will parallel V_3 across an existing control circuit, thus requiring no modification of such circuit. A drop of only about eleven volts appears across V_3 when it is conducting. Any receiver can stand this small drop in screen voltage with no detectable loss of sensitivity.

In a few receivers disabling is accomplished by breaking the power-supply center tap. In these cases it will be necessary to bring out the r.f. and i.f. screen leads. This, however, is no disadvantage, because oscillator stability will be improved as the oscillator will operate continuously.

For keying the transmitter or exciter, blocked-grid type keying is suggested. If this type of keying is already in use, the grid-blocking voltage will be supplied by the transmitter or exciter. In this case the resistor R_9 may be omitted from the circuit, and the cathode of V_4 may be connected to the blocking bias to be keyed.

If blocked-grid keying is not in use, R_9 will be necessary. In this case, the cathode of V_4 should be connected to a buffer-amplifier grid observing the precaution of using an r.f. choke to prevent any r.f. from going astray.

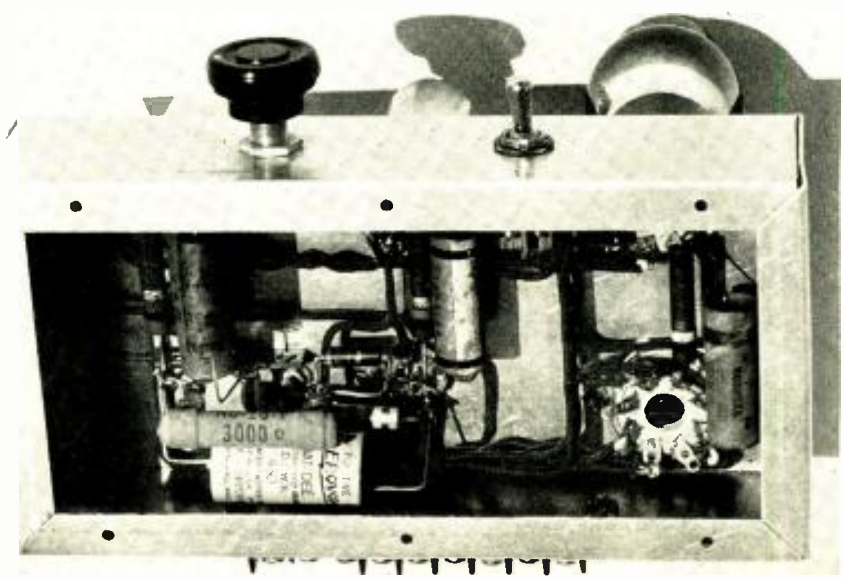
Voice-controlled operation is equally effective on AM, FM, and single-sideband transmitters. When used with AM or FM transmitters, the receiving operator should turn off his a.v.c. and operate the receiver at reduced r.f. gain. This adjustment of the receiver eliminates blasts of noise when the carrier being received turns off. In operation, adjust R_1 for the highest possible gain consistent with the avoidance of false triggering from background noise.

If loudspeaker operation of the receiver is desired, an excellent article[1] has appeared in the past on this subject. Since the circuit referred to in the footnote produces a positive control voltage, it will be necessary to transpose the audio inputs in order to obtain the negative control voltage required by V_{2a}. The circuit referred to in the footnote may be connected at points "X" and "Y".

The time spent in building and installing this type of circuit will be well repaid in the operating pleasure it will afford, not to mention the "lost" transmissions it will save, which were formerly lost due to unheard QRM on the frequency. —30—

[1] Nowak, Edward F.; "Voice Controlled Break-In . . . And a Loudspeaker," QST, May 1951

Under chassis view of the voice-controlled break-in unit. No relays are required.



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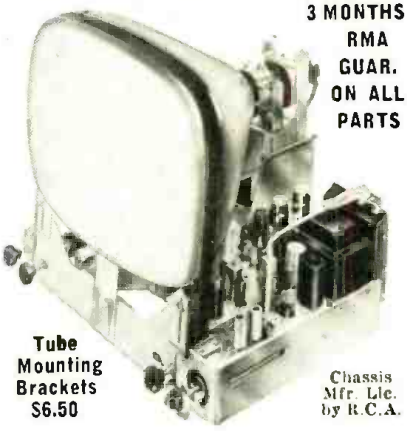

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WATCH THOSE HEATER VOLTAGE MEASUREMENTS

By **JOHN K. FRIEBORN**

Avoid expensive meter burnouts by observing a few simple precautions when making voltage measurements in TV sets.

CAN you burn out a meter measuring the heater voltage of a 6.3-volt tube using the 10-volt a.c. range of the meter? You can, in certain television receivers, unless you take the proper precautions. Probably you don't actually find it necessary to measure the heater voltages of individual tubes very often, so when you do you may not be prepared for some of the surprises which can occur.

Most television receivers have parallel heaters with one side of each heater grounded, so that the heater voltages can be measured with the common lead of the meter connected to the chassis, just as it usually is in measurements of d.c. voltages on plate, screen, etc. Even if, through unfamiliarity with the receiver or carelessness, you measure the voltage between the chassis and the grounded heater terminal, or the heater ground point turns out to be the transformer winding center-tap, it won't do any harm and you'll soon catch on.

So where's the risk? It is in measuring between the chassis and one side of a heater which has a high d.c. voltage with respect to ground. Well, you say, of course you know better than to measure the heater voltage of a power supply rectifier or damper tube that way; is that all? It isn't.

Probably you have noticed that many television receivers of the past couple of years have the cathodes of one or more tubes, other than rectifiers and dampers, positive with respect to the chassis a hundred volts or more. Many of these receivers have the heaters of the same tubes at about the same d.c. potential. Two typical examples are *Motorola* Chassis TS-236 and *Crosley* Chassis 356-1, partial schematics of which are shown in Figs. 1 and 2, respectively. Other manufacturers who have used similar arrangements are: *Bendix, Hoffman, Magnavox, RCA Victor,* and *Raytheon.* The tubes involved are: the audio output (most often), the sound i.f. (sometimes), and other tubes such as

Fig. 1. Partial diagram of Motorola TS-236.

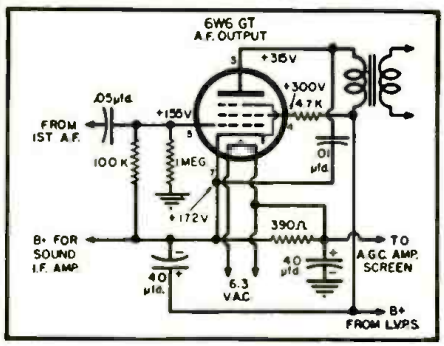


Fig. 2. Crosley's 356-1, partial schematic.

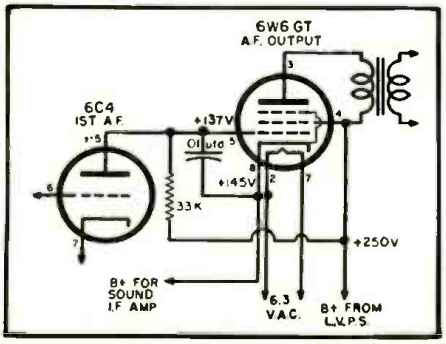
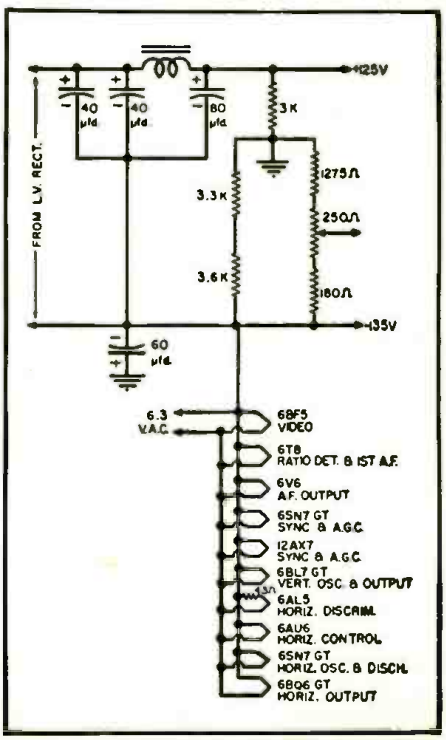


Fig. 3. Partial schematic, Sylvania 1-502-1.



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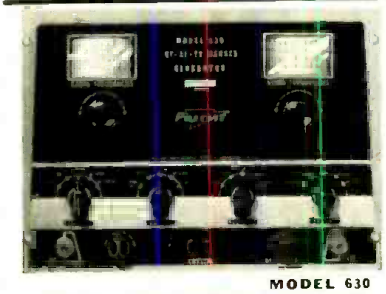

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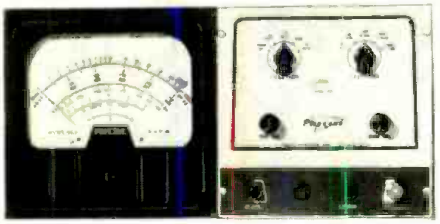

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POSITIONING—Bridge type positioning on vertical and horizontal does not vary tube characteristics.

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.

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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 17"; complete with instruction book and all components; Accessories: Model 912T(MM) Demodulator Probe and Model 960 Capacity Attenuator Probe available at extra cost—please see specifications on following pages.

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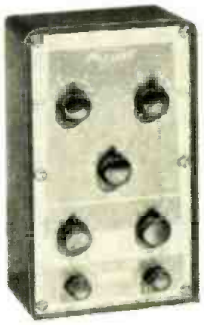

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a.g.c. keyers (in a few cases). Some *Sylvania* models, such as Chassis 1-502-1, have the heaters of about half of the tubes more than a hundred volts *negative* with respect to the chassis. (See Fig. 3.)

Measuring between the chassis and either side of the heater in the cases mentioned will put the high d.c. voltage across a meter which is set for a low a.c. voltage. Some meters would not be harmed; would yours?

One way to avoid the risk is to make all heater voltage measurements in unfamiliar receivers between the heater terminals on the tube sockets. That does not apply to series heater arrangements; they present a different type of danger, as you probably know. An open heater of a series string has almost the entire a.c. line voltage between its terminals when the circuit is completed by a high-resistance voltmeter. —30—

RECEIVER AS MODULATOR

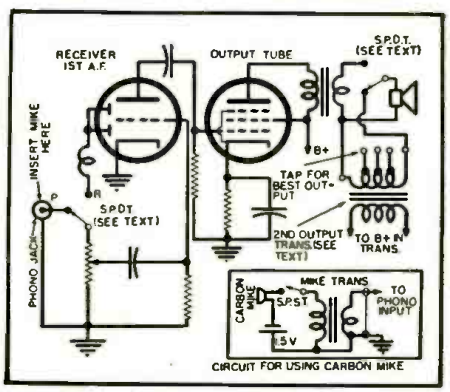
By George R. Anglado

A BROADCAST receiver can be used for modulating a flea-power transmitter when a modulator is unavailable. The diagram shows how the output stages of a broadcast set are used for this purpose. Our receiver had a phono jack which served for connecting the microphone. The s.p.d.t. switch shown in the diagram is part of the "radio-phono" switch in some models, while others do not have it and require the radio to be tuned to a quiet channel for using the phonograph. If the switch is added, the leads and switch should be shielded and the switch mounted as close as possible to the first a.f. tube.

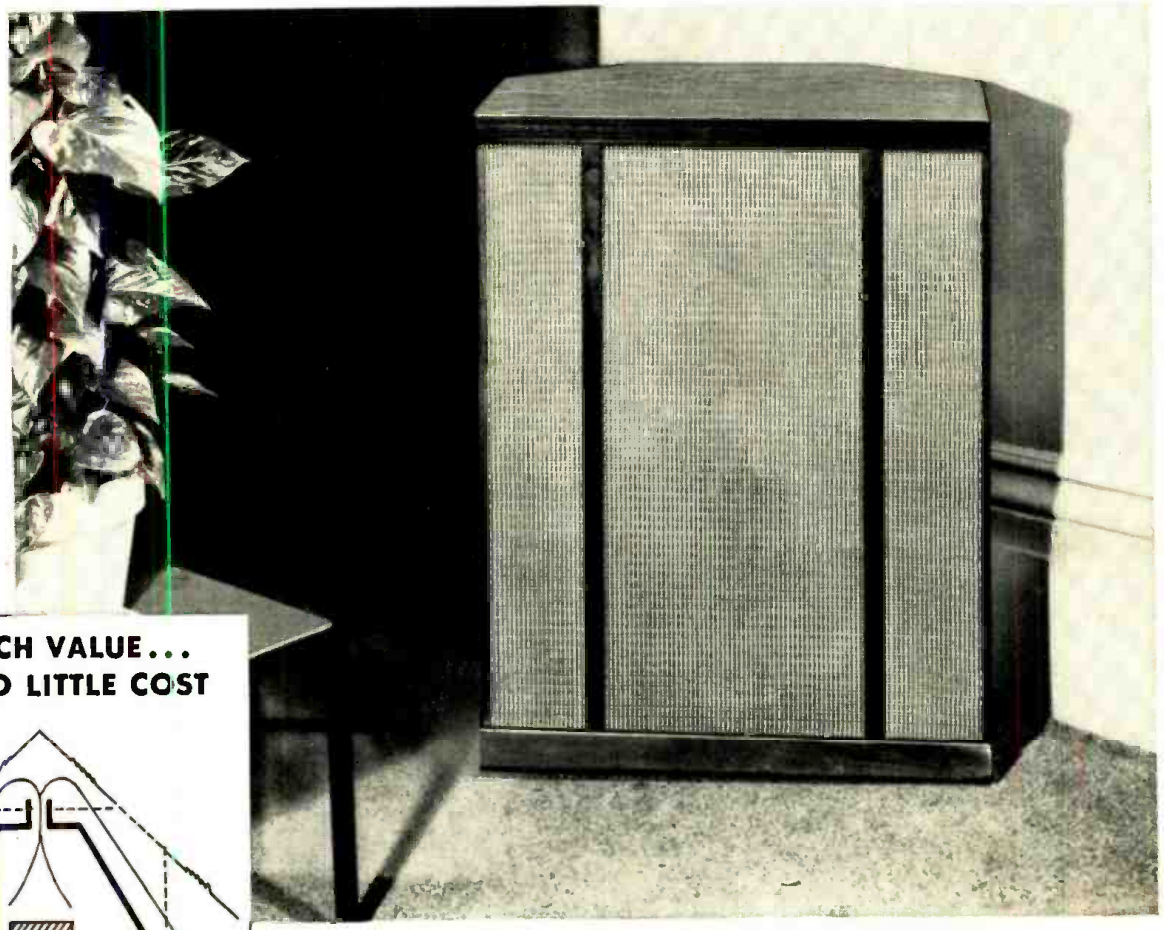
Although a carbon microphone may be used, with a suitable battery and transformer as in the inset diagram, crystal mikes have been used successfully in the phono input.

A heavy-duty universal plate-to-voice-coil transformer is used to couple the audio to the transmitter. Its secondary is connected across the secondary of the receiver output transformer, and its primary is connected in series with the transmitter "B-plus." The taps are chosen on both windings to match the output impedance of the receiver and the estimated plate impedance of the transmitter final tube. An approximate match is good enough. The reason for the s.p.d.t. switch is obvious. The power of this "modulator" depends, of course, on the power output of the receiver audio section. —30—

Using a b.c. set to modulate transmitter.



paul klipsch-designed



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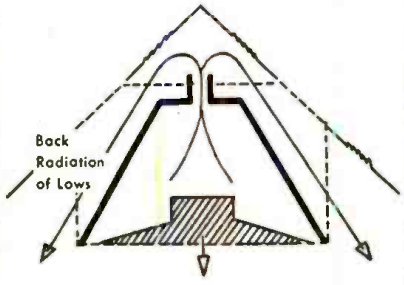

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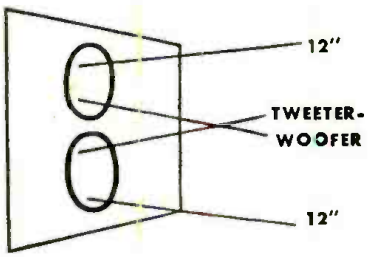

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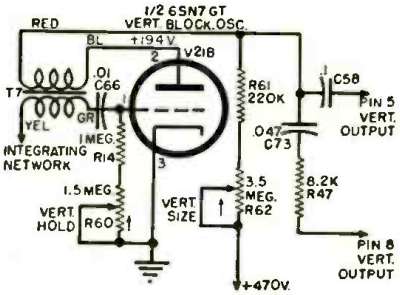
Insufficient width.
This condition is most prevalent in low line voltage areas and may be particularly noticed on 12-inch picture tubes.
To increase the width, connect a .047 μfd., 600 volt condenser across the terminals of the width control. A higher capacity unit (up to .1 μfd.) may be required on some receivers.

Inverted picture.
This condition is usually caused by a defective blocking oscillator transformer (T_7). Also check condenser, C_{73}, the .047 μfd. unit in the plate circuit of the blocking oscillator. See diagram below. Replace with a similar type of condenser if defective.

Poor vertical linearity.
This condition may or may not be accompanied by foldover. If the vertical size control, R_{62}, is connected to the 340 volt "B+" line



(as in early production receivers), remove it from this line and connect it to the 470 volt "B+" line through a 47,000 ohm, ½ watt resistor. The junction of the size control and the 47,000 ohm resistor should be bypassed to ground through a 10 μfd., 475 volt electrolytic condenser. See diagram for original circuit.

Foldover and distortion at top of picture.
When this condition occurs, check the 20 μfd. electrolytic condenser (C_{67}) through which the primary of the vertical output transformer returns to ground.

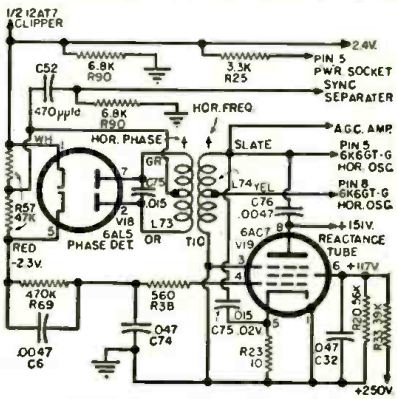
Oscillator frequency shifts.
This may be caused by fine shavings which break loose from the oscillator adjustment screw, and lodge in a channel strip of the tuner. These shavings cause a change in the strip adjustment condenser when the turret is switched from channel to channel. To correct this condition, remove the adjustment screw and blow out the excessive shavings (with an air gun, etc.). Crimp the two ears on the *Tinnerman* clip so that it will hold the slug shaft securely. Re-insert the slug, and adjust for proper tuning.

Brightness control has little or no effect.
This may occur when the 6200 ohm, second video amplifier plate load resistor, R_{40}, increases in resistance. If this has occurred, replace this resistor with the proper value unit.
When replacing this resistor, mount it approximately one-inch from the 3000 ohm wire-wound resistor (R_{50}, connected to the horizontal deflection coils) in order to obtain better heat dissipation.
Also check the 6AU6 sync amplifier plate bypass condenser, C_{62}. This condenser should be 220 μμfd., 600 volts.

Sound from speaker affects picture.
This condition is usually caused by a microphonic 6AC7 reactance tube. It may also be caused by a defective 6J6 r.f. oscillator tube. Check by replacing these tubes.

Horizontal instability.
This may be caused by the following:

1. Drift in the .015 μfd. condenser, C_{38}, connected between pin 5 of the 6AC7 reactance tube and inductance, L_{74}.
   If defective, replace this unit with a *Sprague* .015 μfd. condenser, *Zenith* part #22-1850.
2. Change in the value of the 56,000 ohm, ½ watt resistor, R_{70}, between pin 6 of the 6AC7 reactance tube and ground.
3. Change in the value of the



3300 ohm, ½ watt resistor, R_{28}, between pin 1 of the 6AL5 phase detector tube and pin 5 of the power socket.

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0Z4G	59c	2B3	89c	6AK6	.89	6BK7	69c	6K7GT		6SR7GT	59c	7C7	79c	12AV7	.59
1A5GT	.79	2B7	.89	6AL5	1.08	6BL7	1.19	6K8GT	.89	6SS7	.99	7E5		12AW6	1.19
1A7	.69	2B7	.89	6AQ5		6BN6	69c	6L5G	1.19	6T7G	1.15	7E6	79c	12AX4	.69
1A7GT	.79	2C34	.60	6AQ6	.89	6BQ6G	.81	6L6G	1.19	6T8	.89	7E7		12AX7	.69
1B3GT	.95	2E5	.89	6AQ6	.81	6BQ6GT	1.19	6L6GA	1.19	7F7	.89	12A7	1.95	12AY7	1.95
1B5	.29	2X2/879	.74	6AQ7	1.19	6BQ6GT	1.19	6L6GA	95c	7F8	1.47	12AH6	.59	14A7	1.05
1M5GT	.59	3LF4	1.25	6AR5	.79	6BQ7	1.29	6L7	1.19	6U6GT	69c	7G7	1.19	12BA7	1.19
1N5GT		3Q4	.69	6AT6	.59	6BZ7		6N6G	1.40	6U7G		7H7	1.05	12BE6	
1R4	69c	3Q5GT	.89	6AS5	.90	6C4	.59	6N7GT	1.19	6U8	.89	7J7	1.19	12BF6	69c
1L6	1.29	3S4	.69	6AU5GT	1.29	6C5GT		6P5GT	.89	6V3	1.29	7J7		12BH7	.89
1LA4	1.19	3V4	.95	6AU6	.59	6C6	69c	6Q7GT	.59	6V6GT	.69	7K7	1.19	12BR7	.89
1LA6	1.19	5T4	1.40	6AV5GT	.89	6C8G		6R7GT	.59	6W4GT	.59	7L7	.79	12BY7	.89
1LC5	.69	5U4G	.59	6AV6	.59	6C8	1.29	6S4	.59	6W6	.69	7N7	.69	12BZ7	1.19
1LC6		5V4G	.87	6AX4	.89	6CD6	2.49	6S7GT	1.15	6X4		7Q7	.79	12F5GT	.65
1LD5	1.19	5W4		6AX5	.79	6CD6G	1.69	6S8GT	1.25	6X5GT	59c	7R7	1.19	12M6	.89
1LE3	1.19	5W4GT	59c	6AX6	.69	6DK7/78	1.10	6SA7GT		6X8	1.29	7S7	1.19	12.5GT	.72
1LH4	1.19	5Y3GT	.45	6AY5GT	.89	6DR6	1.15	6SC7	69c	6Y6G	.69	7V7	.79	12R7GT	.69
1LN5	1.19	5Y4G	.54	6AU6	1.44	6E5	.69	6SD7GT	.99	6Z4/84	.72	7W7	1.19	12R8	.89
1N5GT		5X4G	81c	6B8GT	1.15	6F5GT	59c	6SF5	.59	7A4	.95	7X6	1.05	12Q7GT	.89
1P5GT	79c	5Z3		6BA6	.59	6F6GT		6SF5GT	.59	7A5	1.19	7X7	79c	12S8	.89
1Q5GT		6A3	1.68	6BA7	.89	6F7	1.59	6SG7		7A6	.89	7Y4		12SA7GT	.69
1R5		6A7	.89c	6BC5	.69	6F8G	1.59	6SH7	69c	7A7		7Z4	.89	12SC7	1.05
1S4	.99	6A8GT	69c	6BC7	1.05	6G6G	.95	6SH7GT	.69	7A8	79c	12A7	1.59	12SF5GT	.69
1S5		6AB4		6BD5GT	.89	6H6GT	.89	6SJ7	.79	7B4	.89	12A8	.69	12SF7	.99
1T4	69c	6AB7	1.15	6BE6	.59	6J5GT	.59	6SJ7GT		7B5	.89	12AH7	1.38	12SG7	.89
1U4		6AC5GT	.89	6BF5	69c	6J6	.79	6SK7GT	59c	7B6	.89	12AL5	.54	12SH7GT	
1U5	.59	6AC7	1.45	6BF6		6J7G	.69	6SL7GT	.69	7B7		12AT6	.59	12SJ7GT	
1V	89c	6AG5	1.05	6BG6	1.89	6J8G	1.15	6SN7GT	.69	7B8	89c	12AT7	.89	12SK7GT	69
1X2A		6AG7	1.49	6BG6G						7C4	1.30	12AU6	.69	12SL7GT	

12SQ7		25	59c	70L7	79c										
12SQ7GT	69c	27	.99	70L7GT	1.49										
35A5		35B5		71A	.87										
35B5	69c	35C5		75	.79										
35C5		35L6		77	.69										
35L6		35W4	.59	78/6D6	1.10										
35W4	99c	35Y4		80	.69										
35Y4		35Z3		83	1.45										
35Z3	89c	35Z4	.75	84/6Z4	.72										
35Z4		35Z5	.55	85	.79										
35Z5	1.25	35/51	.79	VR90											
36	1.05	37	1.06	VR105	$1.19										
38	1.05	39/44	.93	VR150											
41	1.19	42	88c	VT51	.72										
43	1.89	45	.69	VT52	29c										
45Z5	72c	46	.69	117L7	1.40										
47	89c	50A5	1.05	117N7	1.95										
50B5	1.05	50C5	69c	117P7	1.95										
50C6G	1.19	50L6	1.39	117Z3	.59										
50X6	.69	50Y6	.69	117Z6	1.19										
50Y6	.99			715B	7.75										
				807	1.55										
				866A	1.49										
				1299	49c										
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UNIVERSAL · CONVERTERS ALL SETS — the only converter recommended for the 5,000,000 split sound and video TV sets now in use as well as all intercarrier TV sets. NET $37.46

Bogen UHF Converter . . $31.24

JFD UHF-VHF ANTENNA

Efficient on all channels. Uses conical element and reflector for VHF and "bow-tie" for UHF. Equipped with printed circuit antenna coupler for excellent signal transfer into single transmission line. Easy to install.

Only $11.20

RADAR TYPE TV ANTENNA

For UHF and VHF

RECEIVES ALL CHANNELS

WE FINALLY DID IT

You ordered so many thousands of these radar type TV Antennas, that the cost has come down through the savings of mass production.

WE ARE PASSING THESE SAVINGS ON TO YOU!

The only TV antenna with the money-back guarantee with the new Electronic Dipole Separators. Unbeatable for fringe area and DX at this low, low price we cannot mention manufacturer's name.

Less Mast **$18.75**

5' ALUMINUM MAST heavy gauge 1¼" diam. with interlocking end. Slip two sections together for a ten-footer. Each $1.00

TV Antennas

10 Element conical . . . rugged throughout. Only $3.95

Double bay array, with stacking bars . . $7.75

4 Bay array, with harness and stacking bars $14.95

6 Element Conical. Only $2.85

JFD BOW TIE REFLECTOR

UHF Antenna

Bowtie Reflector

Ultra-high Gain

Completely assembled—ready to mount. For all UHF Channels—easy to stack for two or four-bay.

Single Bay $4.50

Two Bay, complete $8.45

Indoor UHF antenna $7.61

Outdoor UHF antenna $4.77

TELEVISION PICTURE TUBES

	SIZE	PRICE	SIZE	PRICE
SEND US YOUR ORDER AND WE WILL SHIP FROM STOCK IMMEDIATELY	7 Inch	$17.95	16 Inch	$19.95
	8 Inch	23.00	17 Inch	20.95
	10 Inch	12.95	19 Inch	23.95
	12 Inch	16.95	20 Inch	24.95
	14 Inch	17.95	21 Inch	26.95
	15 Inch	19.95	24 Inch	54.95
			27 Inch	69.95

ONE FULL YEAR WARRANTY ON ALL TYPES

METAL TUBES $1.50 extra per tube
Electrostatic Tubes $1.50 extra per tube

TV CONVERSION KITS

Easily Installed

consisting of rectangular tube, 70 degree yoke, beautiful mask, flyback transformer and width coil.

17" Conversion Kit, as above, complete	$24.95
20" Conversion Kit, as above, complete	29.95
21" Conversion Kit, as above, complete	31.95
24" Conversion Kit, as above, complete	69.95
27" Conversion Kit, as above, complete	89.95

RME converter. All UHF channels $29.63

WELLER SOLDERING GUNS

Brand New Models

Model	Watts	
WS-100	150 Single heat	$8.77
S-500	275 Single heat	9.75
WD-135	150-200 Dual heat	10.73
D-550	275-350 Dual heat	11.71

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55 Mil, 100 ft.	$ 1.59
1,000 ft.	13.95
20 Ga, 80 Mil, 100 ft	1.89
1,000 ft.	16.95
UHF TUBULAR 300 OHM LINE 1,000 ft.	$34.50
100 ft.	$4.95

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Service Dealers Net Price. Fresh stock.

50 mfd. @ 25V 50 mfd. @ 50V	.19 ea.
3X10 mfd. @ 150V 30-20 mfd. @ 150V	.39 ea.
40 mfd. @ 150V	.35 ea.
40-40 mfd. @ 150V 40 mfd. @ 150V 20-25V 80 mfd. @ 150V	.39 ea.
8 mfd. @ 450V	.27 ea.
8-8 mfd. @ 450V 10-10 @ 450V	.29 ea.
10-10 mfd. @ 450V 100-25V	.39 ea.
20 mfd. @ 450V 40-400V	.44 ea.
30 mfd. @ 450V 420-20 @ 25V	.39 ea.

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BEST BRANDS AT BEST PRICES

3V4, 1T4, 1R5, 1S5. $2.19 List Value $8.00. Tube Kit only $1.98

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3S4, 1T4, 1S5, 1R5. List Value $7.80. 4-Tube Kit $1.98

1U4, 3S4, 1S5, 1R5. List Value $7.80. All Four Tubes for $1.98

11723, 1U5, 3S4, 1R5, 1T4. AC-DC Portable Kit. All for $4.49

12AT6, 12BA6, 12BE6, 35W4, 50B5. 5 Tubes for $2.59

50L6GT, 35Z5GT, 125C7GT, 12SK7G, 12SA7G. 5 for $3.22

VTVM PRECISE

Vacuum Tube Volt-Meter, 1% accuracy ceramic precision resistors; Coax DC connector; FM zero alignment scale; burn-out proof circuit, rugged oversize 4½" meter. Model 909, factory wired $44.98. 909K—Kit. $25.98

Model 300 Precise Oscilloscope Here Is the Buy

7" tube size, Sweep magnifies, complete push-pull from input through output. Vertical sensitivity better than 10 millivolts. Bandpass + 0 — 3db.. 0 to FIVE mc. complete with phasing control, blanking control, intensity mod. and self-measurement peak to peak feature, with DC amplifiers throughout as found only in scopes selling for over $950.00. Exclusive, easy maintenance feature.

In kit form ONLY $94.95

Completely wired $199.50

TV 2-set antenna couplers $1.17 ea.

Flyback Transformer TV Horizontal output, universal replacement, 14,500 V. $2.49 ea.

P. M. SPEAKERS

12" COAXIAL PM SPEAKERS. High Fidelity with Crossover filter attached. 20 watts; 40-19,000 cps. response; 8 ohm Voice-Coil. ea. $12.95

15" COAXIAL SPEAKER. 20-17,500 cps. ea. $19.95

Very best quality—NATIONAL BRANDS. Individually Packed.

3"	ea. $1.39	8"	ea. $3.23
4"	ea. 1.59	10"	ea. 5.10
5"	ea. 1.59	12"	ea. 5.95
6" SPECIAL PRICE	ea. 1.79		

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PILOT LIGHTS, Type No. 47 ..... 10 for 39c; 100 for $2.95

VOLUME CONTROLS with SWITCH, 2" shaft. 1 meg, ½ meg, ¼ meg . . 34c

SINGLE ION TRAPS 19c

DOUBLE ION TRAPS ..... ea. 29c

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6-foot LINE CORD UL ..... 10 for $1.95

TV INTERLOCK CORDS ..... ea. 49c

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100 Condensers assorted in package $6.95

600-VOLT				400-VOLT			
.001	6c	.01	8c	.05 mfd	ea.	7c	
.002	6c	.02	8c	.2 mfd	ea.	7c	
.005	6c	.05	10c	.25 mfd	ea.	12c	
.1			11c	.5 mfd	ea.	18c	

NEPCO TV WIRE

Twin Lead Type—300 Ohm

20 Gauge—7 Strand No. 28 AWG Copperweld Wire for Maximum Strength and Maximum Flexibility. Constant impedance under all conditions. The "Z" Line is an attractive, easy to handle UHF TV lead for maximum signal.

1000 ft. ..... 2¢/7.50 100 ft. $5.09

Selenium Rectifiers

75 m.l.	79c
100 mil.	89c
150 mil.	$1.32
200 mil.	1.85
250 mil.	1.85
300 mil.	1.84
350 mil.	2.41
400 mil.	2.55
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500 mil.	2.64

70 degree cosine yoke with 4 leads and network $2.95 ea.

Teleron TV Wave Trap

For VHF Channels 2 through 13. Clears VHF picture of stoic interference at once. Set in seconds to attach.

All UHF channels ..... ea. net $1.75

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Add-a-Any Antenna

All-Angle Base Mount, UL Approved Twin Lead Lightning Arrester, 5C-it 300 ohm Twin Lead, 6 Insulated Screw Eye Stand-Offs, 2 Insulated Mast Stand-Offs, 8 ft. Weather-Proof Mast 1¼" OD. $3.95

Lifetime Chimney Mount

30 ft. of Stainless Steel Strap with HEAVY ZINC BRACKETS for dealers who sell quality Chimney Mount for TV and ant. ..... each $3.00 ..... $1.49 ea.

All Burgess batteries in stock

TERMS: 25% DEPOSIT with order, bal. C.O.D. ALL shipments F.O.B. Chicago. ORDERS LESS THAN $5.00—$1.00 SERVICE CHG. CABLE ADD.: CONTULAB. These prices supersede all previously advertised prices, subject to change without notice.

PREMIER RADIO-TV SUPPLY, division of CONTINENTAL CORPORATION

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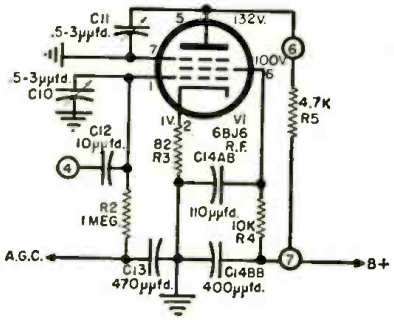
4. Change in the value of the 6800 ohm, ½ watt resistor, R_{90}, between pin 1 of the phase detector tube and ground. See diagram (page 138).

23G22, 23G23, 23G24, 24G22, 24G23, 24G24, 24G25, & 24G26

To improve fringe-area reception.

Considerable improvement in reducing snow in fringe areas can be made by the following modifications in the r.f. amplifier stage:

1. Replace the 6BJ6 tube with a 6AK5. (No socket changes are necessary.)
2. Replace the 10,000 ohm screen resistor, R_4, with a 27,000 ohm, ½ watt unit. See diagram.



3. Parallel a 2.5 μμfd. ceramic condenser (*Zenith* part #22-1891) with the plate tuning condenser, C_{11}.
4. Tune in a weak signal, and adjust the plate condenser, C_{11}, for the best picture with the least snow.

Overheating of the 25Z6 rectifier tube.

When this condition occurs, check the 50 μμfd., 500 volt ceramic condenser, C_{31}, in the plate circuit of the 12AT7 intercarrier sound amplifier.

The *Zenith* replacement for this condenser is part #22-1761, which should have a green durez coating. Condensers with a brown durez coating should not be used in this circuit.

Instability in the sound channel.

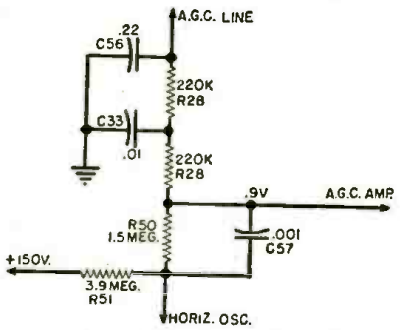
If the sound channel breaks into oscillation when adjusted, do the following:

1. Replace the sound take-off coil, L_{78}, at pin 1 (the plate) of the 12AU7 video amplifier, with a *Zenith* S-16854 assembly.
2. Replace the 10 μμfd. condenser, C_{51}, in the grid circuit (pin 2) of the 12AT7 intercarrier sound amplifier with a .01 μfd., 500-volt condenser.
3. Add a 470 ohm, ½ watt resistor between the black lead and the chassis.

Horizontal instability.

This condition may be caused by one of the following:

1. An open or leaky 100 μμfd. condenser, C_{62}, at the cathode of the 6AL5 phase detector tube. When this condenser is defective, a positive voltage appears at the plate (pin 7) of the phase detector, instead of the normal negative 8 volts.
2. Loose rivets on the "Phonevision" connector plug. Solder the shorting bars to the rivets to correct this.
3. A shorted 470 μμfd. condenser, C_{60}, at the plate (pin 5) of the 6SN7 horizontal control tube.
4. Overheated 56,000 ohm resistors (R_{15}) in the a.f.c. return (from the horizontal output transformer connection 1, to "Phonevision" socket). These resistors are normally ½ watt; however, use 1 watt resistors as replacements.
5. If the receiver cannot be adjusted to snap into horizontal sync when switching from

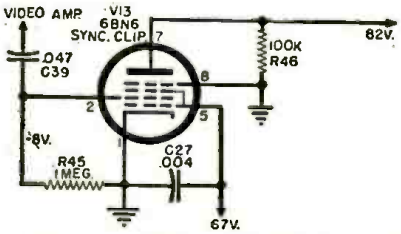


channel to channel, replace the .001 μfd. condenser, C_{57}, in the a.g.c. circuit with a .047 μfd., 500 volt ceramic unit. See diagram.

22H20, 23H22Z, 24H20, & 24H21

Poor vertical sync in weak signal areas.

The vertical sync may be improved by lowering the value of resistor, R_{15}, in the grid circuit of



the sync clipper (6BN6) from its normal 1 megohm value. Values as low as 10,000 ohms may be used. Too great a reduction of this resistance may introduce horizontal distortion into the picture on some signals.

Washed-out picture.

If this condition persists after all normal adjustments have been made, the cause may be low detector output due to a defective germanium crystal. Test the crystal with an ohmmeter for front-to-back resistance ratio (with the crystal disconnected). The resistance in one direction should be lower than 400 ohms, and at least 25 times this value, or 10,000 ohms, in the other direction. Any ratio less than 1:25 indicates a below-standard crystal.

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ARE YOU SATISFIED with the position you now hold? Do you feel you're worth more money? Are you pleased with yourself, your work, your associates . . . and your future? What does the next year hold for you . . . and the year after that?

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19K20, 19K22, 19K23, & 21K20

Ringing or white stripes in picture.

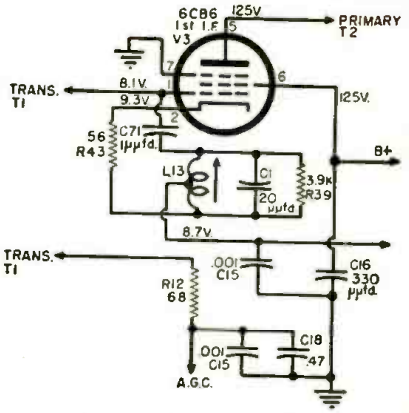
This condition can usually be corrected by re-adjusting the horizontal drive control, or by replacing the 6CD6 horizontal output tube.

In some cases it may be necessary to dress the peaking coil in the second video amplifier plate circuit, L_{22}, and the contrast and picture control leads as far from the sweep transformer cage as possible.

Also, insert a parallel network consisting of a 1000 ohm, ½ watt resistor, a .0047 μfd., 400 volt condenser, and a peaking coil (*Zenith* part No. S-17911) in series with the red-white lead of the sweep transformer.

Airplane flutter.

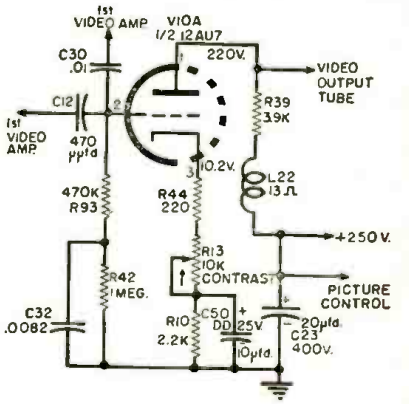
Rapid changes in signal level may be caused by signal fading due to



airplane reflections. To improve the a.g.c. action of the receiver to eliminate this flutter, replace the .47 μfd. condenser, C_{18} (see diagram), with a .047 μfd., 600-volt molded unit. In addition, make the change noted below under *"Horizontal pull."*

Picture flicker.

This may be caused by fluctuations in line voltage, and may be corrected by increasing the second video plate decoupling electrolytic



condenser, C_{23}, from 20 to 100 μfd. (See diagram.)

Horizontal pull on top of raster.

This may at times occur only with certain types of transmitted sig-

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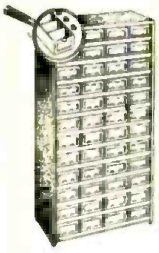

24 DRAWERS
12½" High, 12½" Wide, 6" Deep
72 COMPARTMENTS
STOCK NO. X-334
SINGLE, Ea. $7.95
LOTS OF 3, EACH $6.95

48 DRAWERS
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144 COMPARTMENTS
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BRAND NEW ALL-METAL PARTS CHESTS

Olson gives you a chance to load up on these famous make Parts Chests for less than HALF THEIR REGULAR PRICE. Case is heavy, welded Dura-Steel, strong and sturdy with handsome grey enamel finish. Drawers are ALL-ALUMINUM—1¼" deep, 2⅜" wide, 5¼" long. Each drawer has 2 removable sliding partitions. Index cards provided for insertion in card holder on front of each drawer.

Order your share while they last. Keep all those small things handy—such as Nuts, Bolts, Screws, Small Parts, Condensers, Resistors, etc. Chests may be assorted for quantity price. Shpg. wt. X-334, 9 lbs.; X-335, 18 lbs.

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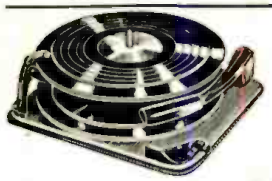
STOCK NO. T-113
SPECIAL PRICE WHILE THEY LAST
ONLY $7.95

Olson gives you first crack at these famous Rytel Reactivators at almost a 50% reduction. A Service Shop and Dealer Must. Give new life to those low emission picture tubes by increasing cathode current. For use on any size picture tube. Handsome black crackle metal case with full instructions. Make Money Rejuvenating Picture Tubes. Reg. Wholesale Price $14.95. Shpg. wt. 3 lbs.



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3-SPEED GENERAL INSTRUMENT AUTOMATIC RECORD CHANGER WITH GENUINE ASTATIC "TURNOVER" CARTRIDGE

Changes All Sizes—7, 10, 12" All Speeds—33⅓, 45, 78 RPM

HI-FI DELUXE MODEL

Equipped with "Turnover" cartridge and dual needle. One side for 33⅓ and 45 RPM discs and the other side for 78 RPM discs. Both sides equipped with precious metal long-lasting tips. Regular retail price $52.50. Shpg. wt. 15 lbs.

Stock No. RA-113

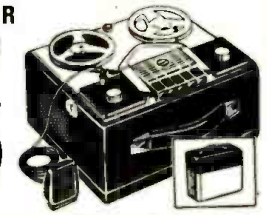
Single, each $22.99
Ea., Lots of 3 ..... $21.99

This General Instrument Record Changer has turned out to be Olson's ALL TIME BEST SELLER. For Good Reasons, too! It performs like the Pace-Setter it is—the smoothest running changer on the market today. Records slide gently down the spindle—no chance of damaging those valuable records. Simple to operate—because it is precision-built by craftsmen who have had years of experience, thus insuring years of trouble-free performance.

Changer may be connected to any Radio, TV or Amplifier. Clever "touch-plate" allows you to reject a record at will. Genuine Astatic "Turnover" Cartridge is included at this fabulous low cost. Of course they're Brand New, in original factory-sealed cartons, and guaranteed 100% by Olson and the manufacturer.

Operates on 115 Volts AC, 60 Cycle. Base size 12" x 12½". 5⅛" above plate and 3½" below.

ONLY WILCOX-GAY Recordio TAPE RECORDER with PREST-O-MATIC push-button keyboard gives Maximum performance for Lowest cost!



DUAL SPEED—Records at 1⅞" and 3¾" per second

STOCK NO. AMP-17

$99.50

Records for 2 hours on half of a 7" reel plus another 2 hours on other half at 1⅞" per second; and at the 3¾" per second speed you can record a full hour on each half of a seven-inch reel. 80-6000 CPS.

This is the famous DeLuxe Wilcox-Gay Recorder that retails all over the country for $179.95. Naturally they are all brand new, in factory sealed cartons and Guaranteed 100% by Wilcox-Gay and Olson.

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600 Ft. REEL	1200 Ft. REEL
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Single, ea. $1.49	Single, ea. $2.19
Lots of 10 ..... $1.29 each	Lots of 10 ..... $1.99 each

Get the buy of your life. Save up to 64% on high quality RECORDING TAPE. A large manufacturer had to sell his inventory and he unloaded the whole deal. Olson now offers you this high grade fully guaranteed recording tape at prices which defy competition. Standard ¼" wide. 600 and 1200 ft. lengths. Frequency response 50 to 8,000 cy. Plastic Reel included with each. Shpg. wt. ea. 1 lb.

RELAYS

CHOICE—ONLY $1.99 EACH

STOCK NO.	CONTACTS	OHMS	USE
SW-30	SPDT	30	6 to 12 V.
SW-41	SPST	3000	Plate Sens
SW-24	SPST	5000	Plate Sens
SW-29	DPDT	6000	Plate Sens

Made by Allied and Potter-Brumfield. Silver contacts. Size: 1¼" x 1½" x 2". Shpg. wt. each 1 lb.

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$41.97

CHOICE OF ANY MODEL

STK. NO.	MAKE OF CAR	YEAR MODEL
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RA-351	Chevrolet	1951-52
RA-142	Chevrolet	1953
RA-200	Dodge	1949-1950
RA-251	Dodge	1951-52
RA-124	Dodge	1953
RA-100	Ford	1949-1950
RA-151	Ford	1951
RA-152	Ford	1952

STK. NO.	MAKE OF CAR	YEAR MODEL
RA-144	Ford	1953
RA-451	Hudson	'48-49-50-51-52
RA-751	Henry J.	1951-52
RA-143	Mercury	1952-53
RA-200	Plymouth	1949-1950
RA-651	Plymouth	1951-52
RA-125	Plymouth	1953
RA-551	Studebaker	1950-1951-1952

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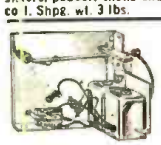

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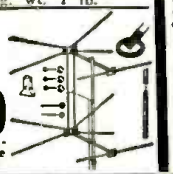

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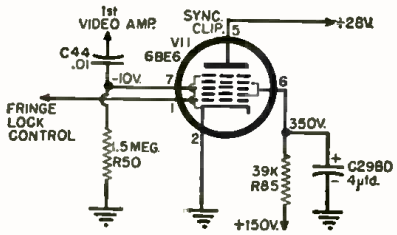
nals, or on some community distribution systems. To correct this



condition replace C_{44}, the .01 μfd. coupling condenser in the grid circuit of the 6BE6 sync clipper. (See diagram.) The new condenser should be a .0022 μfd., 600-volt molded unit.

19K20, 19K22, 19K23, 19K24, & 21K20

Picture shrinks horizontally.

This condition may be caused by an increase in value of R_{78}, the 150,000 ohm resistor in the plate circuit (pin 2) of the 6SN7GT horizontal discharge tube. To correct this, replace the resistor with another 150,000 ohm, 1 watt, 10% tolerance unit.

21K20

Arcing between 1X2A tube and adjacent components.

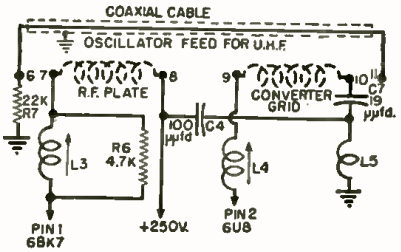
High-voltage breakdown may occur between the 1X2A tube and adjacent components (particularly the 6SN7GT horizontal oscillator and discharge tube) in areas of high humidity. To correct this condition, install a polystyrene corona shield around the 1X2A tube and socket assembly. The *Zenith* part No. for such a corona shield is 83-2102.

K SERIES TUNERS

Poor performance on u.h.f.

Poor performance on u.h.f. may be caused by excessive leakage in the coaxial cable which is used to inject the oscillator signal. (See diagram.)

To check this cable, switch the tuner to a v.h.f. position, unsolder the ground end of the 22,000 ohm resistor, R_{71}, and check for leakage, using the highest megohm



scale on a vacuum-tube voltmeter. If the meter shows anything but infinite resistance, replace the cable.

REMOTE CONTROL UNIT S-17268

Locking of the manual control.

This can be caused by failure of the worm drive gear to disengage, as a result of a weak solenoid armature actuating spring, or because of misalignment of the magnet mounting bracket. The mounting bracket may be aligned through the slotted mounting holes.

Excessive buzz.

This may be due to improper seating of the solenoid clapper plate on the magnet core. —30—

WORLD'S LARGEST TUBE WAREHOUSE OPENED

ELABORATE dedication ceremonies attended by civic and industry leaders of the Midwest marked the opening of the world's largest tube warehouse by General Electric Company.

Located at 3800 N. Milwaukee Ave. in Chicago, the new building provides two acres of warehousing facilities for industrial, transmitting, receiving, and cathode-ray tubes.

Laboratory, application engineering, and sales facilities are also housed at this new tube center.

Besides storage and office space and the laboratory, the building houses sections for tube testing and packing, a medical dispensary, and an employee's cafeteria.

Sheltered loading docks in the new structure provide space for loading five large truck trailers and four railroad freight cars simultaneously. —30—

Two views of the new G-E tube warehouse in Chicago. To the right are parts of the lab facilities while picture below shows portion of the huge loading area for handling all the tube shipments.

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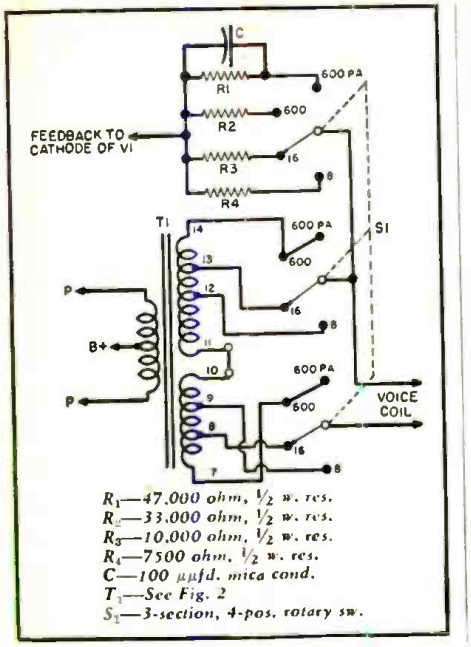
(*Continued from page 42*)

voltage is used for the voltage amplifier and driver stages as well as for the screens of the output tubes. An additional small choke (*Chicago* RS-1540) rated at 15 henrys and 40 ma. with associated condensers supplies additional filtering for these stages. Since there is sufficient power available, a 4-prong *Jones* socket is provided on the amplifier chassis to supply heater current and filtered plate voltage for a preamplifier. The power supply is protected by means of a 3 amp. pigtail-type fuse, wired in the primary circuit of the power transformer.

The builder should have little difficulty assembling and wiring the amplifier and power supply. However, a few suggestions here might help. Since the transformers have a relatively large area devoted to terminal space, they require rather large openings in the chassis. These can best be made by means of a circle cutter in a slow turning drill press. However, a hand brace could be used with the circle cutter to make these openings. Terminal strips should be used in convenient places to facilitate the supporting of the various small components. If the wiring is kept symmetrical, with approximately equal lead lengths on each side of the push-pull circuit, instability and hum problems will be minimized. Care should be taken in the grounding of the various leads so that hum pickup due to ground loops will not be encountered. Room should be provided near the output tubes for the placement of the balancing potentiometer R_{23} and jacks J_1 and J_2. The balancing potentiometer for the driver stage is mounted near its associated tube. The under-chassis view of the amplifier shows the placement of these units.

The schematic diagram of the amplifier shows only one output impedance provided. This was in the interest of simplicity for those who may have need for only one impedance. However, the BO-11 transformer makes available impedances of 8, 16, and 600 ohms and it can be connected so that impedances of 4 and 150 ohms can be obtained. The builder can modify this part of the amplifier to suit his own needs. One method of switching for various impedances is shown in Fig. 4. It will be noticed that separate feedback resistors are used for each value of output impedance. This could be eliminated by having the feedback come from one tap on the output transformer for every impedance used, but if good speaker damping is to be achieved, it is best to have the feedback come from the winding attached to the voice coil. It will be seen that two different positions are given for the 600-ohm impedance. One supplies a lower degree of feedback than the



R_1—47,000 ohm, ½ w. res.
R_2—33,000 ohm, ½ w. res.
R_3—10,000 ohm, ½ w. res.
R_4—7500 ohm, ½ w. res.
C—100 μμfd. mica cond.
T_1—See Fig. 2
S_1—3-section, 4-pos. rotary sw.

Fig. 4. Switching circuit for 600, 16, and 8 ohms. Fig. 2 is for 8-ohm voice coil.

other and can be used for public address work or some similar service where maximum feedback may not be as important as increased gain.

The adjustment of the finished amplifier is not difficult, but it should be carefully done. After a warmup period has been allowed, the bias voltage on the grids of the output tubes should be set to −45 by adjusting R_{23}. The four output tubes chosen should be as nearly matched as possible. The final balancing of the output stage is accomplished by means of R_{23}. The pentode sockets are left empty for this adjustment and a pair of triodes are tried. The current drawn by each tube can be observed by plugging a milliammeter into the jack associated with that tube. The potentiometer, R_{23}, is adjusted until the current drawn by each tube is equal. These tubes are marked and set aside while various other tubes are tried in the same sockets with the same settings of R_{23} until another pair which matches is found. One of these pairs is used in the triode section and one is used in the tetrode section. Of course the tetrodes could be balanced in their own sockets if the bias were changed or if a signal of sufficient intensity were supplied to the grids. However, the method here outlined works very nicely. If the circuit is operating properly and all voltages are correct, the current in each of the triode tubes will read about 55 ma. with no signal.

The driver stage can now be balanced. This is simple and consists simply of adjusting R_{11} until the voltage at each plate of the driver tube is equal when measured with a vacuum-tube voltmeter. A check can then be made on the signal balance of the amplifier, stage-by-stage, by feeding a sine wave into the input and measuring the signal voltage at each grid on each side of the circuit. This measurement can be made with the a.c. range

of a v.t.v.m. or with an oscilloscope. The oscilloscope has the advantage of showing the waveform as well as the amplitude. If all units in each side of the push-pull circuit are matched properly, this signal voltage will be the same on the grid of V_{2A} as on the grid of V_{2B}. It will also be the same on the grids of V_3 and V_4 as on the grids of V_5 and V_6. If such is not the case, it may be necessary to try different tubes in the voltage amplifier and driver stages until tubes are found, the sections of which are balanced.

The results obtained with this amplifier are very gratifying. In the first place, the hum level is extremely low—a condition which is necessary if good results are to be obtained. The frequency range of the amplifier extends to several hundred kilocycles, and is relatively flat to over 200,000 cycles. Sine-wave distortion within this range is undiscernable on the scope, even as maximum output is approached. The author does not have equipment for measuring intermodulation distortion, but listening tests indicate a pleasing clean quality, even at maximum output.

One interesting experiment was made in connection with listening tests. It was desired to observe the quality of radio music, and since no FM station was in the vicinity, a simple crystal detector was connected to a coil and condenser, giving very broad tuning. This was connected to the input of the amplifier and was tuned to the local AM radio station. The results were amazing. Both the highs and lows were reproduced in a very pleasing manner and, to the average ear, the results were comparable to those that would be obtained from an FM signal. It is realized that in such a signal the sidebands are cut, but with the broad tuning used, the effect was that of a fairly wide-band signal.

If the builder desires a high-quality amplifier and is not satisfied with the relatively low output of the average Williamson amplifier, it is strongly recommended that he try this "extended class A" amplifier. —30—

NEW TV STATIONS ON THE AIR

(As of August 25, 1953)

The following new stations bring the lists published in previous issues up to date.

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER (IN KW.)
Arizona					
Yuma	KIVA	11	198-204	4.93	29
California					
Chico	KHSL-TV	12	204-210	4.79	12
Los Angeles	KUSC-TV†	28	554-560	1.77	46
San Diego	KFSD-TV	10	192-198	5.08	316
Connecticut					
Waterbury	WATR-TV	53	704-710	1.40	245
Georgia					
Macon	WETV	47	668-674	1.47	20
Idaho					
Boise	KIDO-TV	7	174-180	5.61	51
Illinois					
Decatur	WTVP	17	488-494	2.01	17
Iowa					
Ford Dodge	KQTV	21	512-518	1.92	23
Kansas					
Wichita	KEDD	16	482-488	2.04	200
Louisiana					
Monroe	KFAZ-TV	43	644-650	1.53	25
Monroe	KNOE-TV	8	180-186	5.43	250
Minnesota					
Austin	KMMT-TV	6	82-88	11.8	18
Missouri					
Kansas City	KCMO-TV	5	76-82	12.74	100
St. Joseph	KFEQ-TV	2	54-60	17.8	52
Nevada					
Las Vegas	KLAS-TV	8	180-186	5.43	28
New York					
Buffalo	WBUF-TV	17	488-494	2.01	166
Oregon					
Medford	KBES-TV	5	76-82	12.74	19
Pennsylvania					
Easton	WGLV-TV	57	728-734	1.35	83
Harrisburg	WTPA-TV	71	812-818	1.21	175
Pittsburgh	WENS	16	482-488	2.04	89
South Carolina					
Greenville	WGVL-TV	23	524-530	1.87	17
Tennessee					
Johnson City	WJHL-TV	11	198-204	4.93	108
Texas					
Abilene	KRBC-TV	9	186-192	5.25	22
Longview	KTVE	32	578-584	1.70	20
Tyler	KETX	19	500-506	1.96	2
Virginia					
Hampton	WVEC-TV	15	476-482	2.06	200
Newport News	WACH-TV	33	584-590	1.68	20
Washington					
Tacoma	KMO-TV	13	210-216	4.65	120
Yakima	KIMA-TV	29	560-566	1.75	55
Wisconsin					
Oshkosh	WOSH-TV	48	674-680	1.46	1

*From Station CP application. †Educational, U. of Southern California.
The frequency of the video carrier = 1.25 + channel lower freq. limit.
Total number of television stations now on the air: 238 (67 of which are u.h.f.)

fixed bias offers several advantages over the conventional cathode bias provided that the cathode resistor is not intended to obtain degeneration. It should be noted that the greatest advantage of fixed bias is for class AB_1 push-pull amplifiers. When used in this type of circuit, fixed bias provides higher power output, increased stability, and reduced distortion for a given output tube plate current. A good example is a push-pull circuit for 2A3, 6A3, or 6B4 tubes. When fixed bias is used, the power output is increased by about 50% and the distortion is decreased by 50% for the same current rating. The fixed bias (Fig. 7) for the output tubes is obtained from the high voltage winding of the power transformer with a voltage divider, a selenium diode, and a filter network. There is no need to consider the loading effect on the high voltage transformer winding, since the additional current drawn by the grids of the tubes or the voltage divider is negligible.

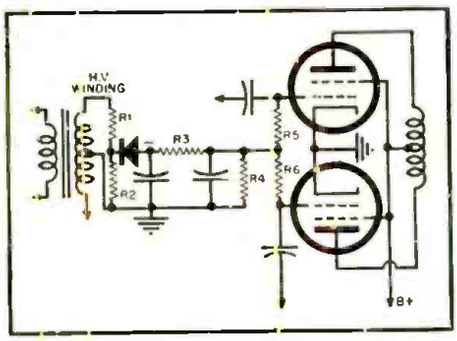
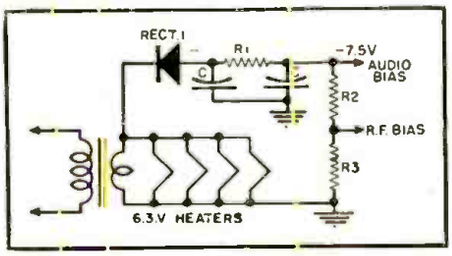


Fig. 7. Push-pull stage with fixed bias.

Fixed bias for the output and r.f. stages of an a.c. radio receiver can be simply accomplished by the use of a selenium diode and associated resistors and condensers. A typical example of such a circuit is shown in Fig. 8. The a.c. input to the rectifier network may be obtained from the 6.3 volt filament winding on the power transformer.

Because selenium diodes range in input voltages from 26 to 130 volts r.m.s., the number of bias voltages that can be provided is practically unlimited when proper voltage dividers are used. For another example, it may be well to note that the power supply of TV receivers can be simpli-

Fig. 8. Fixed bias supply circuit for audio stage and r.f. stages of an a.c. receiver.



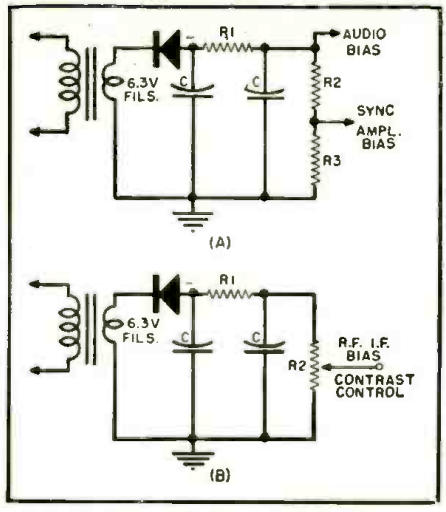


Fig. 9. Two TV circuits illustrating selenium diode applications. (A) In audio and sync amplifier bias circuits, and (B) in the r.f. and i.f. bias circuits of set.

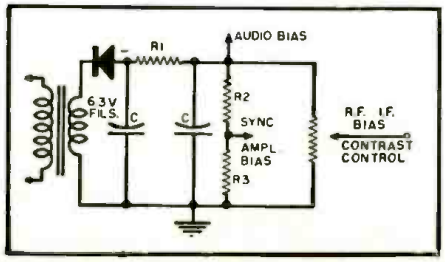
fied by supplying individual bias for the audio, synchronization, r.f., and i.f. stages. This is also desirable since it eliminates the possibility of load changes in one circuit affecting the other circuits which was often the case in earlier TV receivers. The circuits shown in Fig. 9 are two possibilities. On the other hand, they may be combined as shown in Fig. 10, depending upon the choice of the design engineer.

It is believed that the Type 5U1 selenium diode is the most versatile of the line. This unit is rated for a maximum input voltage of 130 volts r.m.s. and can consequently be connected directly to a 117-volt line for its source of voltage. It is obvious that this unit is ideal for use in equipment that does not have any transformer winding such as an a.c.-d.c. radio set. The circuit would be similar to Fig. 7. The resistance of R_1 plus R_2 should be on the order of 150,000 ohms or more.

For higher output voltages, several of these selenium diodes may be connected in series. For example, three Type 5U1 diodes connected in series can be used to deliver 300 volts d.c.

It is believed that the selenium diodes thus far developed have made available a series of new components to the design engineer for consideration in his future circuit designs. The examples given are merely intended as illustrations of a few such possibilities and it is hoped that they may stimulate the imagination and ingenuity of the circuit design engineer. —30—

Fig. 10. Biasing for four stages in TV set.



International Short-Wave

(*Continued from page 75*)

from 1100 to *after* 1830 in Arabic Service. (West) Cairo, 11.815, now appears to run to 1700 *daily*. (Bellington, N.Y.)

El Salvador—YSS, 9.555, San Salvador, good level with popular music 2250, closing 2300. (Morrison, R. I.; Boice, Conn.)

England—MSF, Rugby, has been *testing* for about one hour at 1800 on 2.500, 5.000, and 10.000; call-sign is given in slow c.w. followed by voice announcement and 1000-cycle tone; requests reports to The National Physical Laboratory, Teddington, Middx., England. (*ISWC*, London)

Ethiopia—*Radio Addis Ababa*, 15.050V, "Voice of Ethopia," some days at least has news 1315 followed by a commentary. Should close 1430. (Pearce, England, others)

Fiji—ZJV, 3.980, Box 163, Suva, states reports on *tests* have been received from as far away as Sweden, Norway, and USA; will stay on 3.980 for some time to come since is best frequency yet tested. Studios are in Cable and Wireless buildings, Victoria, Fiji Broadcasting Commission, 2 kw. on 930 kc., 500 watts on s.w.; schedule is now 1400-1600, 1900-2100, 0030-0500, Sun. *only* at 0030-0500; station staff consists of four members—manager, two announcers, and E. K. Broadbridge, technician-announcer. (Cushen, N. Z.) Excellent level in N. Z. on 3.980. (Hardwick) Usually is poor around 0300 in Australia. (Williams)

French Equatorial Africa—Brazzaville, 11.97, has news for Far East 1100. (Pearce, England) Heard with news 1550-1600; CWQRM. (Grace, Conn.) And at 1745. (Esser, Pa.) Good on 15.595 at 1430-1525 sign-off. (Saylor, Va.) Brazzaville noted calling Paris 0830 using 15.416; later played popular music; good level. (Catch, England) *Radio A.E.F.*, 9.970A, noted 1400 with call in French, then news in that language, closing 1524 with "La Marseillaise." (Pearce, England)

French Morocco—Rabat noted on *new measured* channel of 7.220 at 0730 in French, good level in Britain. (Catch)

French West Africa—*Radio Dakar*, 9.560, noted signing on 0200 after interval signal; call in French by woman, light musical recordings. (Pearce, England) Heard closing on this frequency 1715 with "La Marseillaise." Officials of *Radio Dakar* say *Radio Conakry*, French Guinea, operates daily 0715-0730 on the 40-m. band, no frequency given; that a *new* station is *Radio Cotonou*, Dahomey, no further details; that Dakar will have a *new* 30 kw. transmitter next year to replace the 12 kw. one, a 50 kw., and a 10 kw. tropical band station, that *Radio Abidjan*, Ivory Coast, may increase power to 20 kw. soon. (Scheiner, N. J.)

Germany—Stuttgart, 6.030, noted

0100 with call in German, then news in that language; Munich, 6.160, noted 0800 with news in German, also at 1200, and at 0100; Frankfurt, 6.190, has news in German 0100 and 1345. *Overseas Service,* Cologne, noted on 5.98 at 0830 with dance music, also with dance music 1700; with news in German 0100. (Pearce, England) This channel is used parallel 7.29 to North America 2030-2330. (Bellington, N. Y.; Morrison, R. I., others) Heard on 11.795 at 1700. (Scheiner, N. J.)

Holland—Radio Nederland by now should be using a *new* 19-m. channel, probably 15.245. (*ISWC,* London, others) Noted with news to North America 1645 on 11.73, 9.59, 6.025. (Zerosh, Pa., others)

Hong-Kong—ZBW3, 9.525, Victoria, heard 0515 with *English* session of recorded music. (Sanderson, Australia) Noted irregularly with news 0500. (Balbi, Calif.) Has newscast 0930. (Navarro, Philippines)

Hungary — Budapest noted with *English* 1600-1630 on 9.833, 11.91, 7.22. (Pearce, England) Mailbag session Sun.; reports requested. (Catch, England)

India—Delhi, 11.95, noted to West Indies 1830. (Catch, England; Niblack, Ind.) Has replaced 11.85 and has news 1930. (Bellington, N. Y., others) Delhi, 15.35, noted 0245 with news. (Sanderson, Australia)

Indo-China (Vietnam) — Radio France-Asie, 15.420. Saigon, is readable now around 0700 although some days has bad QRM from a N. Y. commercial phone station. (Bishop, Ohio) Heard well with news 0500. Also with news 2035 on 11.925. Heard on 9.745A at 0615 with French session of news, music. Hanoi, 7.405A, heard 0630 with French news and music, fair level. (Sanderson, Australia) "Voice of Vietnam," 9.620, Saigon, noted 0500-0630 in Vietnamese and *English;* good level in Tokyo. (Ishikawa)

Iran—EPB, 15.100, Teheran, has news 1500. Russian 1515, closes 1530 when clock strikes 1200. (Pearce, England, others) Has Turkish 1345-1400; Persian 1400-1430; German 1430-1445; French 1445-1500. (*ISWC,* London)

Israel—Tel Aviv, 9.010A, has news 1415; French 1430-1515, and "Voice of Zion" session in *English* 1515-1600 closedown. (*ISWC,* London, others)

Italy—Rome noted signing on with news 0400 on 17.80, 15.40, 11.905. (Pearce, England) Noted in *English* to North America 1920 on 9.575A. (Esser, Pa.) With news 2145 on 9.575A and 11.810. ("The Knob Twisters," Iowa) Is strong on 15.40 in Spanish 2020. (Niblack, Ind.)

Lebanon—Beirut, 8.036, noted 1600 in French, 1625A with news in Arabic, and closing 1630 with march (*not* "La Marseillaise"). (Pearce, England; Ferguson, N. C.)

Libya—Forces Radio Station, 4.785A, Tripoli, noted around 1400-1600 closedown, when gives time as "11 p.m.," and plays "God Save the Queen;" *announces* as 4.782 and says will return at "6:30 a.m." (2330 *EST*). Often has

BBC recorded features. (Pearce, England; Cushen, N. Z.) Uses 250 watts to a dipole running east-west; reports requested to No. 1, FBS, Tripoli, Middle East Land Forces, Libya. (*Radio Sweden*)

Luxembourg—*Radio Luxembourg* 6.090, noted 1700 with call in French, then dance music; another day at 1325 with news in French. (Pearce, England)

Madagascar—*Radio Tananarive* noted closing 1200 on Sat. and 1230 Sun. in Malgache program on 7.374A; uses "La Marseillaise" at sign-off.

Malaya—BFEBS, Singapore, noted on 11.82 at 1045 when gave frequencies of 15.435, 11.820, 11.955, 7.120; listed schedule at 1130 closedown as 0800-0900 on 15.435; 0915-1030, 11.820; 1030-1130, 15.435 and 11 820 for India-Pakistan; 0800-0815, 7.120; 0900-1130, 11.955 and 7.120 for Burma-Thailand. (Pearce, England) Is fair level on 15.435 around 1100 daily. (Boice, Conn.) *Radio Malaya*, 4.825, Singapore, heard 0615 with news, commentary, music. (Sanderson Australia)

Martinique—*Radio Amateur*, London, says Hardwick, N. Z., has "squeezed a QSL out of FNRI, Fort-de-France on 9.700, which is indeed another nice item for his collection. We are pleased to note that this station is at least still active on this channel." *Not reported as heard in USA for a long, long time!*

Nicaragua—YNOW noted on 6.077 lately up from 6.055, identifies in Spanish 0800; has QRM from YSC. 6.078. El Salvador; is on *before* 0730 and goes to 2300A. (Stark, Texas)

Northern Rhodesia—Lusaka sent schedule of 0700-1400, 4.826; 0700-1200, 7.220; 1215-1400, 3.914. (Pearce, England)

Norway—*Radio Norway*, LLG, 9.610, is good to Eastern North America 2000-2100; extends schedule to 2120A on Sunday when has *English* session "Norway This Week." (Ferguson, N. C., others) Heard to Western North America from 2300. (Niblack, Ind., others)

Outer Mongolia—Ulan Bator, 6.325, noted in N. Z. opening 0100 at weak level. (*Radio Amateur*, London)

Philippines—The Far East Broadcasting Co., Manila. "The Call of the Orient," recently observed its 5th anniversary; broadcasts to Asia, the Middle and Near East, and Europe in 36 languages now over 7 transmitters. (*Radio Sweden*) DZH9, 11.855, good, DZH7, 9.73, good 0315 with news. (Balbi, Calif.) DZH2, 9.64 noted 0500-0730 at good level; DZH3, 9.500, fair 0630-0800; 9 690, good at 0700-0830 in *English*. (Ishikawa, Japan)

Pitcairn Island—Scheiner, N. J., has received word that there is a *new* radio station on this island; was built by a New Zealander and transmitter is called the "Transarctic"; will use an Australian wind charger to provide necessary power; call will be ZBP and will use *English* with 500 watts power between 1.5-13 mc. on the s.w. band. *No further details.*

Poland—Warsaw noted with *English* 0130-0200 on 9.555 and 7.105A; with *English* 1730-1800 near 5.93; at 1200-1230 on 9.555, 7.175, and repeated 1230-1300 on 9.555, 7.145. (Pearce, England) Has quite powerful signal on 9.57 with *English* 1400. (Bishop, Ohio) Heard opening 1715 on 11.74 in *English*. (Bellington, N. Y.) On same channel with *English* 1945. (Scheiner, N. J.)

Portugal—Lisbon's *new* 11.835 channel noted signing on 1230 with news in Portuguese, parallel 11.99A. (Pearce, England) Good on 11.99A at 1622 tune-in. (Bishop, Ohio) Heard closing 1840 on 11.924 and 11.960 parallel, and separately on 11.996. (Catch, England) Heard to North America in Portuguese 1900-2100 on 9.745A (Zerosh, Pa.) And parallel on 5.973A. (Saylor, Va.) Verifies quickly now with a *new*, attractive QSL card. (Stenson, Sweden)

Portuguese India—Radio Goa at present operates on 6.025, 5 kw., 9.610, 10 kw., at 2100-1230, and on 557 kc., 2.5 kw., 0230-1430; shortly will also use 15.235, 17.795, 21.685; the 3.425 channel, 5 kw., is still used *experimentally*. (*WRH*)

Sao Tome—CR5SC, 4.807, noted with news in Portuguese 1545, closing 1602 with "A Portuguesa;" CR5SB, 17.677, noted *Sunday* 0700-0800 close-down. (Pearce, England)

Saudi Arabia—Djeddah, 11.845 and *near* 9.650, heard with interval signal 1030, signed on with march-anthem 1036; all-native. (Pearce, England)

Somalia—Radio Mogadiscio officials list the transmitter as an Imcaradio (Italian), 300 watts, with a doublet antenna, omni-directional, on 7.420 at 0445-0530 Italian; 0915-1015, 1100-1200 Somali; 1200-1300 Italian. (Scheiner, N. J.)

Switzerland—Berne, 9.665, noted at good level in *English* 1445. (Esser, Pa.) Heard closing North American transmission 2300 on 6.165. (Hathaway, Ill.) HEI5, 11.615, excellent level in N. Z. in Spanish 1930. (Hardwick)

Syria—Damascus, 11.910A, has news 1645 and 1715; off 1730. (Baetz, Ill., others)

Taiwan (Formosa)—BED4, 11.920, "Voice of Free China," Taipeh, noted 1325 with news, off with national an-

them 1500. (Pearce, England) Ishikawa, Japan, says is heard on 11.735 and 9.775A at 0400-0900 in Chinese, Japanese, *English*, good level. Sanderson, Australia, notes BED32, 9.778A at 0345 with Western music, Chinese news. Saylor, Va., recently heard BED26. 10.080, at 0100-0215.

Thailand (Siam)—Bangkok's HSK7, 11.910, noted 0515 with news and music, then Thai session. (Sanderson, Australia) By now may have *new* 50 kw. transmitter on air with *news* services to Europe 1700-1800), and to North America 2200-2300, in *English;* not known what frequency will be used, but possibly will be 11.700A. Plans a regional station set up soon, may have two stations in this service in operation next year. (Scheiner, N. J.)

Tangier—Pan American Radio. 7.405A, noted mixed with Athens (Greece) Forces Station to 1703, then in clear to fade-out 1745. (*N. Z. DX Times*) *Radio International,* 6.110, heard around 1600. (Alonso, Spain)

Trieste—The *British Forces Station* has an *experimental* transmission on 15.125 at 1100-1800. (*ISW,* London, others) Fairly good level in N. Y. (Legge) Heard from 1400 onwards. (Saylor, Va.)

USI (Indonesia)—Djakarta now uses 11.735 parallel 15.15 to Europe in *English* 1400-1500. (*N. Z. DX Times;* Pearce, England) The *Indonesian Air Force Station* still operates on 11.945 and is strong in N. Z. around 0500. (*Radio Amateur,* London)

Venezuela—YVKD, 4.890, Caracas, noted 1800 with news in Spanish, good level. YVLA, 4.780, Valencia, fair level 1815. (Catch, England) YVLK, 4.970, Caracas, is good in *English* session 1800-1900. (Kroll, N. Y., others) YVKF, Barquisimeto, noted on 9.510 at 2000-2030 with classical music; all-Spanish. (Middleton, Ohio)

Yugoslavia—Radio Yugoslavia, Belgrade, uses a *new* channel of 9.615A from 2230. (*N. Z. DX Times,* others) Heard with *English* 0130 on 6.100, 9.505; 1200, 6.100; 1315 and 1645, 6.100, 6.150. Mickelsson, Sweden)

Press Time Flashes

Etersvej, Sweden, reports transmissions from Katmandu, Nepal, begin at 2330, 0310, and 0830 on 7.370;

(*Continued on page* 156)

not confirmed. Radio Amateur, London, says a station announcing as Katmandu, has been reported *testing* on 9.856 in Hindi, Pathani, Tamil, and French around 0630.

ZL2, 9.54, Wellington, New Zealand, noted 0300. (Frazier, Texas) Heard over ZL9, 11.810, and ZL3, 11.780, from around 2250 to *after* 0000 with good level on former, fair on ZL3. (Baetz, Ill., others)

A *new* channel of *Radio Thailand* (Siam) is HSK9, 11.700, heard 0500 with news, music, good level in Australia. (Sanderson) May be the *new* 50 kw. transmitter.

The BBC, London, has been *testing* 0430-0800 on 15.390, 15.400. *(N. Z. DX Times)* According to announcement, by now the 1015-1030 news session from *Radio Pakistan* should be on 9.484, 5.990. (Pearce, England) *Radio France-Asie*, Saigon, Indo-China (Vietnam), *tests* to Europe on 11.950A at 1035-1100 in French, 1100-1130 in *English*; reports requested to Box 412, Saigon. *(Etersrep*, Sweden, others) *Radio Luxembourg's new* 50 kw. transmitter is in use on 6.090 at 0040-0930, 1045-1800, mostly in French. (Mickelsson, Sweden) When this was compiled, the VOA relay at Salonika, Greece, was scheduled with *tests* to Europe on 6.040 at 1245-1655; on 7.270 at 0900-1645.

Clandestine *Radio Espana de Independencia* still noted around 1750 with "news" in Spanish on 10.280. (Catch, England) *Radio Sweden* says *Deutsche Welle*, Cologne, the *German Overseas Service*, is on this *new* schedule—2030-2330, 11.795; 0530-0830, 15.275; 0930-1230, 1300-1600, 17.845; 1700-2000, 11.795.

Revised schedules of *Radio Pakistan's* External Service are 2015-2100, 11.885, 15.335 to Southeast Asia; 2315-2400, 15.335, 11.770 to East and South Africa; 0440-0600, 9.645, 15.335 to South Asia; 0630-0715, 15.335, 17.770 to Indonesia; 0830-0915, 11.674 to Burma; 1100-1200, 6.235, 7.010 with Afghan-Persian Service; 1215-1300 same channels with Iranian Service; 1310-1330 General Overseas Service (dictation-speed news in *English*), 11.650, 7.010 (or 9.645?); 1330-1430 same channels for Arabic Service; 1445-1530 to Turkey and 1530-1615 to the United Kingdom, 9.645, 11.650 *(Radio Australia*, others) Djeddah, Saudi Arabia, seems back on 7.255A again from 7.305AV; noted 2143; has QRM now. (Washington, N. J.) The Nicaraguan on 6.197A seems to be YNVP up from 6.185 and 6.188; announces "En Managua, Las Emisoras de Radio Mil;" has gone to 2335 sign-off. (Stark, Texas)

Zurich sunspot count predictions are—Sept.—15; Oct.—14; Nov.—13; Dec.—13. (Ferguson, N. C.) *Radio Hirondelle*, Hanoi, Indo-China (Vietnam), noted on 7.410A opening 0500 with news in French or Vietnamese to 0515, then Western music; starts to fade out by 0600. The *Thai Army Signal Corps Radio Service*, HSIJS, 4.875, noted daily 0630-0700 with weak signal in Australia; DZI7, 6.080, Manila, noted in *English* 0500 relaying DZMB; *Radio Peking's new* 12.620A channel noted in *English* 2200-2215 but with bad CWQRM. (Williams)

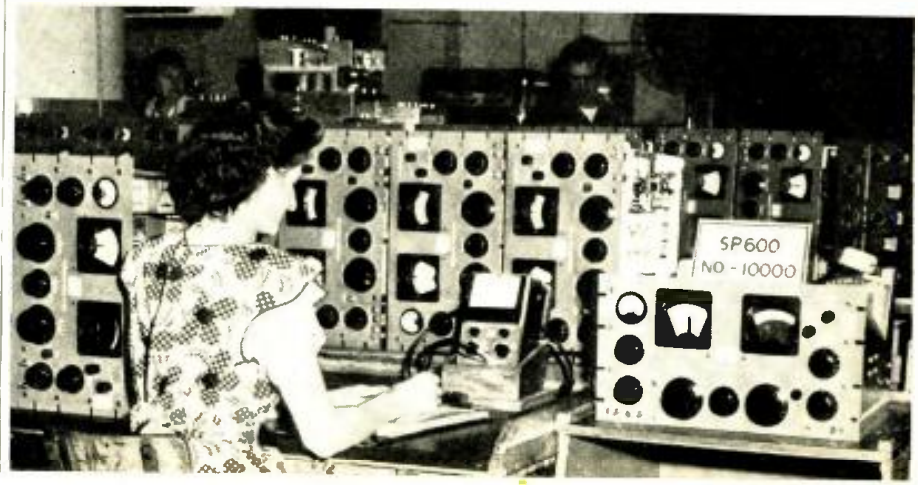
A *new* Brazilian station is *Radio Universidado do Rio Grande do Sul*, Porto Alegre, 3.944, with 1 kw. Port Stanley, Falkland Islands, is reported now on 580 kc. and 6.100 in addition to 3.440; further details desired; *not confirmed.* "Radio Liberation," Munich, Germany, heard on 15.105 at 1400-1415, with news in Azerbaidjani followed by an Armenian program 1415-1430. The Technical School of Istanbul, Turkey, *closed* its s.w. station in June and *probably will return to the air in October*, presumably on same channel—6.690. *(WRH)*

* * *

Acknowledgment

Thanks for your fine reports. Keep them coming in during the fall and winter DX season to Ken Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. ISW DEPARTMENT monitor's certificates will be sent to any contributor *free on request*. . . . . K.R.B.

The Hammarlund Manufacturing Co., Inc. of New York recently produced its 10,000th "Super-Pro 600" communications receiver. The receiver, which is in use by all the military services as well as by governments and commercial groups all over the world, has been in production since 1950. It is used in the Presidential Communications car.



an incredible range of orchestral colorings. From the opening snare flourish and sharply accented bass drum, through the wonderful pizzicati and xylophone of the third movement, to the tremendous tympani explosions and savage drum rolls of the movement called "Protest," this is a grand and glorious feast of transients! Believe me the "Protest" movement is well named. Watch your gain control or you'll find the speaker cone in your lap! With controls set for AES equalization, no touch up of bass or treble, cut or boost was required. Surfaces were exceptionally good, in spite of the super-wide dynamic range.

Musically, this is certainly the best thing Dorati and the Minneapolis have done to date for the *Mercury* "Olympian Series." Dorati is one of the best orchestral craftsmen around. His meticulously detailed reading of this complex score bears witness to this prowess. The orchestra responds sensitively to Dorati's deft direction, with sumptuous string tone and extraordinary percussion.

If you enjoyed "Spirituals" in the old Rodzinski version on *Columbia*, you will find this up-to-date recording superior in every aspect and well worth your investment.

WAGNER
SIEGFRIED'S RHINE JOURNEY and FUNERAL MUSIC and PRELUDE AND LIEBESTOD (from Tristan und Isolde)
The Pittsburgh Symphony Orchestra conducted by William Steinberg. Capitol "FDS" 8185, 33⅓ rpm, AES curve. Price $5.72.

Here are two standard "warhorses" brought up-to-date with *Capitol's* slick new "Full Dimensional Sound." I've always admired Steinberg's conducting, especially since hearing him do the Verdi "Requiem" at the Ravinia Festival in Chicago some seasons back. He is on familiar ground with the "Siegfried" work, and evokes some splendid sonorities from the orchestra. Soundwise, this is a very luminous "big hall" type of recording, very live and with sufficient detail to hold it together. Strings are very clean and percussion sharp and crisp. My only quibble is that the big climaxes seem to lack the punch and weightiness we associate with this music. Otherwise, this is certainly the best "Siegfried" at the present. In the "Tristan," Steinberg is competent and musicianly, the recording excellent. However, this score still seems to be the property of Stokowski, who has a way with this music, and whose recording remains unmatched.

WALTON
FACADE
LAMBERT
HOROSCOPE (Ballet Suite)
The London Philharmonic Orchestra conducted by Robert Irving. London

ffrr LL771, 33⅓ rpm, London ffrr curve. Price $5.95.

London has just issued a spate of music by English composers in what they call the "Special Commemorative Coronation Series." In spite of this mouthful, this is a very noteworthy collection of the works of some of England's most highly regarded musical talent. The disc here reviewed is the one most likely to appeal to hi-fi fans. The Walton "Facade" is racy, impudent music, chock full of the things dear to the audiophile's heart. Snarling snare drums, bells, and triangles in profusion, really high register flutes and piccolo, and in one section some wonderful castanets. A superb job of recording. The only thing I missed was the fantastic and amusing poetry of Edith Sitwell, for whom Walton wrote this music. However, many will prefer this orchestral version over the difficult-to-follow edition with the spoken words. Lambert's "Horoscope Ballet" is a frothy trifle, very pleasant to listen to and with enough dissonance here and there to make it interesting. Sharp, brilliant recording, especially fine woodwind playing. Robert Irving conducts both of these works with a sure and knowing hand and gets the best from a good orchestra.

VAUGHN WILLIAMS
A PASTORAL SYMPHONY

The London Philharmonic Orchestra conducted by Sir Adrian Boult. London ffrr LL721, 33⅓ rpm, London ffrr curve. Price $5.95.

Another disc in the "Special Coronation Series," this is a notable "first" for *London*. Those who have patiently waited over the years for some enterprising company to give them a recording of this great work will rejoice in the splendid job that has been done. Very frankly, this is not the kind of recording preferred by the hi-fi crowd. There are no tricky effects, no bombast. There is, however, a very wonderful recording of a most unusual work. The score has a strange and mystic quality, a sort of "other worldliness" which even the most hardened hi-fi fan can't fail to be interested in and attracted to. Sir Adrian is thoroughly at home with Vaughan Williams and his reading is powerful without being pedantic. Silken string tone, some huge sonorities and a quiet surface add to the attractiveness of this "off-the-trail" disc. Well worth your attention.

EDITOR'S NOTE: *This new column is presented as a "bonus" to our audio readers. It will be continued and expanded in scope if reader interest indicates a demand for this type of review. Your letters, either "pro" or "con," will be appreciated and will serve to guide your editor in the conduct of this department.*

May we have your comments? —30—

MIDWEST RELAY

A. T. & T. has announced the completion of a new radio-relay system between Chicago, Milwaukee, and Minneapolis.

It will provide 400 additional long distance phone circuits and a TV channel between Chicago and Milwaukee.

ELECTRONIC FLASH PROJECT

CAPTAIN J. E. BROYLES, F. E. Warren Air Force Base, Wyoming, has reported on the success of a building project undertaken by the personnel responsible for the operation of the MARS amateur radio station at the base.

The group built the electronic flash unit described in the March, 1953 issue of RADIO & TELEVISION NEWS ("Build This Electronic Flash") and are so enthusiastic over its performance that they sent in a photograph of the completed unit.

According to Captain Broyles, the flash is housed in a mahogany box no larger than a lady's "cosmetic case." The cabinet contains both the battery pack and the a.c. power supply. The group had to make a few changes in the circuit diagram as printed because of the unavailability of parts. They used three 75 ma., 125 volt selenium rectifiers in place of the two 20 ma. rectifiers specified in the original parts list. They substituted an NE-51 neon lamp for the NE-1 shown and added a 2 amp. fuse in the primary of the power transformer.

The cabinet was built with the side width slightly less than the front width with the depth about the same. The internal parts are accessible by means of a hinged cover which is fastened by a brass trunk-type lock. Both switches and the fuse holder are conveniently located on the front. The indicators, the a.c. light, and the neon lamp are located on the top of the hinged lid. The back of the box carries the two parallel plugs wired for the flash lamp and an extra unit which can also be used. In addition, a plug is provided to connect the two-wire connector that goes to the synchronizing switch on the camera. —30—

Airman George A. Lehmkuhl poses with the electronic flash unit constructed by the MARS station (K7FAO) group at the F. E. Warren A. F. Base in Wyoming. The reflector is a standard Kalart flash modified slightly to take the 4-prong plug and flash lamp. The camera Mr. Lehmkuhl is using with the electronic flash is a Leica.

Tape Recorder Counter

(*Continued from page 51*)

inch brass rod. Twelve-inch lengths of solid brass rod are a standard radio hardware item at any parts jobber.

Assembling the Counter

The spring is first assembled to the rubber bulb. The end result of this operation is seen in Fig. 1. The easiest way is first to select a screw which can be driven into the end of the spring, using the coils of the spring as threads. Then pierce the closed end of the bulb as near the exact center as possible. Push the screw through the hole, with the head of the screw inside the bulb; use a washer if the screwhead is not large enough to insure that it won't itself come through the hole.

Next place a good-sized nut, or a washer and a nut, on the screw, over the top of the rubber bulb. At this point we should have a bulb with a screw firmly fastened into it, threads pointing up through the top. Now fasten the spring to the screw by threading its end over the screw threads and tightening. A little *Duco* cement spread around the top of the bulb and allowed to dry will avoid any possibility of the arrangement coming apart.

Attention goes now to the brass rod and the counter. Fig. 1 shows how the assembly will be mounted. Select the mounting point and dimensions for the particular recorder first. With the *Concertone* the lower end of the rod was simply pushed into a ¼-inch hole in the edge of the wood case and the over-all rod length is 8½ inches. Use a ruler, or preferably a metal measuring tape, to figure over-all length once the rod has been bent, so that the counter at the rod's end will sit about 2 inches above the upper face of the take-up reel and about 1 inch from the center of the spindle. Then cut the rod to this length, locate the bending point, and bend the rod in a vise. Bend it gently, using if possible a round-edge piece of stock in the vise so that the bend has a good, big radius. This rod can be broken.

Placing the counter experimentally on the inner end of the rod, determine the best angle from which to view the numbers. Then mark the rod and drill two holes at this angle by which to mount the counter. The counter skirt has two holes tapped for 4-40 screws and they can be used as is if available screws are just long enough to come flush with the skirt surface when fed through from the bottom of the rod. The writer did it the other way, however, drilling out the threads and threading the brass rod holes for 4-40 screws which were placed through the top. If taps are not at hand, drill ordinary holes and use lockwashers and nuts under the rod to hold the screws.

Now mount the rod-counter assembly. The easiest way is that shown —simply a ¼-inch hole in the wood case, into which the lower end of the rod is pushed. This also allows the rod to be swung out of position if necessary, without demounting it.

The inner diameter of the spring should, if possible, be slightly less than the outer diameter of the counter shaft, so that the spring can simply be pushed over the shaft. If the spring is too large, make a sleeve to fit over the counter shaft. A little tape or thin metal or foil is usually sufficient. There will be no occasion to remove the spring from the counter so it can be made solid by any necessary means.

The assembly is now complete. After a take-up reel is in place on the spindle, the counter is engaged by pushing the rubber bulb down over the spindle end. When the reel is to be removed, just pull off the bulb, and let it dangle at the end of the spring.

On the *Concertone* the center hole of the plastic NARTB reel adapter was countersunk about 1/16 inch with a half-inch drill; this revealed a little more of the spindle for better seating of the rubber bulb. The same can be done with adapters or reels on other machines if it is an advantage.

Using the Counter

It is desirable to be able to locate a given point on a reel of tape by winding to the same counter number no matter how many times the reel is removed from the recorder and replaced. Therefore, we set up one rule of procedure which works as follows:

Place the full reel of tape on the supply spindle or adapter. Thread the end into the notch of the take-up reel. Now give the take-up reel one counterclockwise turn by hand, reaching the point when the second layer of tape just begins. At this point stop the reel. With the counter at 0000 place the rubber bulb over the take-up spindle. Then begin operations. This insures that the zero count is always just at the same point on every tape and on a given tape every time.

The bulb should remain on the spindle until the end of operation when the supply reel is again full and the counter back to zero. In this way it always indicates exactly what section of tape is against the heads, since it travels with the tape in forward and reverse operation as well as in fast forward and rewind. If the take-up reel is to be removed when full, as is true when using both tracks of most dual-track machines, the counter will be far from zero. Either omit to use the counter in these cases or first rewind the reel, disconnect the hub, then get the tape back to the take-up reel with fast forward.

The ideal way to connect a counter would be so that each count would indicate a specific length of tape. This would mean connecting it to the capstan, in which case it would fall out of step on rewind and fast for-

ward, or using a separate roller, which would create the danger of wow and flutter.

The present method of connection—to the take-up reel—means that the count is not proportional to tape length. At the start each turn of the take-up reel pulls a rather small amount of tape. Toward the end of the tape, when the effective outer diameter of the reel is rather large, each revolution takes up a much larger length of tape.

The "Timing Chart" of Fig. 2 allows the operator to time selections by using the counter, despite this nonlinearity. It is calibrated for use with an NARTB take-up reel or hub and for speeds of 7½ and 15 inches-per-second. The horizontal axis is calibrated in take-up reel revolutions as indicated on the counter; the vertical axis shows time in minutes. Both calibrations are repeated along the curve to save time and temper in tracing graph lines back to the axes.

Suppose a selection is to be timed. The beginning is located on the tape and the counter number recorded—suppose it is 100. Then the end of the selection is found and its counter number jotted down—say 650. Assuming the tape speed was 7½ inches-per-second, reference to the chart shows that 100 is equivalent to 3 minutes and 650 is equal to 22½ minutes. Subtracting 3 from 22½, we find that the time for the selection is 19½ minutes.

The counter is useful for purposes other than timing. Sometimes, for example, several selections are on a tape but only some of them are to be transferred to a disc. The usual procedure would be to edit the tape by cutting and splicing. This waste of time and tape can be avoided merely by noting the counter numbers at the ends of the wanted selections and the beginnings of the following desired selections. When dubbing to disc, the gain controls are closed when the first selection ends, the tape is rolled fast forward until the counter indicates the next desired selection is ready, then recording resumed. With a little practice the "dead air" during the forward roll is at a minimum. Broadcasters will also find the counter useful for cueing and for timing, all without the necessity of cutting and pasting tape.

For a very small investment of time and money, the counter saves a good deal of wear and tear on nerves and temper, and opens up new fields for every tape recorder owner.

—30—

IMPROVING INTERCARRIER SOUND SYSTEMS

By CHARLES ERWIN COHN

THE usual intercarrier sound system used in low- and medium-priced TV sets comprises a pentode driver stage followed by a ratio detector feeding the audio amplifiers, with the ratio detector being depended upon to eliminate the AM impressed on the sound carrier during the intercarrier heterodyning process. However, since the limiting properties of the usual ratio detector are far from perfect, some buzz is unavoidably present. What is needed to eliminate this is positive limiting action in the driver stage, which can be provided by replacing the pentode driver with a 6BN6 limiter, as shown on the accompanying schematic.

The 6BN6 gated-beam is usually used as a combined limiter and discriminator, but if the existing ratio detector is in satisfactory condition there is no reason to replace it with the full 6BN6 circuit. Therefore, this tube is used here as a limiter only.

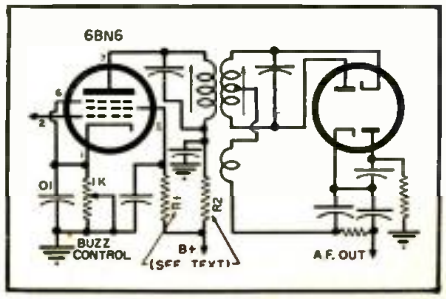
On the schematic, all unlabeled components are those which are already in the set, so only a few new components are needed. It is necessary to add a 1000 ohm potentiometer for buzz control, which must be mounted on the rear of the chassis where it is accessible for adjustment. The screen and plate dropping resistors R_1 and R_2 may also have to be changed to apply the correct operating voltages to the 6BN6. R_1 should be sufficient to keep the accelerator voltage at 100 volts or less at a current of 10 ma. For example, 2200 ohms is a good value for a 120-volt supply. R_2, however, serves only a filtering and decoupling function since the plate voltage rating is high, and thus should be around 1000 ohms or less. All grid leaks and condensers are removed, so that the grid can have a d.c. path to ground through the take-off coil.

The grid input (terminal 2 of the 6BN6) goes to the sound take-off coil in the TV set.

Alignment and adjustment are simple but, like all intercarrier alignment, should be done with an actual TV signal to insure accuracy. The ratio detector transformer is aligned in the usual manner, after which the signal is attenuated by some means until it is below the limiting threshold and noise appears. Then the sound take-off coil is peaked up and the signal then restored to normal. The buzz control is then adjusted for minimum buzz. Since the optimum adjustment of this control depends on signal level, it should be adjusted under operating conditions on the worst channel.

This circuit will do an excellent job of eliminating buzz, and is also effective on impulse noise. However, it will not be effective on signals which are below the limiting threshold, nor will it eliminate excessive downward modulation. Due to its improved properties, it might also be an effective circuit for use with FM receivers and separate-sound TV sets. —30—

A simple circuit change for intercarrier television receivers which provides positive limiting action in the driver stage.



Hearing Aid

(*Continued from page 47*)

When a 22½ volt "B" battery is used, adjust the bias by connecting a 5000 ohm, ½ watt shunt resistor between "A—" and "B—" (effectively shunting the 1500 ohm bias resistor for the output stage).

The penlight cell used as an "A" battery may be replaced with one of the newer mercury cells, either to obtain a more compact layout or to obtain longer battery life (depending on the size mercury cell chosen). For the maximum in "A" battery life, use the *Mallory* type RM-1200 cell.

If the reader desires to achieve the most compact design feasible for easy home construction, it is suggested that the following modifications be made, and that the smallest case which will hold the various components be obtained. (1) Omit tone control circuit; (2) Use transformer output with a *UTC* type SSO-4 transformer; (3) Use a 15 volt "B" battery (*Burgess* U10); (4) Use a *Mallory* RM1000 "A" battery; (5) Use the smallest microphone available to the builder; and (6) Omit the output jack and wire the earset directly into the circuit.

Centralab recently announced a new 3-stage printed circuit amplifier which is even smaller than the type PC-200 used in the model shown. The use of the later version would permit an even further reduction in over-all size. However, the author was unable to obtain one of these newer amplifiers, even after contacting a number of distributors, and it appears likely that the PC-200 will be the most readily available unit for some time.

In this article, the author has presented the information necessary for a skilled technician to assemble a basic hearing aid; however, *no individual should indiscriminately build and use a hearing aid without competent medical advice*. Whether or not a hearing aid is required should be determined by a *physician*.

In operation, the tone control is generally adjusted so that speech is intelligible or so that music and other sounds seem realistic to the user. The volume control is adjusted to provide the minimum gain necessary for adequate volume and sensitivity; the "ideal" setting is where the individual's hearing, compensated by the amplifier, becomes normal. With this adjustment, there is a minimum of "blasting" from loud sounds, yet good sensitivity is maintained.

Often, where the individual's hearing with one ear is much weaker than with the other, the earpiece is placed on the weaker ear so that the hearing aid acts to bring the weaker ear up to "normal."

While battery life is fairly long due to the low current requirements of the subminiature tubes, their life may be extended even further by turning the unit "off" whenever it is not needed for long periods of time. —30—

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

THE one thing about TV service on which everyone is agreed is that independent service badly needs a dynamic public relations program to remove the fog that beclouds it in the eyes of the average set owner. The public, reading about TV service gyps, assumes that all service businessmen are shady characters who leech a living from those who own TV sets. "Just imagine," said one set owner indignantly to her neighbor, "these TV service people want five dollars just to come out and see what's wrong with our set!" Talk to the next fifty average TV set owners you meet and you will find they all harbor the same feeling.

Day after day, TV technicians working on home service calls take a terrific pounding from set owners about service charges. While it's easy to talk about being nice to customers who speak caustically about service and its costs, it is difficult for a technician to match wits with the vagaries of TV circuitry and with consumer ignorance and consistently maintain a pleasant decorum. It is understandable that customers who have bought "lemons" will sometimes trigger the resentment in a service technician and get told what kind of a set he thinks they bought.

Regardless of who is at fault, it is known that TV set owners are inclined to expect more service out of sets than was built into them in the first place. They have been misled on the need for service and misinformed on what they should expect to pay for competent service when it is needed.

This all adds up to a public relations (PR) job of first magnitude and one that should be of concern to every segment of the industry.

The recognition of the need for a major public relations job in the interests of TV service quite naturally brings up the subject of how it can best be accomplished. Some people feel that an immense program should be launched on a national scale. This idea, however intriguing, fails to take into account the two most basic factors of the problem. The first of these is that any effective public relations program, to be successful, must be geared to the peculiarly local needs of every TV area. The second factor is the prohibitive cost of a national program that could be localized to meet metropolitan and urban requirements.

Service executives who have studied this problem have reached the conclusion that the best initial attack on it should be made at local or sectional levels. At the present time there are several excellent national campaigns underway sponsored by individual manufacturers, but it has been obvious to service businessmen that even these programs would accomplish little if they are not bulwarked by effective local level public relations programs.

However, regardless of whether you plan a local campaign or a national program, it costs money to do the right kind of a PR job. The question always arises, "Who is going to foot the bill?"

In an attempt to find a workable answer to the problem of financing a badly needed PR program in the greater Chicago area, a group of service operators got together earlier this year and formed the Greater Chicago TV Service Industry Committee to develop a PR program and to find some way to finance it.

A Service PR Program

In Philadelphia, where the Joint Electronic and Radio Committee on Service (JERCS) has been functioning effectively for several years, a sound method for raising funds to finance an effective PR program in the interests of service has been evolved.

The Philadelphia committee is made up of representatives of all segments of the industry in that area. Although there are several organizations in that city whose members are engaged in TV service, practically all of these groups cooperate whole-heartedly in the JERCS planning and in following through to help make selected programs successful.

The basic merit of the JERCS fund-raising program is that it provides an opportunity for all elements of the industry to participate, and for each participant to gain some definite promotional value in return for his cooperation.

The Joint Committee has developed

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a consumer show which will be given in the Convention Hall in Philadelphia next November. The show will feature prominent TV stars and perhaps recording artists whose services will be made available by the television manufacturers who sponsor their programs. Income from the show will be derived from the sale of admission tickets.

Interest in the show will be built to a high pitch through the use of tickets by set dealers and service operators who will purchase blocks of tickets and use them in special business promotion programs during the Fall months. Dealers will plug the show in their TV receiver newspaper ads and service businesses will promote it in their advertising and direct mail campaigns.

The JERCS program is being handled by Paul V. Forte, an experienced public relations counsel. It is directed by a committee comprised of representatives of the set distributors, parts distributors, set dealers, service dealers, and electronic technicians with the cooperation of manufacturers' representatives and manufacturers in the Philadelphia area.

It is the JERCS' plan to employ the proceeds from this show to carry out an expanded public relations program in the interests of service during the 1953-54 season.

Which Way U.H.F.?

There has been a lot of loose, uninformed talk lately about u.h.f. going down the road to oblivion in the wake of FM. All of this seems to come from areas where u.h.f. pictures have had to compete with good, established v.h.f. service. It fails to take into consideration that u.h.f. has gotten better consumer acceptance in new TV areas than v.h.f. was accorded in its early days.

Of course, u.h.f. has not proven to be the business bonanza that every one hoped it would be and it didn't keep the industry from going into the usual seasonal doldrums when summer weather set in. Perhaps this experience with u.h.f. will finally teach us that "boom" business in television is definitely a thing of the past; that new developments will merely represent a slow, orderly expansion of the industry without boom proportions.

Unfortunately, many of the people who have much to gain from a growing acceptance of u.h.f. on the part of the set owning public in their areas have retarded that acceptance through their uninformed, negative statements about it.

Manufacturers, broadcasters, dealers, and service people all have much to learn about u.h.f. and its peculiarly individual requirements to produce good TV pictures. Many dealers have killed interest in u.h.f. by telling customers interested in converters that they wouldn't recommend them—they would only recommend new sets already equipped to tune u.h.f. stations. Many people do not want to trade sets

now—they feel that color television will be available soon and when they trade they will want a color TV receiver—but they would like to buy a converter for the present set to receive a newly added u.h.f. station. A negative attitude on the part of a dealer toward conversions will not sell a new dual set and it may certainly kill the customer's interest in u.h.f.

The u.h.f. broadcaster's biggest problem is to build up a viewing audience as rapidly as possible to be able to get top programming. Where v.h.f. broadcasters are entrenched, they are going to do everything in their power to hold back, if not kill, that competition for their TV audience.

From a purely selfish standpoint, the service industry stands to gain most by helping to *sell* every new TV service that is offered. The sale of a converter means another service possibility in the user's home—a bigger market for service.

The pattern of interest in u.h.f. among service dealers and technicians is following that of the early days of v.h.f. Service people do not take a really active interest in u.h.f. until a station is practically on the air and then there is a mad scramble to learn something about it. This has resulted in independent service having to share the responsibility for the troubles of u.h.f. as reported in all of the surveys of present u.h.f. markets.

There is no reason why a service businessman cannot develop a high degree of proficiency in his technicians on u.h.f. long before they have to work with broadcast programs and sets in the customers' homes. Many simple devices can be easily built that will enable technicians to work with signals in the u.h.f. band to check antennas, transmissions lines, and converters. With all of the equipment and information currently available, service people should be *right on top* of this whole u.h.f. problem.

Color Television

Late in June, *RCA-NBC* filed a petition with the FCC for approval of their compatible color television system. The industry-wide group, the National Television Systems Committee, completed their report and filed their petition with the Commission a short time afterward. Since the technical standards proposed in both petitions are said to be identical it is generally felt that the FCC will set an early date for hearings that will result in the acceptance of this industry-endorsed compatible color TV system by the first of the coming year.

Industry opinions vary considerably as to the length of time it will take to get color television receivers into large scale production.

RCA, which is the most optimistic, anticipates the production of only about 2000 tri-color tubes per month, six to nine months after standards are set by the FCC. While it is expected that imminent prospects for color television will slow down sales of new sets

in all TV areas, this would not become a really serious problem if the TV retail industry will become sales-minded and sell the product as it can and should be sold.

The decided advantage of the NTSC system is that it is completely compatible with the present monochrome system. No one who now owns a TV set will have to discard it when broadcasters change to color telecasting. It will accept the color TV signal and produce a better black-and-white picture from it than is now available from the average telecasting station. There is a very simple reason for that. The basic signal in a colorcast under the NTSC standards is a high resolution monochrome interpretation of the picture. Color is added by a second signal which is fitted into the present 6 mc. channel. Color information is interspersed between the black and white picture information. Present TV receivers will accept the high resolution monochrome part of the signal but will reject the frequencies that represent the color information. The result is a very fine black-and-white picture on present sets from an NTSC system color telecast.

TV service technicians could render a signal service to the entire industry if they would present the color television story properly to the people who will be asking them about color TV. Most set owners are greatly influenced in their feeling about what to buy and what not to buy in TV sets or equipment by the information they get in reply to questions they put to the service technicians who call to fix their sets. As the *RCA* and NTSC system moves toward acceptance by the FCC it will undoubtedly get increasing attention in the daily papers and, of course, feature writers will have a field day writing articles on it for the consumer weeklies and monthlies. Set owners will be interested, of course, and there may be a tendency toward wanting "temporary" repairs to failing TV sets because the owner thinks he may soon be able to trade the old one in on a new color TV receiver. The public is like that. They skimp on automobile maintenance and repairs for a year in anticipation of trading the old jalopy on a new model.

What should a TV technician say to a set owner who inquires about color TV and how soon it would be available?

The best thing, of course, is to tell the truth. The truth in this instance would be phrased like this:

"Mr. Set Owner, no one can tell you for sure when you will be able to buy a color television receiver at a price you would be willing to pay. Color is the glamor phase of TV but to add that glamor a great many very complicated production problems must be solved.

"But there is one thing that color television broadcasts will do for you on this very fine set you now own. They will give you the best black-and-white pictures you ever have seen on this set. And you won't have to spend a cent to get those extra good pictures on this set.

"In a few years perhaps, color television sets will be sold at a reasonable price and then I'm sure you will want to buy one. But even then, you will probably want to keep this set as a second or spare set to use when your more complicated color set is tied up for service."

Customer Relations

Many parts distributors perform a real service for their service customers by sending out a locally prepared news bulletin in the form of a house organ. Where the news is prepared by competent local writers it usually carries a fast analysis of national developments that have a special significance in the distributor's local market. This monthly house organ also serves as a showcase for products the distributor has stocked for special sale that his service customers might not otherwise have known about.

One of the most informative house organs of this type is the *"Almo Broadcaster,"* a monthly four-page bulletin mailed to its customers by the *Almo Radio Company* of Philadelphia. This company, headed up by Morris Green and Al Margolis, is a merchandising-minded distributing firm that now operates eight stores located in Pennsylvania, New Jersey, Delaware, and Maryland.

The news features of the *"Almo Broadcaster"* are written especially for it by competent writers. A typical example of the timeliness of its articles is the following story prepared by Paul V. Forte about *G-E's* summertime service business program based on a contest:

"General Electric is running a contest for service operators. All you have to do, in fifty words or less, is tell the company how you would spend $2500 to improve your service business and, presto, you may get a check in that amount from *G-E* to do so. Of course, the fifty words go on a special blank which you pick up at your *G-E* distributor, usually with the purchase of *G-E* parts or equipment.

"To my mind, this is a wonderful contest, even if you don't win the main prize or one of the numerous lesser ones. The mental exercise it should give every service dealer and operator is something he should undertake, whether *G-E* gives a prize for it or not. After all, there's the bigger prize of getting more and better television service business which a lot of service people could use right now.

"Since I am not a service dealer or operator, I have no right to be in the contest. However, I have this little space in the *'Almo Broadcaster'* and, with no hope of winning any prizes, I'm going to tell *G-E* what I would do with that $2500.

"First, I would recognize that any kind of service business is based on the extent to which the public has confidence in me, my company, and the company which I keep. I would surround myself with name brands and ride the coattails of name brand national advertising. I would obtain, imprint with my own name, and distribute all the literature that name brand manufacturers are constantly making available.

"Second, I would spend part of that $2500 to provide myself with adequate but economical addressing and mailing machines, place the name and address of every TV owner I could locate on plates, and proceed to make Uncle Sam my best salesman *via* the post office. My mailing would go out regularly and be interspersed with mimeographed special offers and observations on the intricacy of television, as well as its need for expert service of the kind I offer.

"Third, I would get thousands of copies of *'Service Management's'* national average price chart, with my imprint, and send them out to every customer before his next service call. I would attach one to every bill that I render and, in this way, persuade the customer to understand and accept fair prices for honest, high grade service and parts.

"Fourth, I would become an active member in my local TV service association and work hard to help it do the job, in behalf of myself and my fellow businessmen, which I cannot do as an individual. I would recognize that the public is quick to accept the service operator who can be readily identified with a code of ethics in association with other responsible operators.

"Fifth, I would be my own best public relations man and become a member of every possible civic organization in my community.

"Sixth, I would, of course, back this all up with the best in service personnel and equipment that is available.

"There it is, *G-E*. We'll be interested in hearing who wins the big prize." —30—

NETWORK FACILITIES

FIVE years ago the Bell System opened for commercial use 916 miles of television channels to provide network service to twelve stations in five cities.

These facilities have now been extended to some 34,000 channel miles enabling more than 130 stations in 87 cities to receive live network television programs. Another 13,000 channel miles will be added to the system between now and the end of the year.

Both coaxial cables and microwave radio-relays are used to provide the network service. —30—

NEW YORK AUDIO FAIR

MORE than 20,000 music lovers, audiophiles, and sound engineers are expected to attend this year's Audio Fair to be held at the Hotel New Yorker October 14, 15, 16, and 17.

Paralleling a new high in attendance will be a record-breaking number of exhibitors, more than one hundred of whom have already engaged display space. The Fair this year will occupy three floors instead of the two floors which have sufficed in previous years.

RADIO & TELEVISION NEWS will, as in past years, be represented by its editors. The place: Room 504.

The Audio Engineering Society's annual convention will be held at the same time as the Fair. Technical papers on a wide variety of audio subjects will be presented to the AES membership.

This year's Audio Fair will be open to all interested parties, professional and amateur, free of charge. —30—

Miss Pat Marand, singing star of Broadway's "Wish You Were Here" has been named "Miss Audio Fair 1953" by the Fair's Advisory Committee of Exhibitors.

of an anesthetized rhesus monkey and brought out leads to miniature tube sockets fastened to the animal's body. The monkey recovered quickly from the operation and showed no bad effects, but Dr. Delgado was able to measure the brain waves coming from the electrodes and to send tiny electrical currents deep into the brain of the animal. He found out that by passing a current through different parts of the cortex he could make a resting monkey raise his paws, turn around, yawn, scratch himself, or try to catch imaginary insects. A funny thing was that he could even change the monkey's emotions by passing current through certain parts of the brain. Current through the frontal lobe turned the animal against his favorite bananas. Current through a point midway between the ears in the brain of a savage rhesus monkey changed him into a gentle creature, but the instant the current was cut off he tried to bite.

"The interesting part of all this is that it was possible to assume a certain amount of control over the human machine from without. To a degree, it was possible to control the animal with electrical currents exactly the same as if he were a machine."

"If I may be so bold as to ask," Mac said, "does it look as though these wizard machines are going to take the place of man's brain-cells in the near future?"

"Not in the near future," Barney reassured him, "but there are some who think that eventually cybernetics will do for mediocre brains what the Industrial Revolution did for muscle. Machines will undoubtedly take over many of the simple mental tasks now performed by human beings. So far, though, nature is able to pack a lot more communication and control equipment into a given space than our scientists can. Take an earthworm, for example, and its ability to detect and turn away from light. We could make a machine that would do the same thing by using several photocells, amplifiers, servo-mechanisms, power supplies, etc.; but we would never be able to build all this into the chassis of an earthworm. Dr. Wiener calculates that to duplicate mechanically the million-odd nerve fibers that exist in a human brain would require a machine ten feet high spread over a space equal to 222 football fields."

"Our steady progress toward miniaturization is in the right direction," Mac pointed out. "Transistors ought to help."

There was a considerable silence, which Barney finally broke.

"Say, Mac, I'll not deny that I haven't got a kick out of being the one who does the 'telling' around here

for a change; but I guess it was rather a cheap trick for me to bone up on an off-trail subject and then lord it over you on the strength of it. I probably should have been reading about sync circuits and u.h.f. converters instead of spending so much time with books and magazine articles on cybernetics, but the subject fascinates me and I just can't seem to leave it alone."

"Wait up there!" Mac interrupted. "You certainly have no reason to apologize after having done me two of the most important favors one person can do for another in a single afternoon: first, you showed me where I was mistaken; second, you gave me something new and interesting to think about. As soon as you are finished with that cybernetics book, I want to borrow it.

"As for your reading up on a subject that does not contribute directly to your work, I'm all for it. If all a guy knows is how to do his job, he's pretty poor company—for himself as well as other people. His kind of intellect will be the first to be replaced by a machine someday. But the man whose brains are constantly alert to grasp and analyze and digest new ideas, the fellow who has *fun* with his intellect, no machine will ever take his place." —30—

TEST BENCH TIP

By PHIL WEISS

HERE'S a practical solution to the problem of grounding the instruments on the test bench, without getting into trouble with "hot chassis" radios or TV sets.

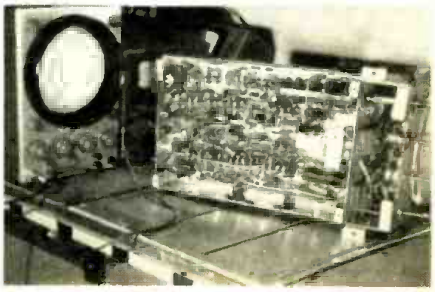
Lay a piece of sheet metal on top of the bench, to which all the instruments are securely grounded. Mount a 117 volt, 6 watt lamp over the bench in a conspicuous position. Connect one side of the lamp to the metal bench top, and the other side to a water pipe, or other good ground. Now everything is grounded to earth through the cold resistance of the lamp, about 200 ohms.

When a hot chassis is placed on the bench and turned on, watch the lamp. If it glows, turn over the a.c. plug. When the lamp is out, it means the chassis and instruments are at ground potential.

Now all measurements are made relative to chassis, without bothering to connect to "B—" in the set.

Caution. It is a good idea not to use the "on-off" switch in a hot chassis set, since this switch is usually in the ground circuit. Instead, install an extra a.c. outlet and a double-pole switch on the bench, for turning sets on and off. —30—

How metal plate is used to obtain common ground for test units and a TV chassis.



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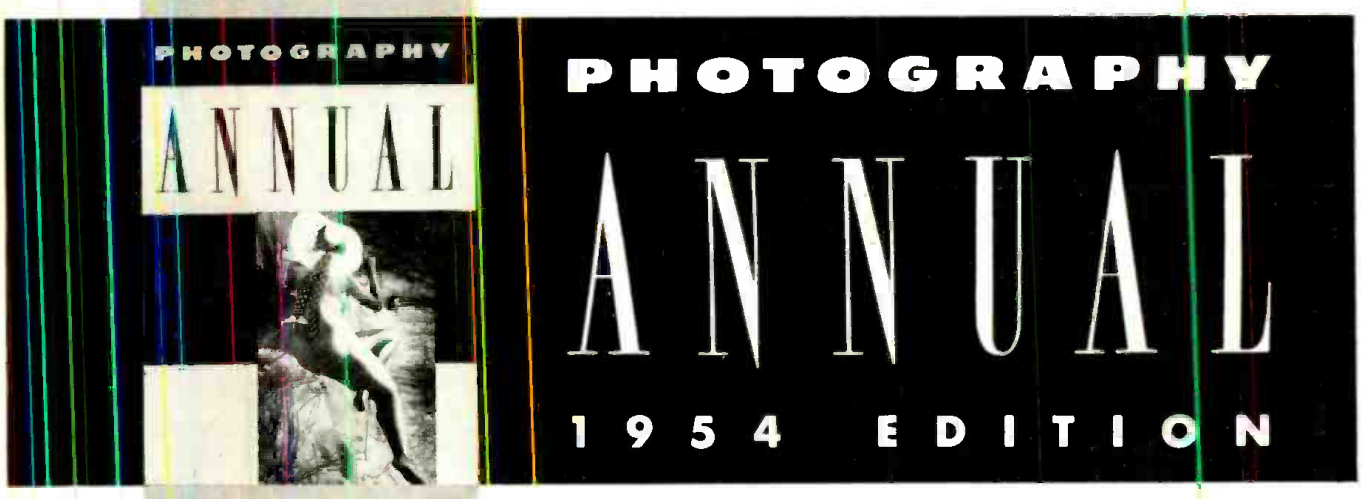

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Spot Radio News

(*Continued from page* 18)

revealed that 18 per-cent of the viewers found misregistration not observable.

In an additional analysis of picture texture, it was pointed out there are approximately 900 colored phosphor dots along a line in a 16-inch tri-color tube, and about 700 from the top to the bottom of the normal raster area. As noted, this would mean that the diameter of an individual dot is about 70 per-cent of the thickness of a scanning line. In answer to a query of whether viewers could observe any dot pattern, 93 per-cent, it was said, said no.

One of the highlights of the brief is detailed descriptions of the color receivers developed for compatible pickup. Available for reception of the standard or the ultra-high bands, one new chassis features an intercarrier 41.25 i.f. system, noise inversion sync separation, electrostatic convergence and focus, along with dynamic modulation of the picture tube plates, quartz-crystal a.f.c. color synchronization, low level color demodulation using quadrature techniques, picture-tube grid drive with d.c. restoration, and a color killer to disable the color channel during black and white transmissions. Particularly interesting in the new tri-color chassis is the picture i.f. channel, designed for a 45.75-mc. picture carrier, 42.17-mc. color subcarrier, and 41.25 mc. sound carrier. The amplifier consists of six stages, using a single 6BQ7A, four 6CB6's, and one 6CL6. In the second detector is a 1N60 crystal operated at 6 volts peak output level to preserve linearity.

At the ultra-highs, the noise factor of the tuner in the set depends primarily on the noise contributed by the crystal mixer and by the first i.f. amplifier following the mixer circuit. Thus, a low noise driven grounded-grid stage is used for this i.f. amplifier which uses a 6BQ7A; it is fed from the crystal mixer by means of a single-tuned circuit. The output network is a link-coupled bridged-T, *m*-derived bandpass circuit with a rejection trap tuned for accompanying sound or 41.25 mc. To reduce cross modulation, the sound carrier is attenuated as soon as possible in the i.f. amplifier.

The video section of the color receiver is also unusual, consisting of three separate functions: luminance channel, chrominance channel, and a matrix which combines the two channels. The luminance (Y) channel serves to amplify the luminance information to a level satisfactory for application to a picture tube, information being applied *via* the matrix. The chrominance channel serves to recover the color difference information contained in the color subcarrier and its accompanying sidebands. By a process of synchronous detection in phase quadrature, two independent signals are recovered from the color subcarrier; these signals are called I (in phase) and Q (quadrature phase). Both of these channels are band limited. That is, the Q channel passes information up to approximately .5 mc., and the I channel passes information up to about 1.8 mc. While band limiting of these channels prevents crosstalk, it necessitates equalization of signal delay time since the channels have different bandwidth characteristics. Similar equalization is required in the luminance channel.

The color picture tube requires simultaneous excitation with red, green, and blue signals; the matrix provides these simultaneous signals by combining predetermined proportions of the Y, I, and Q information. To synthesize the color drive signals, a fixed resistive mixing type of feedback amplifier is employed. Using one triode section of a 12BH7, in conjunction with three fixed matrix resistors for red, green, and blue adder stages, linear addition of Y, with the proper amplitude and polarity of I and Q is accomplished. The added luminance and chrominance signals are then amplified by output amplifier stages (second half of a twin triode 12BH7) to a level satisfactory for application to the grids of the picture tube. Unequal picture-tube drive signals are required due to the unequal phosphor deficiencies of the tri-color tube. Red requires about 100 volts, while blue and green use about 50 to 70 volts of drive. Over-all gain controls for the green, red, and blue channels are provided.

Color synchronization, also an extremely important factor in picture control, is thoroughly analyzed in the petition. To recover the color information contained in an NTSC type signal, it is necessary to generate a local subcarrier of proper frequency and phase. To accomplish this, phase reference information is transmitted as a component of the composite color video signal. This color sync information is transmitted in the form of a *burst* of approximately 8 cycles of the color subcarrier frequency and appears immediately following each horizontal sync pulse in the composite signal.

This *burst*, the discussion points out, is separated from the composite video signal and is used in establishing two continuous wave signals of color subcarrier frequency having a 90° phase displacement from each other. These two signals are generated by a quartz crystal oscillator whose exact frequency is controlled by a reactance tube. This tube derives its control information from an error signal proportional to the difference in phase between the transmitted *burst* and the local crystal oscillator output.

The color sync channel includes a keyed *burst* amplifier stage, phase detector-3.579-mc. driver and color phasing amplifier, crystal oscillator, reactance tube, and quadrature 3.579-mc. amplifier.

In a color tube, convergence is a key item. Center convergence of three beams is accomplished in this chassis by adjusting the d.c. potential of a convergence electrode for best super-

positioning. That error which still exists is due to the mechanical inaccuracies of gun alignment and is corrected by the use of individual-beam convergence magnets. To effect overall beam coincidence, dynamic convergence is employed. Reviewing this technique, the brief declares that since the phosphor plate and shadow mask are flat surfaces, the distance the beams must travel from the deflection plane to the central area of the shadow mask is less than the distance they must travel when the beams are deflected away from the central area. If the potential on the convergence electrode, necessary to produce center convergence, remained unchanged, the three beams would then cross over at some point before reaching the shadow mask. This would result in a misregistered picture. To correct this condition, it is necessary to modulate the d.c. potential on the convergence electrode in such a manner as to produce a larger convergence electrode voltage as the deflection angle increases. This condition also exists with respect to focus.

A dynamic convergence voltage and focus modulatinn voltage, each with the proper waveform, amplitude and synchronism with deflection, are generated by the use of a pair of tapped transformers and a single triode amplifier, one half of a 6BL7. These dynamic voltages are produced by linear addition of horizontal and vertical waveforms derived from the cathodes of respective deflection output stages. The composite alternating output voltage is coupled to the picture-tube convergence electrode and focus electrode through their respective output transformer taps.

While the brief submitted by *RCA* is extremely complete and thorough, the NTSC report will offer an even more exhaustive review covering engineering and statistical data compiled by many panels with scores of subcommittees whose membership totals hundreds. To illustrate, in one field report, results obtained during over 3000 observations were recorded, and such studies covered co-channel interference, lower and upper adjacent channel troubles (if any), random noise, sine-wave interference, and multipath problems. In addition, a variety of receivers were under study during these tests; in some examinations, as many as thirty receivers were scrutinized for picture quality, flicker, general compatibility, brightness, contrast, picture texture, adequacy of sync, and even sound reproduction. Another report covers broadcasting over direct, microwave, and coax facilities with scores of observations by experts from receiver and transmitter manufacturers, as well as broadcast stations.

As this is being written, two questions are spinning about Washington: Will anyone oppose either the *RCA* or NTSC appeals? Will the patent situation be taken in stride or subjected to a microscopic inquiry not only by the Commission, but by our legislators? Some feel that Dr. Du Mont might object to the standards, for he has declared on several occasions that he didn't feel that the system was currently strong enough. Others say that he'll go along, notwithstanding his earlier remarks. It is also believed that *CBS*, whose wheel system had been approved, will now follow the compatible march. While the Commission, as an official body, has been silent on its views, it has been reported that some of the members have been impressed with advancements made with the new compatible color TV system. During the recent RTMA conclave in Chicago, one Commissioner was quoted as declaring that compatible color will be approved before Christmas. That will be quite a headliner for the Yuletide season.

A BIRTHDAY, the first anniversary of the lifting of the freeze, highlighted

the end of the fiscal year in Washington. During those twelve months, station permits were routed to some 300 cities throughout the land. Of the post-freeze approvals, 256 were for ultra-high stations and 142 for standard bands, with educational groups receiving seventeen of the allotments, or thirteen for u.h.f. and four for v.h.f.

Texas, California, Pennsylvania, and New York led the parade in grants, with Texas receiving 41 approvals (25 v.h.f. and 16 u.h.f.), New York 36 (15 v.h.f. and 21 u.h.f.), Pennsylvania 34 (9 v.h.f. and 25 u.h.f.), California 33 (24 v.h.f. and 9 u.h.f.).

All states except Vermont now have station authorizations, and some in New England, such as New Hampshire and Maine have but one and two, respectively. However, Massachusetts has received OK's for twelve, with two for present-band operation and ten for the upstairs use.

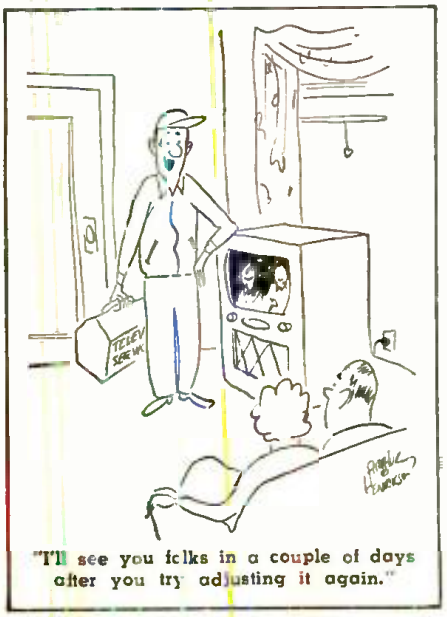
The hearing calendar is still a crowded one, with over 600 applications awaiting approval at this moment, and more and more petitions coming in daily.

ONE OF INDUSTRY'S stalwart pioneers, a bold crusader whose vigorous drives for better broadcasting won the acclaim of the nation, is dead. Lewis Allen Weiss, who served as chairman of the board of the *Mutual Broadcasting System*, and headman of the *Don Lee* network on the Pacific coast, committed suicide a short while ago, after learning that he was suffering from an incurable ailment. Everyone will miss the sparking wisdom of this inspiring leader . . . . . L.W.

WCOS-TV ON NETWORK

SOUTH Carolina's first television station, WCOS-TV in Columbia has been connected into the Bell System's nationwide television network.

It is connected to a section of the intercity facilities which carries net programs from Charlotte, N. C. to Jacksonville, Florida. —30—



"I'll see you folks in a couple of days after you try adjusting it again."

"CONVERTERLESS" 75-METER MOBILE RECEPTION

By HOWARD R. SHANNON, VE7AGE

An easy modification of your car broadcast set, that does not harm broadcast reception, gives you 75-meter coverage.

IF YOUR CAR is equipped with a good broadcast receiver, you will find that it can be made to work on 75 meters without loss of efficiency on the broadcast band. This will please the XYL and save much-needed space for the transmitter, v.f.o., or what-have-you in the front end of your car.

First, let's take a look at one of the permeability-tuned coils used in nearly all late-model car receivers and consider the effect of adding a second coil in parallel. The tuning range will now be higher and can be extended to 75 meters.

With the two coils in parallel, any change of inductance in one will change the inductance of the whole tuned circuit; in other words, the iron slug that moves in and out of the coil to tune the broadcast band may now be moved in the same way to tune the higher frequencies. The new range should be from 3825 to 4000 kc. Since the added coil has less inductance than the other, we can get the bandspread required for easy tuning.

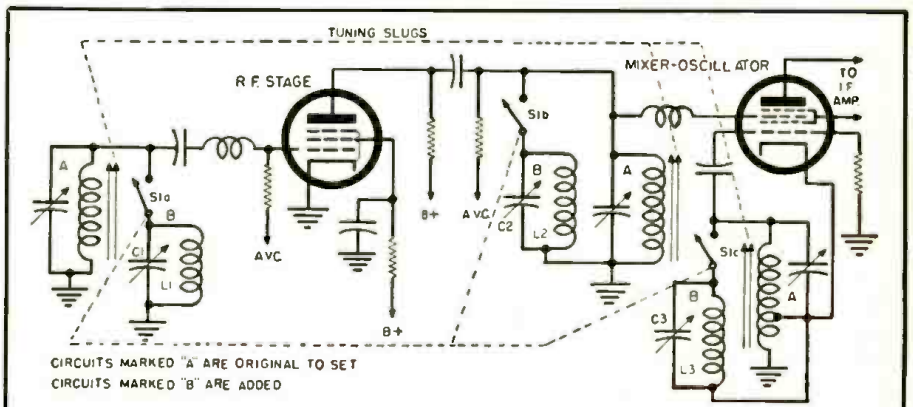
In making the change, first connect a new coil across the antenna coil, calculating the number of turns so that the two coils together, with the slug out, tune to the high end of the 75-meter band (1500 kc. on the dial). Then with the dial turned and the slug in, the coils will tune to the low end of 75 meters. For the author's receiver, the required coil turned out to be 27 turns of No. 22 enamel closewound on a 1-inch diameter form.

A coil is similarly added to the mixer and a third to the oscillator. The new coil connects across the "tuned" part of the oscillator coil (not including the feedback winding). The oscillator will continue to operate with ample output for good mixing, regardless of the type of oscillator circuit used in the car set. The normal oscillator coil has, by comparison with the other radio frequency coils, few turns and high fixed capacity; similarly, the new "double" oscillator coil will have effectively fewer turns yet a high capacity. By keeping the ratio correct, tracking problems can be avoided.

The added mixer coil had 26 turns of No. 22, closewound, and the added oscillator coil had 9 turns, closewound, each on a 1-inch diameter plastic form. Small peaking padders across the new coils are switched in and out along with the coils when changing bands.

Both C_1 and C_2 in the diagram are 7-150 $\mu\mu$fd. padders. The value of C_3 should be determined experimentally, to cause the oscillator to tune from 3825 kc. plus the intermediate frequency to 4000 kc. plus the intermediate frequency. For a 456-kc. i.f., as used in the author's set, the cor-

Broadcast receiver circuit changes for "converterless" 75-meter reception. Coils and condensers are switched into the circuit across the slug-tuned r.f., mixer, and oscillator coils to change their tuning characteristics to cover the amateur band.



C_1, C_2—7-150 $\mu\mu$fd. padder cond.
C_3—140 $\mu\mu$fd. (max.) trimmer cond.
S_1—3-pole, s.t. rotary sw.

L_1—27 t. #22 en. closewound on 1" dia. form
L_2—26 t. #22 en. closewound on 1" dia. form
L_3—9 t. #22 en. closewound on 1" dia. form

rect value will be found somewhere in the range of 85-140 micro-micro farads. This value will cause the oscillator to tune from approximately 4281 to 4456 kc. For lower i.f.'s, it should only be necessary to add an extra turn or two to the new oscillator coil, using the same condenser.

We need, then, for the new two-band receiver only three coils, three padders, and a simple bandswitch (since in changing bands only one side of each coil must be connected or disconnected). Custom sets pretty well take care of engine noise over the broadcast band, and their design in this regard shows their merit on 75 meters too. You will find no undesired signals, just the ones that should be there.

The author's set is custom-built by *General Motors* and the coils shown are the ones used in it. The bandswitch is on the back of the set but is not hard to reach even while driving. I have tried other makes of sets with equal success, and feel that the system should work on 40 meters as well as on 75—possibly on 20 or 10. —30—

SOME PORTABLE RADIO SERVICE HINTS

By JACK DARR

THERE is no substitute for experience in rapid portable radio servicing. The hints below may serve to bolster the service technician's own experience in servicing such sets and make such work more rapid and, hence, more profitable.

SILVERTONE 101.802-1

This portable came into the shop with almost no volume. The trouble turned out to be an open plate resistor in the 1LD5 circuit, a one-megohm unit, which has been found bad in several of these sets. Another source of trouble in these sets is the 3.3-megohm screen resistor of the same tube. Replace this unit if its value has increased by about 20%.

WESTINGHOUSE H-105

This set came into the shop with the volume extremely weak. It would just barely get the local station, and others not at all. All tubes were good, all supply voltages up to normal. Eventually, the a.v.c. voltage was checked. Over most of the bus the voltage was normal, but about 10 volts negative appeared on the input grid of the 1R5 mixer-oscillator. This voltage was observed to rise and fall as the set was tuned from one end of the dial to the other. The oscillator coil in this set uses a few turns open-ended as a "gimmick" coupling for the oscillator grid. This gimmick was shorted to the rest of the coil, which returned through a 10-megohm resistor to the a.v.c. bus. This caused the oscillator grid voltage to feed through into the a.v.c., reducing the sensitivity. The gimmick was cut off, and a small mica condenser was connected from the oscillator grid to the hot end of the coil. After realignment, good performance was restored.

PHILCO 46-350 AND 47-350

If these sets have low sensitivity and the tone is poor, look for a bad screen resistor on the 1U5 tube. These are 3.3-megohm matchstick units. Also, check the 1-megohm plate load resistor on the same tube. —30—

MANUFACTURERS' LITERATURE

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

CD PUBLICATIONS

Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey has issued a catalogue on its TV rotor line, including the TR-2, the CDR rotor models TR-11 and TR-12, as well as accessories to the rotors, including the automatic clock.

Also available is a new catalogue on the company's full line of u.h.f. and v.h.f. antennas for both indoor and outdoor installation.

A third publication is a supplement to the "Vibrator Replacement Guide" which gives complete and up-to-date listings.

A series of promotion aids for the television rotor, including illuminated and animated displays, envelope enclosures, and window streamers are also available, according to the company.

SWITCH BULLETIN

A comprehensive selection of inexpensive line and slide switches for radios, TV sets, appliances, small motors, toys, instruments, and similar equipment is described in a new 16-page bulletin released by the Electronic Components Division of the *Stackpole Carbon Company*, St. Marys, Pa.

Bulletin RC-9B includes complete specifications, dimensions, and helpful application data on seven new line switches recently developed for use with the company's variable composition resistors. In addition, similar data is given for a wide variety of slide switches including several new heavy-duty types for fractional horsepower motors.

Copies of this bulletin are available on letterhead request.

MAILING PIECE

G & H Wood Products, 75 North 11th Street, Brooklyn 11, New York has issued a new mailing piece on its "Cabinart" line of interior styled, high-fidelity cabinets and kits.

Equipment cabinets, speaker enclosures, and combinations are listed in relation to wood and style so that they can be properly matched at the right price. Custom builders, dealers, and audio enthusiasts will find the catalogue of interest.

Copies may be obtained from local parts distributors or from the company direct.

ELECTRONIC TUBES

Amperex Electronic Corporation, 230 Duffy Avenue, Hicksville, Long Island, New York has issued a condensed catalogue covering its line of electronic tubes for communication, industrial, rectifier, radiation detection, electro-medical, amateur, and special applications.

This 24-page catalogue is intended as a quick reference guide to the correct tube for any given application. More detailed data sheets on the listed tubes are available on request.

Please write the company direct for copies of this publication.

REPLACEMENT PARTS

An up-to-date, revised replacement catalogue has been issued by *Sprague Products Company*, 51 Marshall Street, North Adams, Massachusetts.

Catalogue C-609, a 20-page booklet, contains detailed listings of all standard stock condensers and the company's "Bulplate" printed circuits for radio and television service, lab applications, amateur radio, and experimental purposes.

An unusually complete line of condensers is included with more than 375 ratings in voltages from 300 to 20,000 volts d.c.

Copies of this publication are available either from the company's distributors or from the company direct.

STANDARD TUNER DATA

Parts prices and descriptions and installation and performance data on the company's new television tuner and u.h.f. coil strips are included in the new 8-page brochure just released by *Standard Coil Products Co., Inc.* of Chicago.

Available from the company's wholesale distributors, the brochure gives a detailed circuit diagram of the tuner, trimmer location, and mounting dimensions. How to adapt the company's "Super" cascode tuner and the new pentode tuner to split-sound i.f. systems is also explained.

TUBE BOOKLET

An educational picture booklet of photographs, cut-away drawings, and exploded views showing structural details of electron tubes has been published by the Tube Department of *Radio Corporation of America*.

The "Tube Picture Book" was prepared especially for use as a visual instruction aid in schools. The tubes "dissected" in the booklet include: typical glass, metal, and miniature types; a subminiature triode; a thyratron; a high-voltage rectifier; a power triode; a super-power triode; television picture tubes; studio and industrial types of television camera tubes;

pencil-type tubes; and a multiplier phototube.

The booklet is priced at 25 cents a copy and is obtainable from Commercial Engineering, *RCA* Tube Department, Harrison, N. J.

"REPS' ROSTER"

"The Representatives" of Electronic Products Manufacturers, Inc. has announced publication of its new 1953 National Membership Roster.

Copies are available without charge to any manufacturer, distributor, or other industry person by request on business letterhead. Write the national headquarters office at 600 South Michigan Avenue, Chicago 5, Illinois for copies.

UTC CATALOG

United Transformer Company, 150 Varick Street, New York 13, New York is currently offering copies of its catalogue 530 covering transformers, reactors, and filters.

This 24-page publication is completely indexed and contains specifications and prices for the company's entire line of audio, power, and filament transformers; chokes; Williamson amplifiers and amplifier kits; high-fidelity equipment; toroids; equalizers and filters; etc.

Write the company direct for copies of this publication.

RECTIFIER STACKS

A new bulletin on miniature selenium rectifier stacks for electronic circuit applications is now available from the *General Electric Company*, Schenectady 5, New York.

The illustrated, four-page publication contains data on the applications, construction features, and electrical characteristics of small selenium rectifiers. Included are tables of ratings and dimensions, plus graphs on the effect of temperature and life expectancy of the various types of stacks.

When writing for this bulletin, please specify publication GEA-5935.

ATLAS SOUND EQUIPMENT

Atlas Sound Corp. of 1449 39th Street, Brooklyn 18, New York has released its 1953 catalogue describing its line of p.a. speakers and accessories and mike stands and accessories.

The catalogue illustrates and lists specifications for such products as projectors, radials, pagings, talk-backs, tweeters, baffles, driver units, transformers, etc. in its loudspeaker section and floor stands, desk stands, boom stands and brackets, sky hooks, cable hangers, etc. in its microphone section.

LOW-COST SPEAKER DATA

Ultrasonic Corporation of 61 Rogers Street, Cambridge, Massachusetts will forward a four-page data sheet on its new high-fidelity speaker unit to those requesting such information.

The publication describes and pictures the company's Model U-25 speaker and its compact cabinet. The system is based on the *Baruch-Lang*

principle which permits high quality performance from a compact unit.

DU MONT PUBLICATIONS

Allen B. Du Mont Laboratories, Inc. has announced the availability of three new publications of interest to service technicians.

The first is a spiral-bound service information book containing schematics, parts lists, alignment data, and miscellaneous service data on all of the company's television receivers. This publication is available from *Du Mont* parts distributors.

The second publication is a thirty-two page guide of original television parts and picture tubes for replacement in the company's TV receivers. The cross-indexed guide also includes electrical values of the components. It is available from the company's parts jobbers.

The third offering is the eighth edition of the company's "Picture Tube Data Chart". Printed on heavy stock suitable for hanging on the wall or folding into a notebook, this chart lists complete specifications for more than 150 picture tubes of all manufacturers. Parts distributors are handling this item.

TV TUBE RENEWAL

Eisler Engineering Co., Inc., 750 South 13th Street, Newark 3, New Jersey is currently offering copies of its new catalogue, "Equipment Required to Renew Burned Out Television Tubes".

This 8-page publication contains 70 illustrations of the various items needed by television tube manufacturers.

Copies of catalogue TV-RN-53 are available on request.

AUTO RADIO DATA

Thordarson-Meissner of Mt. Carmel, Illinois has announced the release of its new 1953-1954 "Automobile Radio Replacement Guide".

The new publication lists replacements for vibrator transformers, interstage transformers, output transformers, oscillator coils, input and output i.f. transformers, and ratio detector i.f. transformers.

All makes of automobile radios are listed in this informative and compact guide. Copies are available from Dept. C of the company.

FREE TOOL GUIDE

United Catalog Publishers Inc., 110 Lafayette St., New York 13, N. Y. has recently released a 36-page "Handi-Guide" covering a wide assortment of tools for the repair and maintenance of radio, television, and electronic equipment.

This handy reference book for technicians, engineers, experimenters, amateurs, and purchasing agents is available without charge. It contains detailed specifications, illustrations, technical data, and prices on tools made by 17 leading manufacturers. Included are TV alignment tools, chassis punches, pliers, screw and nut

drivers, soldering irons and guns, tool kits, wire strippers, etc.

TELEVISION HARDWARE

A 12-page catalogue which describes and illustrates its complete line of television mounts, hardware, and accessories is now being offered by *I. E. Manufacturing Company*, 325 N. Hoyne Street, Chicago 12, Illinois.

The self-bound catalogue, No. 16, lists the features of each unit together with detailed specifications and retail prices.

Copies are available on request. —30—

SOUTH JERSEY HAMFEST

THE South Jersey Radio Assn. will hold its annual hamfest on Sunday, September 13th at Locust Grove Farm on Almonesson Road near Westville, N. J.

The program starts with registration ($1.00 per family) at 10 a.m. Each family should bring its own picnic lunch. Free soft drinks will be furnished.

Mobiles should contact K2AA on 2, 10, and 75 meters for driving instructions. Bill Bowers, W2EGP, 303 Lakeview Ave., Haddonfield, N. J., will supply additional information. —30—

ELIMINATING FOLDOVER

By ELMER FISCHER

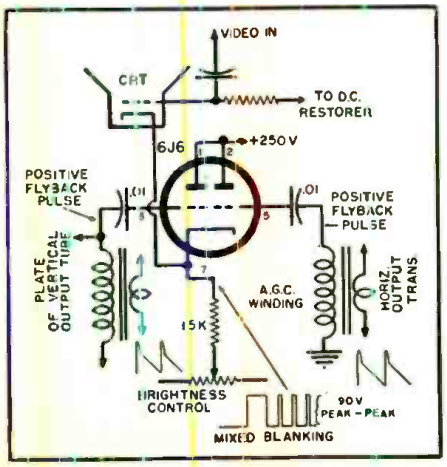
WHILE converting to a larger screen for a critical customer, the author encountered the problem of obtaining rapid enough flyback to avoid foldover. After exhausting all possibilities of doing it the easy way, a vacuum-tube circuit, as follows, was developed.

Positive-going flyback pulses were obtained from the plate of the vertical-output tube and the a.g.c. winding of the horizontal-output transformer. These pulses were applied to the grids of a 6J6 through .01 μfd. condensers, no grid resistors being necessary. The 6J6 plates were connected directly to "B+", and the two cathodes and the kinescope cathode were tied together and returned to the brightness control through a 15,000-ohm resistor.

About 90-volts peak-to-peak mixed blanking voltage appeared at the kinescope cathode.

Resistor values in the brightness-control circuit may have to be changed slightly as compensation for the 15,000-ohm resistor and the 6J6 current. —30—

Method for increasing flyback pulse rate.



Standard Coil Tuner

(Continued from page 37)

u.h.f.-v.h.f. changeover switching. The outer fingers of this molded piece hold the u.h.f. coil sections in place, the inner portion forms a double-action cam in which a follower rides and this, in turn, is linked to the u.h.f.-i.f. coil section "C" in Fig. 3.

The appearance of three typical coil sections as they were removed from the drums is shown in Fig. 5. In front is the u.h.f. coil section with the two front stators and coils forming the oscillator tank circuit. Between the oscillator tank circuit and the u.h.f r.f. bandpass network is a small wire link which couples the oscillator voltage to the mixer. This link is on the outside of the coil form, see Fig. 4. The center coil section in Fig. 5 is the v.h.f. oscillator and mixer strip with the slug-tuned oscillator coil and the slug retainer spring visible in the front. The last coil strip carries the 300-ohm balanced v.h.f. input circuit. A better view of the operation of the u.h.f. and v.h.f. switching section can be had in Fig. 6, showing the inside of the tuner with the drums removed. The cam follower which accomplishes the u.h.f.-v.h.f. switchover can be seen right at the partition of the two chassis. Its linkage extends to the pivoted section "C" which contains the coils for changing the v.h.f. into an i.f. amplifier. Also visible in this photograph is the u.h.f. fine tuner, the u.h.f. oscillator tube socket, and split-stator master trimmer just below it.

The v.h.f. circuitry shown in Fig. 6 is conventional except for the use of ceramic feedthrough condensers to isolate "B+" and heater leads. Note the extra long contact springs. For v.h.f. channels contact with the drum coil sections is made at the approximate center of each spring. For u.h.f. operation, coil section "C" is tilted forward in the illustration by the action of the cam follower and linkage, and this puts pressure on the contacts at the far end of the springs, pushing

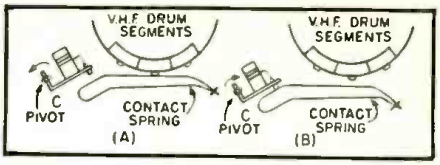


Fig. 8. Simplified drawing of the operation of the pivoted i.f. coil section. (A) In v.h.f. position. (B) in u.h.f.

these springs away from the v.h.f. coil segments and, instead, connecting them to the i.f. coil section "C." This coil section can be seen better in Fig. 7. Here is shown the u.h.f.-i.f. input cable, connector, and lead to L_{17} (see Fig. 3). L_{15} and L_{16} are slug-tuned and also mounted on coil section "C." As shown in Fig. 7, this coil section is tilted away from the spring contacts and only v.h.f. stations would now appear. The simplified sketch in Fig. 8 shows the two positions of coil section "C" as seen from the rear of the tuner.

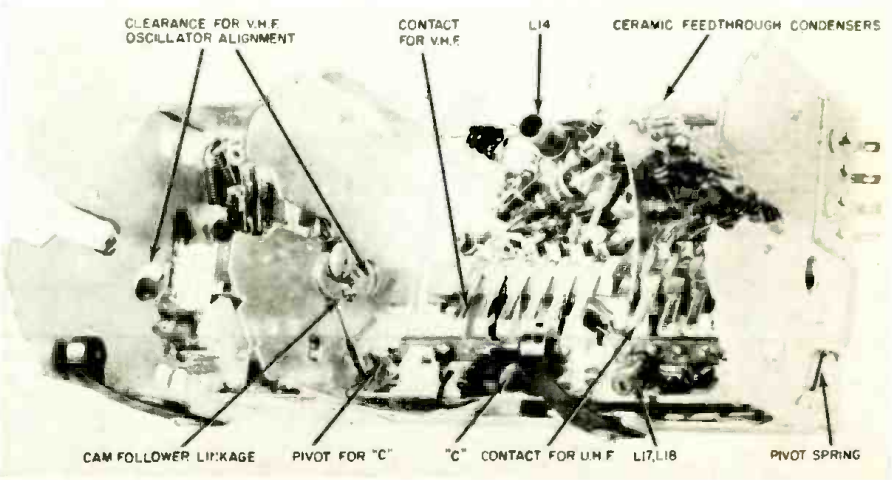
Another feature which cannot readily be shown in photographs is the rocking motion which takes place each time a channel is switched. This motion is due to the design of the cam and serves to wipe all v.h.f. contacts to keep them clean and noise free.

Although individual manufacturers will use different types of knobs, the channel presentation is dictated by the operation of the tuner itself.

Assume that Channel 37 is desired. Simply turn the middle knob to 3 and then turn the inner knob until the 7 appears next to the 3, showing 37. Then adjust the outermost knob for fine tuning. To tune in Channel 8, turn the middle or u.h.f. knob until the v.h.f. window shows some number. Looking at the v.h.f. window, turn the v.h.f. or inner knob until 8 appears. Adjust the outermost knob for fine tuning. If the set is tuned to Channel 15, for example, it is not necessary to tune through all intermediate channels to get Channel 79. Simply turn the u.h.f. knob from 1 to 7 in either direction, then turn the inner or v.h.f. knob from 5 to 9 in either direction.

The 6.3-volt a.c. heater bus re-

Fig. 7. Another view of tuner chassis showing the pivoted i.f. coil section.



quires a total of 1.075 amps. The a.g.c. bias voltage may vary from 0 to 5 or even 6 volts on very strong signals. Naturally any variation in bias will also vary the d.c. current drawn by the 250-volt "B+" since the bias controls the 6BZ7. "B+" current from the 250-volt bus varies from 20 to 30 ma. as the bias changes from 1.5 volts to zero. When more than 3 volts of bias are applied, the gain of the tuner is reduced by about 12 db and the current will drop to about 12 ma.

Current through the 150-volt "B+" remains at 17 ma. for u.h.f. operation, and 12 ma. for v.h.f. Neither the 150 nor the 250-volt "B+" values are critical as long as a minimum of 140 and 230 volts respectively is available.

The most important characteristic of any tuner is its noise figure. Because a low-noise cascode input circuit is used, the v.h.f. noise figure of the tuner described here is excellent. Production samples of this tuner give noise figures below 4 db on Channels 2 to 6, and below 6 db on the higher v.h.f. channels. The noise figures for u.h.f. are not so uniform since they are, to a great extent, dependent on the 1N82 mixer crystal. Representative measurements, however, show that individual channels or groups can be aligned to less than 10 db noise figure, while the worst noise figure for any channel is below 14 db.

Although these figures do not look as attractive as the v.h.f. noise characteristics, they are based on the limits of crystal noise, impedance matching, and other circuit parameters. In actual field tests, the noise performance of the 82-channel tuner on u.h.f. compared very favorably with other tuners and converters.

Next to noise, the over-all conversion gain of the tuner is of interest. Exact figures on this are not yet available but, from the circuit itself, it is apparent that the v.h.f. gain is somewhat better than in current v.h.f. tuners, due to the use of a pentode mixer. For u.h.f. the loss in the r.f. bandpass network is on the order of 1 or 2 db, but the i.f. gain through the 6BZ7 and 6U8 considerably boosts the over-all gain until it is almost the same as for v.h.f. An approximate over-all gain figure is about 40 to 50 db, depending on i.f. bandwidth, a.g.c. bias, and "B+" voltage supplied. Because of this high gain it is possible to use only two or three i.f. stages after the tuner and still have a very sensitive receiver.

Bandpass characteristics for the v.h.f. channel are the same as in any other v.h.f. turret tuner, *i.e.*, 6 mc. between peaks with less than 3 db valley on any channel. For u.h.f. such narrow bands are not practical and are not used. On the lower u.h.f. channels the r.f. bandwidth of the input circuit is approximately 20 mc. between peaks, while at the higher u.h.f. channels the bandwidth increases up to 35 mc. Because the crystal mixer is part of the load across the r.f. input

circuit, the amount of crystal current will affect the "*Q*" and, therefore, shape of the r.f. bandpass. Average crystal current is on the order of 1 to 2 ma. so that the valley in any response curve will be less than 2 db. Actual wave shapes show a very flat and symmetrical bandpass characteristic.

The u.h.f. and v.h.f. oscillators are both tuned above the incoming signal by 41 mc. or 21 mc., depending upon the i.f. For v.h.f. operation, the v.h.f. oscillator is adjusted just as in current v.h.f. models, through a hole in the front. By passing a long fiber alignment tool through this hole a brass or aluminum slug may be turned inside the oscillator coil which tunes it to a particular channel. The hole for the alignment tool goes clear through the u.h.f. tuner section only when v.h.f. is tuned in. On u.h.f. channels no clearance is available, and only the u.h.f. oscillator itself can be aligned. As shown in Fig. 4, the u.h.f. oscillator adjustment consists of a screw which protrudes through the u.h.f. detent plate into the region of the oscillator condenser stator plate.

The i.f. coils mounted on section "C" are tuned by powdered iron slugs which are accessible from the bottom of the tuner. All other adjustments are available from the top of the tuner and can be made with the tuner in the set. The range of the v.h.f. fine tuning adjustment is approximately 1 mc., while the u.h.f. fine tuning control shifts the u.h.f. oscillator frequency by only 2 to 3 mc. This latter shift is relatively small at these high frequencies, but if it were any greater serious mistuning would be possible by the unskilled viewer. As it is, it does not permit tuning in the wrong channel through the fine tuning, if the u.h.f. oscillator screw is adjusted correctly.

Undoubtedly many improvements will be made on this and successive tuner models, and it is foreseeable that a single r.f. amplifier, oscillator, and mixer will soon be used for all 82 channels. In such a tuner the decade and digit switching system, together with the changeover cam arrangement, would be of real value. Until tubes are available which can amplify u.h.f. and v.h.f. equally well, the tuner described here will certainly find wide and successful application in many different TV receivers.

-30-

AN IMPROVEMENT FOR OLDER TV SETS

By CHARLES ERWIN COHN

ALTHOUGH all present-day TV sets use some form of a.f.c. in their horizontal sweep circuits, many older sets did not have such circuits, but used triggered sweep, which has since been abandoned due to its extreme noise susceptibility. However, many of these older sets are still quite serviceable, and it may be desirable to improve the horizontal action, but a complete conversion to an a.f.c. circuit is a major operation and might not be worthwhile on an old set. However, with the modification to be described here the noise immunity can be greatly improved with very little work, if the set uses a multivibrator in the horizontal circuit.

The nature of the modification can be seen from Fig. 1A, and consists of placing a tuned "ringing" circuit in series with the cathode resistor. L_1 can be a commercial ringing coil such as the Miller 6210, while C_1 can be about 3900 $\mu\mu$fd.

Adjustment of the circuit is very simple and can be done without instruments. To do it, first short out the tuned circuit and also short the grid of the first triode to "B+," cutting out the sync. Then adjust the horizontal hold control until the picture is synced in as nearly as possible. Then without changing anything else, remove the short from the ringing circuit. This will make quite a change in the image, but you can then adjust the slug in the ringing coil until the picture is again synced in, leaving the hold control at its original setting. Then remove the short from the first triode grid and the modification is complete.

The action of this circuit can be seen from Fig. 1B. Waveform "A" shows the grid-cathode voltage of the first triode without the ringing circuit. Here the dotted line is the cut-off level below which triggering takes place. It can be seen that a noise pulse (shown dotted) coming in between the sync pulses has no trouble in triggering the circuit and causing tear-out of a line. However, as shown in waveform "B," the ringing circuit superimposes a sine wave on the sync pulses and thus, as shown, hinders the false triggering of the circuit by a stray noise pulse.

This simple modification cannot be expected to give the same accurate sync as a standard a.f.c. circuit, especially on weak signals, but it does give an improvement which makes it well worthwhile to install.

-30-

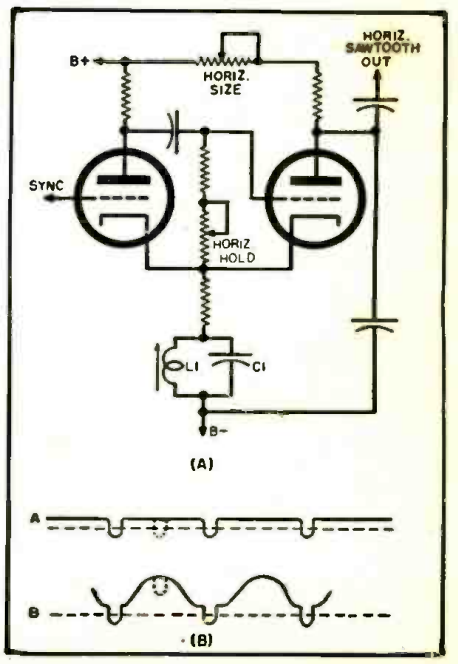


Fig. 1. (A) Modification to add a "ringing" circuit. (B) Circuit waveforms. See text.

Electronics at the Fair

(*Continued from page 73*)

the Radio-Television Building, the outdoor amphitheater, the Mexican Village, and the school exhibit, along with the various livestock judging rings.

The equipment used in the Radio-Television Building auditorium consists of a high-fidelity installation with two complete amplifying systems. The high-frequency system employs *RCA* re-entrant-type trumpet horns, while the low-frequency system uses *Western Electric* type 728-B bass reflex speakers with audio power obtained from two *RCA* 30-watt high-fidelity amplifiers. A four-channel *Western Electric* 22E amplifier is used to feed these two high-fidelity amplifiers simultaneously.

Typical outdoor installations throughout the rest of the Fair grounds include *RCA* re-entrant-type trumpet horns and *RCA* amplifiers. A system located in the stable area notifies the jockeys and trainers of the next race. Since the stable covers considerable area, large *RCA* re-entrant trumpet horns are used, along with powerful amplifiers.

Children, who are lost, are placed in a small *Austin* roadster and driven through the grounds while their parents are being paged through loudspeakers mounted on top of the car.

During the run of the 1952 Fair, nightly musical entertainment was provided by the well-known pianist, "Liberace." These performances were held on a large stage erected in front of the grandstand and required a high-fidelity, theater-type installation to cover sound reproduction over an area 420 feet wide, 65 feet high, and 120 feet deep. To accomplish this, five special *Stephens* "Tru-Sonic" reproducing systems were installed. Each system consisted of a double folded horn 80 inches long, 40 inches high, and 30 inches deep and two low-frequency driver units. On each side of the folded horn was mounted a 2 by 5 multi-cellular high-frequency driver unit. These speaker banks, when assembled, weighed approximately 400 pounds each and presented quite a problem to mount 65 feet in the air. This was done by block and tackle, hoisting the units up to steel crossmembers supporting the grandstand roof and then securing them in place by chains at the correct elevation to distribute sound evenly throughout the entire grandstand with no dead spots.

Amazing lifelike reproduction was accomplished through the use of the *Stephens* 500-D direct-drive amplifier, which eliminates the output transformer. Power is delivered from the cathode of the amplifier output tubes through a 600-cycle crossover network to specially wound 500-ohm voice coils of the high- and low-frequency units. Frequency response of

this amplifier is ±¼ db from 20 to 70,000 cps with distortion less than one-half of one per-cent. This method of coupling is so efficient that only 20 watts is required to drive each one of the five banks of four speakers to the maximum output. The output of each bank of speakers was phased and connected to a separate amplifier, inputs of which were phased and terminated together and fed at a zero level by a *Western Electric* 22-E, four-position remote amplifier.

Microphones used on the stage for the pick-up were the *Stephens* C-1 condenser and *American* DR330 "Cardioid." The results obtained were most gratifying and tape recordings made during the musical extravaganza were equal to those obtained from any fine acoustically-treated sound stage. An engineer, located between the grandstand and the stage, mixed the sound for the musical production.

Open time is allocated by local Los Angeles radio stations to broadcast various types of radio programs direct from the Fair grounds. As these programs are planned they are channeled into the radio and television program office headed by Mr. Lisle Sheldon, who checks the available time and assigns it to the proposed program. Upon confirmation of the program, an announcer is assigned from this same office and a broadcast time notification is sent down to the master control room to allow the assignment of an engineer and equipment to handle the pick-up.

The radio control center is the heart of all radio and tape recording activities. It is located in front of the Radio-Television Building and enclosed behind plate-glass windows, which allow Fair patrons to witness engineering operations. A studio is built on each side of the control room for the broadcasting of news, interviews, and disc-jockey shows. These studios are individually equipped with their own remote amplifiers and microphones and terminate at the master control patch bay. The master control room is equipped with an *RCA* type 76B consolette, two custom-built turntables, and four "Concertone" tape recorders. Since a great many of the programs broadcast are recorded and released by tape, two "Concertone" network recorders are mounted on each side of the control desk for convenient operation by the engineer.

Outlying remote points of origin, such as the race track, the main auditorium, the Agriculture Building, Mexican Village, etc., are connected to the master control room by telephone lines and terminated on a patch bay. This allows instant, finger-tip control for the engineer to select incoming programs to be sent direct by special broadcast lines to Los Angeles radio stations or channeled through to the tape recorders for recording and subsequent rebroadcasting.

With finger-tip control, it is possible for the engineer to have five

programs in operation at the same time, namely: Studios A and B located in the control room feeding programs to Los Angeles over direct telephone lines; tape recording the daily races originating at the grandstand; tape recording a program by telephone line from a remote point of origin, such as the Agriculture Building, for rebroadcasting at a later time; or releasing a previously tape-recorded program over a direct telephone line to Los Angeles. Programs may also be channeled direct through the master control patch bay.

Tape recording plays a major part in the broadcasting activities at the Los Angeles County Fair as it affords flexibility in the recording and rebroadcasting of various radio programs. Field tape recording equipment, consisting of "Concertone" portable tape recorders, allows programs to be made at any location on the Fair grounds where broadcast lines are not readily available. When necessary, remote broadcasts originating from such locations as the Agriculture Building, Mexican Village, Floral Building, Sportsman's Area, and the Live Stock Judging Rings may be channeled directly through the master control room and handled by the engineer at the point of origin.

Since the Fair ground covers such a large area and activities are geared to such a fast pace, it is imperative that a rapid method of transportation be available at all times to carry an engineer and equipment to any part of the 400 acres in a matter of minutes. To accomplish this, special-built electric "Autoettes" are used.

Telephone order wires connected to the radio control center are located throughout the Fair grounds in thirteen locations, which allow immediate communication and the assignment of an engineer, if necessary, to originate a program in the field.

A completely-equipped control room is located on one side of the stage in the main auditorium allowing the origination of local and network radio programs. When programs emanate from the auditorium, they are bridge fed through the dual, high-fidelity public address installation for the benefit of the audience.

Broadcasting equipment includes a *Western Electric* 22-E, four-position mixer along with various types of microphones used for different stage presentations.

Through television, Fair activities were witnessed by thousands of Southern Californians.

Thus, electronics plays a very important part in the world's largest county fair by allowing patrons to hear the various Fair activities through sound reinforcement and by bringing many of its features into the homes of thousands of people through the medium of radio and television.

EDITOR'S NOTE: *Interested audio readers in the area are urged to visit the installation at the forthcoming Fair in Pomona.*

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NEW TV PRODUCTS on the Market

U.H.F. TUNER

Radio Receptor Co., Inc. of 251 West 19th St., New York 11, N. Y. has developed a new u.h.f. tuner circuit

which has been tradenamed the "Cavi-Tuner".

The new circuit has also been incorporated into a second unit which serves as a u.h.f. converter. The "Cavi-Tuner" is designed as an original equipment component to provide both v.h.f. and u.h.f. reception while the converter has been designed to be used as an accessory for existing v.h.f. receivers.

The "Cavi-Tuner" consists of three cavities—two functioning as a band-pass preselector while the third controls the local oscillator frequency. The preselector is essentially an over-coupled, double-tuned transformer. Two antenna inputs are available for use with 300 ohm twin-lead or shielded 75 ohm coax. Mixing takes place in a low-noise diode with an i.f. appearing at v.h.f. Channels 5-6. A single knob functions both as a channel selector and fine tuning control.

TRANSMISSION LINE

Rego Insulated Wire Co., Inc. of 830 Monroe Street, Hoboken, N. J. has introduced a new 300-ohm transmission line with #18 copper or *Copperweld*.

Especially designed for u.h.f. and v.h.f. applications, this line has pure polystyrene spacers 4½ inches apart. According to the company, the line performs well in both local and fringe areas and matches the input of all sets tested. No transformer is required.

"PACKAGE" TV STATION

General Electric Company of Syracuse, New York has announced a low-cost "package" television station, designed to expedite the advent of television in 1100 small cities (under 50,000) allotted channels by the FCC.

The new "package" station requires only a single technical operator to prepare and broadcast film and network programs. The "package" station will be available for either v.h.f. or u.h.f. telecasting and in several different power ratings.

Complete details on this new transmitter "package" are available from the company's broadcast equipment division.

NEW TUBE FOR TV

Sylvania Electric Products Inc.'s Radio Tube Division has released a new tetrode beam power amplifier, the Type 6BQ6G.

The new tube has been designed for service as a horizontal deflection amplifier in television receiver sweep circuits. It is similar to the company's Type 6BQ6GT except for increased bulb size.

The new amplifier is contained in a ST-12 bulb, thus providing a greater safety margin for dissipation. As a horizontal deflection amplifier, a d.c. plate supply voltage of 600 volts and a peak positive plate voltage of 6000 volts are allowable.

TV SIGNAL GENERATOR

Radio City Products Co., Inc., 152 West 25th St., New York, N. Y. has developed a new u.h.f.-v.h.f. signal generator which has been designated as the company's Model 750.

Covering all u.h.f. and v.h.f. channels for TV and FM, the new unit contains test facilities for use as a pattern generator, marker generator, and signal generator. The instrument features an "Inductuner" which insures accuracy within ½ of 1% over the entire range of 9 mc. to 900 mc., according to the company.

All v.h.f. frequencies are on fundamentals. The horizontal-vertical bars and crosshatch pattern are individually produced on all channels.

NEW U.H.F. ANTENNAS

JFD Manufacturing Co., Inc., 6101 16th Ave., Brooklyn 4, N. Y. is in production on the Model UHF611 "Bow-tie-Flector" antenna. Featuring rigid wire-frame screen reflectors that minimize vibration, the new unit also carries the company's "Bronzidite" plating that prevents rust and corrosion of non-aluminum parts.

LaPointe Electronics Inc. of Rockville, Conn. has added the "Corner Reflector, Model COR-U," to its "Vee-D-X" line of u.h.f. antennas. Fiberglas booms provide strength without weight and permit the use of small diameter solid aluminum rod to prevent icing. A compact, swing-open design requires less than 30 seconds for assembly.

Q-Line Manufacturing Corp., 1362 61st Street, Brooklyn 19, N. Y. is mar-

keting a pre-assembled, vibration-proof u.h.f. corner reflector, the Model 150. The antenna features a unique three U-bolt mounting which eliminates vibration by anchoring the center and ends of the reflector to the mast. The company has literature available on this unit for those requesting it.

Radio Merchandise Sales, Inc., 2016 Bronxdale Ave., New York 60, N. Y. is currently introducing the "*RMS* Bo-Tenna", Model BT-10, a flexibly constructed bow tie and reflector antenna. The bow tie element and reflector section are standard fitted units, each of which is available separately. The reflector is comprised of tuned elements to help eliminate ghost pickup.

Television Hardware Mfg. Co., 919 Taylor Ave., Rockford, Ill. is offering a new series of antennas for u.h.f. The "Telco" units are available in both single- and two-bay styles.

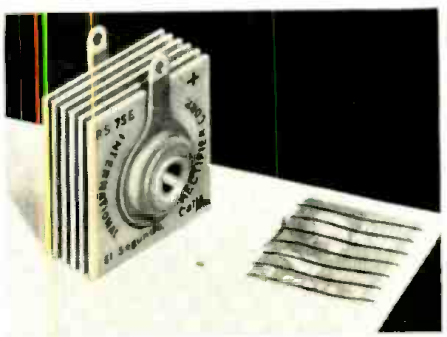
Telrex, Inc. of Asbury Park, N. J. is now offering a "Duo-Band" array, an all-channel antenna which is said to provide high gain coverage of Channels 2 through 83 with one major in-line lobe, constant center impedance, and high signal-to-noise ratio. The Model 420 requires a single transmission line and needs no lossy filter or isolation networks. Stacked arrays, Model 440, are also available.

SELENIUM RECTIFIERS

International Rectifier Corporation, 1521 E. Grand Ave., El Segundo, California has developed a complete line of selenium rectifiers for use in television, radio, TV boosters, and u.h.f. converters.

Units are rated for 130 volts r.m.s. maximum input for load currents of 20, 30, 40, 50, 65, 75, 100, 150, 200, 250, 300, 350, 450, and 1000 ma.

The rectifier illustrated is the Type RS75E rated at 130 volts maximum peak inverse; 75 ma. maximum output current. A series resistor of at least 22 ohms is recommended as a current limiter when



used with a capacitive filter. Over-all dimensions of this unit are 1" wide by 1¼" high by ¾" deep and provided with a clearance hole for a number 8 machine screw for mounting.

Complete information on the full line is available from the company.

CLOSED-CIRCUIT TV

Radio Corporation of America is currently introducing its "Private-

Line" camera chain which has been designed for schools, hospitals, prisons, stores, small factories, and even homes.

Featuring low price, small size, and simplified operation, this newest and most compact closed-circuit television system yet offered by the company has been tradenamed "TV-Eye".

The unit is designed to utilize any standard home-type receiver as a monitor and can be tuned to an other-

wise unused channel without interfering with reception on other channels. The complete unit, including the camera and control box, weighs less than 20 pounds.

RESISTOR OUTLET

A new, simplified resistor outlet box has been developed by *Blonder-Tongue Laboratories,* 526-536 North Avenue, Westfield, N. J., for providing isolated TV outlets in all types of master TV systems.

The new unit, Model RO1, will tap off from RG/11U or 59U with only ½ db insertion loss. Signal attenuation of 17 db at the TV outlet terminal prevents interaction among sets in the system.

The detachable face plate contains all cable connections and will fit any standard outlet box. Screw terminals provide a 75 or 300 ohm outlet to the set. Center conductors are attached to inner screw terminals and coax shields are grounded by the clamp.

TV FUSE KIT

Littelfuse, Inc., 1865 Miner Street, Des Plaines, Illinois has brought its popular "One Call Kit" up-to-date to meet the requirements of television service technicians and set manufacturers.

The revised kit represents the latest usages of fuses as indicated by set makers and technicians. It is estimated that service technicians can handle 95 per-cent of their fuse replacement requirements from this single unit.

TELEVISION CONDENSERS

Sangamo Electric Company of Marion, Illinois has developed a new molded paper tubular condenser especially for television applications.

By using "Humiditite", a new molding compound with unusually high moisture resistance characteristics, the new molded tubular will meet the minimum moisture resistance requirements of MIL-C-91A (proposed), while the new impregnant holds the condenser to rated capacity under all conditions and provides additional strength.

An engineering data sheet TEL and further information on the new "Telechief" condensers is available from the company.

OPEN LEAD

Imperial Radar and Wire Corp., New York 66, N. Y. has developed an open lead with a nominal impedance of 250-275 ohms with either 4½ or 6 inch spacing.

The new transmission line can be used with 300-ohm equipment without concern for mismatch. The narrower spacing for 250-275 ohms is said to be more desirable at the u.h.f. frequencies. Its low-loss characteristics, .35 db dry line loss in 100 feet at 500 mc., make it adaptable for both u.h.f. and v.h.f. installations.

The product is being handled through distributors in 100 and 250 foot spools.

U.H.F. "AUTOBOOSTER"

Industrial Television Inc., 359 Lexington Ave., Clifton, New Jersey is marketing a new booster for u.h.f., the IT-124A "AutoBooster".

Factory pretuned for a single u.h.f. channel, the booster is a two-stage high-gain, low-noise amplifier which utilizes the 6AJ4 grounded-grid triode in a unique design.

Automatic operation is retained by the use of a magnetic relay. In multiple u.h.f. areas combined operation of several of these units may be used by means of switching or combining networks.

V.H.F. TV BOOSTER

Electro-Voice, Inc. of Buchanan, Michigan is in production on an improved Model 3002-A, three-tube "Tune-O-Matic" all-channel v.h.f. television booster.

The new multi-power low noise circuit has three tubes in broadband balanced stages, including a power multiplier stage. It provides extra

gain with minimum internal noise and higher signal-to-noise ratio, according to the company. The unit can also be used at the output of a u.h.f. converter to increase signal strength of the first i.f.

The 3002-A is automatically self-

tuned to all v.h.f. channels. No separate tuning of the booster is required. It turns "on" or "off" with the television receiver switch. Input and output is to 300-ohm twin-lead

Bulletin 182 covering this unit is available from the company on request.

TV COUPLER

The Tube Department of *Radio Corporation of America*, Harrison, N. J. has announced the development of an inexpensive coupler unit which makes possible the quick installation of a secondary receiver.

The TV-set coupler, *RCA*-240A1, can also be used in combinations of two,

three, and four units for the operation of as many receivers from a single antenna.

Designed for use with antennas having 300-ohm, ribbon-type transmission line, the coupler is a quick-service item. It requires only a screwdriver and a few minutes' time for installation and features a self-contained woodscrew which facilitates mounting on wall or baseboard.

The company's tube distributors are handling this item.

"FILTER TESTER"

Vidaire Electronics Mfg. Co. of Lynbrook, N. Y. has introduced an unusual piece of test gear, the "Fil-Test".

This new wave trap meter permits the technician to determine which type of filter and/or wave trap to install. The unit covers the entire i.f. and r.f. range of TV and employs a unique switching arrangement. Any interfering signal reaching the set through either the a.c. supply line or the antenna may be located by switching in the correct filter number on the "Fil-Test". In each instance the indicator shows which filter or wave trap to install.

"CUSTOM-BUILT" TV

A new custom-built 630-type television chassis designed for 27" and 30" picture tubes as well as the new 24" rectangular tube has been announced by *Tech-Master Products Co.*, 443 Broadway, New York 31, New York.

Known as the Model 2430-9, the new unit features the latest type high-voltage and sweep circuits, 22 kv. second anode voltage, polyethylene enclosed high-voltage socket, new and

exclusive quick retrace autotransformer, full horizontal and vertical sweep even under low-voltage line conditions, variable vertical linearity and height controls, edge-to-edge focus, and the latest 90 degree ferrite cosine yoke.

The chassis comes completely wired, aligned, and factory tested with all tubes except the picture tube.

"SOLID" TV LINE

All channel reception in both u.h.f. and v.h.f. bands, irrespective of weather, is being offered by means of a new form of low-loss insulation—Foamed Polyethylene—by *Anaconda Wire & Cable Co.*, Hastings-on-Hudson, New York.

Known as ATV-270 FOAM, the new line is easy to terminate, all that is needed is a skilled hand and a penknife. Developed to solve the problem of internal moisture condensation, the new product provides one-piece insulation which virtually eliminates the problem and considerably improves the line's attenuation characteristics.

FIELD STRENGTH METER

Radion Corporation, 1130 W. Wisconsin Avenue, Chicago 14, Illinois is currently offering a new battery-operated field strength meter, the Model FSM-5000.

This compact unit features continuous one-knob tuning for Channels 2 to 83, direct, accurate reading in microvolts of either the video or audio portion, and extreme sensitivity ranging from 5 to 50,000 microvolts on v.h.f. and 50 to 100,000 microvolts on u.h.f.

The FSM-5000 is powered by standard "A" and "B" dry cell batteries and battery condition is shown at all

times on the dial. Microvolt readings are not affected by line voltage variations.

Full details on this unit are available from the company. Address your request to Dan O'Connell in care of the firm.

TEST SOCKET ADAPTER

Pomona Electronics Company, 524 West Fifth Avenue, Pomona, California is currently introducing its TVS-1 duo-decal test socket adapter to the trade.

The new unit is designed to permit operating tests, while the set is in operation, on all circuits going into the television tube socket. It is inserted between the CR tube base and its socket to complete the circuit

and make all connections readily accessible to meter test leads.

Measurements can be made without tracing circuit wiring to test points below the chassis, thus saving valuable service time by giving an immediate answer without removing the chassis from its cabinet.

For further information on the TVS-1 and a complete list of products made by the company, write to the firm direct or consult your local distributor.

TURNER'S U.H.F. CONVERTER

The Turner Company of 909 17th Street, Cedar Rapids, Iowa, is currently marketing a new u.h.f. television converter especially designed for low signal area installations.

The new unit features a two-section preselector with two silver-plated coaxial cavity tuners, a double-shielded fundamental oscillator, and a broadband amplifier with cascode circuit. According to the company, signal power loss in the preselector is reduced to 3 db. The noise figure is a maximum 17½ db and a minimum of 15½ db.

The converter has an illuminated slide-rule dial, continuous single-knob tuning from 470 to 890 mc. using Channels 5 or 6, and measures 8" x 6" x 6". It may be used with either a u.h.f. or combination antenna. It is self powered.

BROADBAND ANTENNAS

Two new broadband antennas, one for v.h.f. and the other for v.h.f.-u.h.f. reception, have been introduced by *Best Electronics Corporation* of 2254 Colby Avenue, Los Angeles 64, California.

According to the company, the new antennas have good directivity and a gain of up to 15 db over a standard reference dipole. A unique feature is the elimination of insulators at the lead-in terminals in all of the company's "Double-Diamond" models. In this way performance of the antennas is not affected by heavy rain, ice, fog, snow, or dust storms.

The v.h.f. design, Model 213, covers Channels 2 through 13. The second unit, for v.h.f.-u.h.f. reception, is available in three models. All are similar

in shape and performance characteristics to the v.h.f. design except that no crossarms are required. The Model 1440 covers Channels 14 through 40. Model 3570 provides high-gain reception of Channels 35 through 70, and Model 6083 covers Channels 60 to 83. Each model weighs slightly over one pound.

Details on any or all of these antennas are available from the company on request.

PROGRAM TIMER

International Register Company, 2620 West Washington Boulevard, Chicago 12, Illinois is currently offering a new electric timer which will follow the desired time schedule day after day without resetting.

Called the "Time-All", the timer is unique in that it does not have to be reset after each "on-off" cycle has been completed and can be used to control home appliances as well as radio and television programs.

TV REMOTE CONTROL

An inexpensive remote control unit for television that operates from a single connecting cable and can be installed in less than 15 minutes is now being offered by *Industrial Development Engineering Associates* (*I.D.E.A.*) of Indianapolis, Indiana.

The new "Regency" remote control performs four major functions: it selects stations, adjusts fine tuning, and controls contrast and volume. All of these operations are performed with the single cable connecting the TV set and the control unit. Tests show that the control will operate up to 150 feet from the set. —30—

STAG HAMFEST

THE Greater Cincinnati Amateur Radio Assn. will sponsor its annual Stag Hamfest on Sunday, September 13th at Ash Grove on Winton Road, Cincinnati.

As is customary, refreshments, dinner, and supper will be included in the share-the-cost plan. The fee will be $2.00 at the gate.

For additional details write W8IVE or W4OMW. —30—

PHOTO CREDITS

Page	Credit
35, 36, 37, 180	Standard Coil Products Co.
38, 39	Gately Development Laboratory
52, 53, 54	Walter Ashe Radio Co.
56, 57	Philco Corporation
60, 61, 62	Zenith Radio Corporation
64, 65	International Rectifier Corp.
73	P. J. Samerjan
76	Service Instruments Company
144	General Electric Company
156	Hammarlund Manufacturing Co., Inc.
166	New York Audio Fair

ERRATUM

The radar unit shown on our July cover and described on page 35 was erroneously identified as the product of Electric Service Co. of Seattle. The unit was originally made by Raytheon and later modified by Electric Service Co. to operate on the 3 inc. commercial band.

INDEX OF Advertisers

SEPTEMBER 1953

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Classified

Rate 50c per word. Minimum 10 words

RADIO ENGINEERING

COMPLETE radio, electronics theory & practice: television; broadcasting; servicing; aviation, marine, police radio. 12 or 18 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

ELECTRONIC engineers with minimum of 3 years research or developmental work in field of Electronic Control Systems needed immediately in a permanent capacity by rapidly expanding firm located near Dallas, Texas. Varo Mfg. Co., Box 638, Garland, Texas.

ELECTRICAL Engineer. Large gulf coast chemical company has opening for graduate electrical engineer. 25-35 years of age. Communications experience desirable. Supervisory position. Salary open. Reply Box 536, Radio & Television News, 64 E. Lake St., Chicago 1, Ill.

FOR SALE

G.E. MODEL 910 Projector. Used three weeks. Complete or in parts. Write to. Caya's Radio Shop, Main St., Northbridge, Mass.

TWO National NC-183 Communications Receivers, factory wired for diversity operation, $250 each. Nagrodsky, 85 Shields Ave., Williston Park, N. Y.

TAPE Recorders, Tapes, Accessories. Unusual Values. Dressner, 624-R East 20th St., N.Y.C. 9.

TUBES and equipment bought, sold, and exchanged. For action and a fair deal, write B. N. Gensler, W2LNI, 136 Liberty, New York 6, N. Y.

NEW RCA 3AP1A original cartons, $8.75 each. Tubes, surplus—bought, sold. Free list. Write, Mark, Box 14, New York City 72.

DIAGRAMS—Radio $1.00; record changers, recorders $1.25. Television with service data $2.00. Where model unknown, give part numbers. Kramer's Radio Service, Dept. S53, 36 Columbus Ave., New York 23, N. Y.

TV-FM antennas. All types including UHF. Mounts, accessories. Lowest prices. Wholesale Supply Co., Dept. H, Lunenburg, Mass.

300 ohm TELEVISION lead-in, 1,000 feet $11.00; RG-29/U coax 100 feet $4.00; Postpaid to 600 miles. Van Dick, Little Falls, New Jersey.

NEW 1953 Heath model V-6 VTVM wired, tested, calibrated; $44.95 complete. Jerry Cohen, 340 Frost Street, Brooklyn 22, N. Y.

TELEVISION high pass filter, Guaranteed, only $1.00 Postpaid. Box 8, Hillside Manor Branch, New Hyde Park, N.Y.

WANTED

AN/APR-4, other "APR-," "ARR-," "TS-," "IE-," ARC-1, ARC-3, ART-13, everything surplus; Tubes, Manuals, Laboratory equipment. Describe, price in first letter. For Sale: Reconditioned Watthour Meters, four for $10.00. Engineering Associates, 431 Patterson Rd., Dayton 9, Ohio.

WILL buy all ART-13/type T-17A $200.00; ART-13/type T-47, $150.00; BC-348 unmodified $65.00, BC-348 modified $50.00; APN-9 $200.00; ARC-3 complete $600.00; R77 Receivers $300.00; ARC-1 $300.00; BC-312 $60.00; BC-342 $60.00. Ship via Express C.O.D., subject to inspection to: H. Finnegan, 49 Washington Avenue, Little Ferry, N. J.

WANTED used coin operated radios, good condition. Quote best price. B. Kugler, % Chas. C. Giles, Clinton, South Carolina.

CORRESPONDENCE COURSES

USED correspondence Courses and Books sold and rented. Money back guarantee. Catalog free. (Courses bought.) Lee Mountain, Pisgah, Ala.

USED correspondence courses and educational books bought, Sold, Rented. Catalog free. Educational Exchange, Summerville, Ga.

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ATTENTION: Inventors of Electronic, Electrical, Audio, Automobile Products. Will buy or pay royalties on any manufacturable ideas if inventions are possible money makers. We manufacture. Please write Box 535, % Radio & Television News, 64 E. Lake St., Chicago 1, Illinois. Advise arrangement for discussion.

MISCELLANEOUS

SPEAKERS repaired, wholesale prices, guaranteed workmanship. Amprite Speaker Service, 70 Vesey St., New York City 7.

KITS assembled; units constructed from schematics. Audio amplifiers our specialty. Neil Laboratories, IA, 164 Prospect Place, Brooklyn, N. Y.

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IN23B SYLVANIA $1.89

Lots of 10

Smaller Quantity, Unit Price $2.25

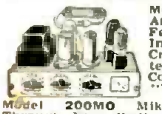
1N21	.85c; 6 for	$ 4.00
1N21A	$1.55; 5 for	7.00
1N21B	2.89; 4 for	10.00
1N27	1.55; 5 for	7.00
1N46	.69c; 5 for	3.25

HI-FI AUDIO AMPLIFIER

Model 1150 HI-FI 10 watt, less than 2% distortion—response ± 1 db, 20 to 20000 CPS, Hum —70 db. Separate bass & treble controls. 3 pos. selector switch. Built-in equalized pre-amp for GE cartridge. Tubes 6/6SL7, 2-6V6, 5Y3 ..... $29.95

Model 1150 & GE S1201A, HI-FI Amp & Spkr "TAB" SPECIAL $47.00

AUDIO AMPLIFIERS READY TO GO



Model 305MP 5 Watt Ampl. as Pictured Above Features Mike & Phono Inpts. W/Sep. Gain Cntrls. Latest Compensated Tone Cntrl. Design. Complete with Tubes. "TAB" SPECIAL $14.98

Model 200MO Mike OSC. Broadcasts Through Your Radio with No Direct Connection. W/Tubes $6.98

Model 100PO Phono OSC. Phonograph Broadcasts Through Your Radio. No Direct Hook-up. W/Tube $4.98

Model 302PA 3 Tube Phono Ampl. Ideal for Custom Building Your Phonograph. W/Tubes. SPECIAL $4.98

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GE RPX041 Phono Cart. .$ 4.49
GE RPX050 Triple Play .. 6.98
Electrovoice Triple Play .. 2.69
Pickup Arm&Xtal Hi-Outpt. 2.39
PM 12" GE S1201A Hi-Fi Speaker .. 18.69
PM 8" Blue 8T18-1 Permflux 13.00
PM 10"Hi-Fi Woofer & Separate Horn Tweeter. 10watt 40-20KC. 19.98
Crystal Mike & Cable 2.98
Crystal Mike Cartridge (Lapel type) 1.98
Crystal Mike Cart. Ceramic Wetpruf 3.98

OIL CONDENSER

WAREHOUSE CLEARANCE SALE

RECTANGULAR CASE

.5MFD 1500VDC	95c; 2 for	$1.50
2MFD 1000VDC	55c; 4 for	1.95
5MFD 600VDC	$1.50; 3 for	4.00
10MFD 600VDC	1.98; 2 for	3.50
3MFD 330VAC 1000VDC	.3 for	1.20
2X2MFD 600VDC	.89c; 2 for	1.59

BATHTUB SIDE TERMINALS

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4MFD 50VDC	.50c; 5 for	2.00
.1MFD 2000VDC	$1.05; 5 for	4.50
2X .1MFD 400VDC	.49c; 5 for	2.00

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2 MFD 330 VAC
1000 VDC
STD MFGR Lots of 10

25c

Smaller Quantities.
Each 49c; 3 for $1.25

2MFD 600VDC Porcelain Insulators with Adjustable Mtg Clamp ..... 3 for $1.50

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29PCS CHROME VANADIUM SPEED STEEL. Top quality for Machinists or all purpose use. Standard Full Length 1/16" to 1/2" by 64ths. "TAB" SPECIAL $7.49

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SPEED ELECTRIC DRILL 1/2" w/Jacobs Wormgear Chuck & 29 Pcs Drills & Index. "TAB" SPECIAL $39.00

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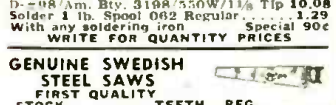

FIG.	SIZE	PRICE
A-55	Watt 3/4 Tip/11/2 Lng/.38 lbs.	1.25
A-60	Watt 1/4 Tip/12" Lng/.38 lbs.	1.91
B-100	Watt 3/4 Tip/12" Lng/.5 lbs.	2.55
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Similar to American Beauty types as shown

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C-238 Am. Bty.	215W/100W/3/8 Tip	4.29
C-258 Am. Bty.	3158/200W/5/8 Tip	6.30
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D-298 Am. Bty.	3198/550W/1 1/4 Tip	10.08

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With any soldering iron Special 90c
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701-20-10	20"	10 PT	$9.00	$3.95
701-24-10	24"	10 PT	9.75	4.15
701-24-8	24"	8 PT	9.75	4.15
701-26-8	26"	8 PT	10.85	4.25
701-26-6	26"	6 PT	10.85	4.25
701-26-10	26"	10 PT	10.85	4.25
701-28-8	28"	8 PT	10.85	4.35
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701-30-6	30"	6 PT	11.00	4.50

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Electrolytic Condensers Asst.	.5/ 1.25
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1800VDC 35MA, Using Doubler Crkt. Transformer, Rectifiers, Socket, Resistors, Capacitors and Diagram $6.98

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20Hy/300ma or 15Hy/400ma/12KVins	8.95
13.5 HY 1 Amp./17KVins/Raytheon	39.95
12Hy/300ma, Hmsld 5KVins	4.95
Dual 2Hy/300ma, 5KVins	.95c; 2 for 1.49
10Hy 100 MA Freed	1.39
6Hy/175ma 250 ohm	.$1.49; 2 for 2.49
10Hy 85ma 550 ohm	.95c; 2 for 1.69
3Hy 40ma UTC HI "Q"	.95c; 2 for 1.39

POWER TRANSFORMERS

3200VC/200MA $12.95; 2 units in Series Rated 6400VCT $24.00

1000VCT 45MA, 705vct, 80 ma, 360vct 55ma, 3x5V/3A, 6.3vct/1A, 6.3vct .3A esd Hvins can be used as ballast Hypersil core $4.98

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900V 35MA, 2x2.5V/2A, xcint 1800-V dble two 2x2 fil. windgs hsld 2.25

840VCT/110MA, 5V/2.5A, 21ma, 2x5V/3A, 6.3vct/1A, 6.3vct/3A 3.45

780VCT/250MA, 5V/6A, 12.6V/5.5A 7.95

770VCT/200MA, 5V/6A, 12.6V/5.5A 6.95

700VCT/120MA, 2x6.3V/3A, 6.3V/1A ..... $3.98; 2 for 7.25

700VCT/100MA, 2x6.3V/1.5A, 5V/2A, Isolation Wndg 120MA 3.49

680VCT 200MA, 5V/3.5A, 6.3V/4A, 78V/1A ..... $4.39; 3 for 12.00

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500VCT 60MA, 6.3V/3A Hsld 2.98

420VCT/90MA, 6.3V/1.9A, with INPTS 6, 12, 24, 115VDC & 115 230VAC Vibrator Trans. $1.49; 2/ 2.25

FILAMENT TRANS.

6.3V/2A	$1.08; 2 for $1.98
2.5V 2A @ 75c; 2 for $1.49; 10 for	6.49
2.5VCT/10A 5KVINS	3.59
5VCT/10A/12KV INSUL G.E.	8.25
7.5 VCT 12A CSD KENYON 15KVINS	10.95
24V 1.25A CSD @	$1.98; 2 for 3.49
2X12V/2A or 24V/2A @ $3.89; 2 for	6.98

FL-5 FILTER

Range or Voice. Filters 1020cycle Audio. Excellent for CW work. 59c; 2 for $1

TV & COAX CABLE

300 OHM Twinex, heavy duty 65 mil all copper TV lead-in. Per Ft. 2c; 100 Ft. $1.39; 1000 Ft. Reel $11.95

RG59U 73 ohm TV coax cable mfgrd to rigid UHF specs.

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Special 500 Ft.	$22.00
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Mobile whip antenna P/O AN/ARQ8, 72" w/ant matching base $2.98

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SRT-120M in mobile cabinet $198.50

PS-500 115VAC PwrSupd SRT-120 $49.50

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JOHNSON VIKING Mobile Bit (LN) $100.00

JOHNSON VIKING II Built (LN) $295.00

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36 Volt WILLARD Mini-BRAND 5 oz. DSGN. .98c; 4 /$3.00

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2V/20AH Battery with 2 Volt Vibrator 2.98

2V/20AH w/vlb & acid. 3.59

6V/6AH Wild NT6/BB214U 2.98

6V/6AH Battery w/acid 3.25

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STANDARD SIZE
16 OUNCE BRAND NEW

Stillson Wrench 1st Quality 8" .98c
Stillson Wrench as above 10" $1.25

YOU PICK THEM **39c** WHILE THEY LAST

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20MF 25VDC	2X15MF 350VDC
20MF 450VDC	2X20 25V/30MF 450V
25MF 300VDC	40MF/250V,20MF/25V
50MF 350VDC	3X100MF/35VDC
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TABOGRAM

WRITE FOR T-7

WE STOCK LARGE VARIETY OF COMPONENTS. TELL US YOUR NEEDS. SELL US YOUR TUBES & EQUIPMENT.

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"TAB" TESTED & GUARANTEED

PRICES SUBJECT TO CHANGE

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0B3 VR90	1.09	3D23	4.90	6SL7GT	.69	FG168	49.00	809	2.43
0C3/VR105	1.15	3E29	14.99	6SN7GT	.70	FG172	29.95	810	9.95
0D3/VR150	.90	4CS5	19.95	6SQ7GT	.63	250TH	18.97	811	2.90
1B3 8016	.81	EL5BHD	16.98	6SR7	.65	250TL	17.75	812	2.70
1B21/471A	2.85	5C21/C6J	9.89	6SS7	.75	304TH	8.90	813	12.49
1B22	2.20	5C22	39.85	6ST7	.98	304TL	8.90	814	2.97
1B23	2.20	5CP1/C5B	3.95	6SU7GTY	2.69	388A	1.49	815	5.97
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1B26	2.45	5D23		6V6GT	.57	417A		829	11.49
1B27	12.75	RK85	36.50	6W4GT	.57	5R42	18.50	*829B	14.45
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1B42	4.49	6AH5G	4.49	12AT7	.81	15.95		837	1.45
1B46	1.98	6AH6	1.22	12AU6	.72	GL471A	2.69	849	29.45
1B53	49.95	6AJ5	1.40	12AU7	.63	CK501X	1.26	860	4.90
1B56	38.50	6AK5	.74	12AV6	.63	CK501AX	2.20	861	39.95
1B58	175.00	6AK6	1.05	12AV7	.98	CK502AX	1.49	R65	1.29
1B60	69.75	6AL5	.54	12AW6	1.79	CK503AX	1.49	866A	1.50
1B63	50.00	6AL7GT	1.29	12AX4GT	1.20	CK505AX	1.79	R72A	3.29
1B63A	75.00	6AN5	2.90	12AX7	.79	CK506AX	1.49	CK1005	.95
1P21	33.00	6AQ5	.51	12AY7	2.79	RK5001	9.98	CK1027	2.98
1X2A	3.95	6AQ6	.81	12AZ7	1.49	CK509AX	1.79	5654	2.79
2C36	27.00	6AQ7GT	1.29	12BA6	.59	CK512AX	1.45	5670	5.30
2C39	21.00	6AR5	.79	12BA7	.79	CK522AX	1.29	CK5672	1.29
2C39A	29.50	6AR6	2.98	12BD6	1.23	CK523AX	1.29	CK5678	1.89
2C40	1.28	6AS5	.79	12BE6	.59	CK526AX	1.49	5687	5.49
2C43	17.75	6AS6	2.43	12BF6	.85	CK528AX	1.49	CK5702	3.49
2C43/464A	9.49	6AS7G	4.65	12BH7	1.29	CK529AX	1.79	CK5703	1.29
2C44	1.20	6AT6	.63	12BY7	1.35	GL530	22.00	Xtal Diodes	
2C51	5.49	6AU5GT	1.10	12BZ7	1.25	CK531DX	1.89	1N21A	1.55
2D21	1.28	6AU6	.59	12SA7GT	.69	531	6.98	1N21B	2.89
2E31	1.49	6AV5GT	1.29	12SC7	.80	CK532DX	1.89	1N21C	21.50
2E43	1.49	6AV6	.49	12SF5GT	.77	WL532	3.98	1N22	1.25
2G21	1.49	6AW6	1.89	12SF7GT	.83	CK533AX	1.29	1N23	1.35
2J31	27.00	6B4G	1.23	12SG7	.83	CK534AX	.99	1N23A	2.20
2J31A	79.95	6BA6	.63	12SH7	.63	CK536AX	.99	1N23B	2.25
2J32	37.00	6BA7	1.27	12SJ7GT	.59	CK537AX	3.04	1N25	4.98
2J33	27.00	6BC8	.83	12SK7	.72	CK538DX	1.79	1N26	6.75
2J34	27.00	6BC7	1.23	12SL7GT	.65	CK539DX	2.19	1N27	1.55
2J36	108.00	6BD5GT	1.65	12SN7GT	.75	CK541DX	1.99	1N34	.64
2J37	12.70	6BD6	.83	12SQ7GT	.63	CK543DX	.99	1N34A	.90
2J38	11.75	6BE6	.59	12SR7	.63	CK547AX	1.49	1N35	1.65
2J39	44.00	6BF6	.65	19T8	3.95	CK548DX	1.99	1N38	1.43
2J42	187.00	6BF7	2.55	19TR	1.09	CK547DX	1.98	1N38A	1.49
2J48	24.25	6BG6G	1.39	19VR	1.62	CK571AX/		1N41	1.95
2J49	67.25	6BH6	1.98	RK20A	8.95	5886	2.49	1N41A	1.98
2J50	21.25	6BH6	.63	2S8Q6GT	1.50	CK573AX/		1N42	16.95
2J52	249.50	6BJ6	.69	2SL6GT	.69	WL673	117.00	1N44	1.24
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2J61	49.95	6BN6	1.79	FG27A	8.70	703A	4.75	1N47	4.00
2J62	49.45	6BN7	1.69	2B07	1.95	705A	1.98	1N48	.55
2K22	39.45	6BQ6GT	1.20	FG32		707A	7.90	1N51	.45
2K23	39.45	6BQ7	1.05	5558	13.85	707B	13.50	1N52	1.39
2K25	28.49	6BZ6	.89	35Z5GT	.59	715A	6.00	1N54	.89
2K25/		6CB6	.89	50L6GT	.69	715B	11.90	1N54A	1.15
723AB	24.90	6CD6G	1.69	RK61/XFG1	3.05	715C	24.00	1N55A	4.00
2K27	29.00	6D4	2.70	80	.69	717A	.90	1N57	.89
2K33	259.00	6EJ/5C21	9.89	81	1.69	719A	28.50	1N58A	1.15
2K35	389.95	6J4	8.66	82	1.19	721A	2.49	1N58	1.19
2K41	126.00	6J5GT	.47	82V	1.39	721A/287	2.45	1N60	.69
2K48	120.00	6J6	.63	83	1.45	723A	11.95	1N61	2.07
2X2	.49	6K4A	6.45	84/6Z4	.99	723A/B	25.00	1N63/K63	2.49
3B22	2.70	6L6	2.09	FG95		724A	3.95	1N64	.69
3B23/RK22	4.95	6L6G	1.85	5580	24.85	724B	3.45	1N65	.69
3B24	8.50	6L6GA	1.35	FG98	19.95	725A	8.49	1N66A	.98
3B25	4.50	6L6GAY	2.29	100TH	7.83	726A	21.97	1N69A	1.75
3B26	3.70	6L6GAY		FG104	37.98	726B	45.00	1N70	2.98
3B28	7.90	6SA7GT	.63	FG105	17.64	726C	79.95	1N70A	3.50
3C22	89.00	6SC7	.90	117L M7GT	1.59			1N86	1.15
3C23	9.90	6SD7GT	.80	117N7GT	2.49	801A	.45	1N87	1.15
3C31/C1B	3.45	6SF5	.77	117Z6GT	1.19	803	3.89	1N88	1.15
3C33	14.98	6SG7	.72						

HAM SPECIALS

Mobile whip antenna P/O AN/ARQ8, 72" w/ant matching base $2.98

Sonar SRT-120 multi band XMTR less pwr supply10to80mtrsPhon&CW(LN) $175.00

SRT-120M in mobile cabinet $198.50

PS-500 115VAC PwrSupd SRT-120 $49.50

Gonset "Super Six" converter. (U) $47.50

Gonset Communicator, 7 watts on 144-148.3 MC ..... (LN) $185.00

JOHNSON VIKING Mobile Bit (LN) $100.00

JOHNSON VIKING II Built (LN) $295.00

NEW (N) LIKE NEW (LN) USED (U)

STORAGE BATTERIES

36 Volt WILLARD Mini-BRAND 5 oz. DSGN. .98c; 4 /$3.00

(4) 36V Batt/acid 3.35

2V/20AH Battery with 2 Volt Vibrator 2.98

2V/20AH w/vlb & acid. 3.59

6V/6AH Wild NT6/BB214U 2.98

6V/6AH Battery w/acid 3.25

6V/40AH Battery 6.98

6V/40AH Battery w/acid 9.25

WE SHIP ACID IN BOTTLES R'EXP ONLY

SPECIALS

Powerstats & Test Equipment

Type 200/0-135V/3 Amp LN	$10.98
Type 116U/0-135V/7.5 Amp/LN	17.49
Type 1126/0-135V/15 Amp/LN	42.98
Type 1226/0-270V/8 Amp/LN	42.98
Simpson Model 260 VOM LN	34.98
Hickok 600A Mutual Tube Chkr LN	142.98
GE ST4A Sweep Generator (N)	300.00
GE ST5A Marker Generator (N)	325.00
GE ST2A Oscilloscope (N)	275.00
HF-1 Oscilloscope (N) Special	79.95
(N) New & (LN) Like New	

PALMER CLAW HAMMERS

Regular $2.95

98¢

Lots of 3

STANDARD SIZE
16 OUNCE BRAND NEW

Stillson Wrench 1st Quality 8" .98c
Stillson Wrench as above 10" $1.25

YOU PICK THEM **39c** WHILE THEY LAST

Lots of 10

ELECTROLYTIC CONDENSERS

20MF 25VDC	2X15MF 350VDC
20MF 450VDC	2X20 25V/30MF 450V
25MF 300VDC	40MF/250V,20MF/25V
50MF 350VDC	3X100MF/35VDC
100MF/25VDC	30,15 10MF,250VDC

ALL SIZES & TYPES

TABOGRAM

WRITE FOR T-7

WE STOCK LARGE VARIETY OF COMPONENTS. TELL US YOUR NEEDS. SELL US YOUR TUBES & EQUIPMENT.

RHEOSTATS

AT BARGAIN PRICES

6 Ohm	25W Model LH.	.$1.49; 2/$2.49
15 Ohm	25W w/knob	1.49; 2/ 2.49
20 ohm	50W Model J.	1.98; 2 for 3.50
60 ohm	50W w/knob	2.25; 2/ 3.98
100 ohm	50W Model K	1.98; 2/ 3.50
200 ohm	25W Model D	1.49; 2/ 2.49
250 ohm	25W	1.19; 3/ 2.98
300 ohm	225W Model P	2.98; 2/ 5.00
350, 500, 5000 ohm	Slotted shaft, 25 watt	.79c; 3/ 2.00

FEDERAL "ITT" SELENIUM

BATTERY CHARGER RECTIFIER

10-0-10V (CT) 100 Amp., fan cooled. Replace your old inefficient sulfide rectifier w/new selenium type. SPECIAL .. $11.98

SELENIUM RECTIFIERS

1/2 WAVE FOR RADIO & TV

CURRENT (CONT.)	LIST PRICE	PRICE	QTY 12 FOR
65MA @ 130V	$1.50	50.59	$6.48
75MA @ 130V	1.85	.69	7.58
100MA @ 130V	2.05	.79	8.68
150MA @ 130V	2.25	.99	10.78
200MA @ 130V	3.15	1.39	14.98
300MA @ 130V	3.30	1.49	15.98
400MA @ 130V	4.25	1.89	20.38
500MA @ 130V	4.40	1.98	21.28

SELENIUM RECTIFIERS

We specialize in Rectifiers and Power supplies to your spec's. Immediate delivery.

Current (cont.)	18/14 Volts	36/28 Volts	54/40 Volts	130/100 Volts
1AMP	1.35	3.70	7.50	
2AMP	2.20	3.60	5.40	10.50
4AMP	4.25	7.95	12.95	25.25
6AMP	4.75	9.00	13.50	33.00
10AMP	6.75	12.75	20.00	40.00
12AMP	8.50	16.25	25.50	45.00
20AMP	13.25	25.50	39.00	79.50
24AMP	16.25	32.50	45.00	90.00
30AMP	20.00	38.50		
36AMP	25.00	48.50		

Full-Wave Selen Rect & Trans. in Kit Form. All 115V/60 cy inputs.

up to 14VDC at 12 amps	$23.98
up to 28VDC at 12 amps	31.98
up to 28VDC at 48 amps	129.00

RECTIFIER XFMRS

18-12-9-CT-9-12-18V/4 Amp	$ 8.75
18-12-9-CT-9-12-18V/12 Amp	16.75
18-12-9-CT-9-12-18V 24 Amp	35.75
18 Volt 2 Amp	$1.98; 3 for 5.49

DC POWER SUPPLY

0 to 12 VDC/2 Amp. Variable DC supply, uncased and completely built—Impt. 115V/60 cy. Usable LAB supply, filament D.C. plating, battery charging, model railroad. Includes voltage or speed control and center off reversing sw. Ideal for two "TAB" locomotives. "TAB" SPECIAL ... $10.95; 2 for $20.00

RECTIFIER CHOKES

4 AMP	.07 HY	.6 OHM	$ 7.95
12 AMP	.01 HY	.1 OHM	14.95
24 AMP	.004 HY	.025 OHM	29.95

100 WATT SEC PHOTOFLASH KIT

Includes DX Flash Lamp Rated .50 Watt Sec., Flash Lamp Holder & 8" Reflector & Cable. Power Transformer & CD Flash Capacitors. (5) 200 Mfd Each W.V.D.C. Input ..... All Resistors, Capacitors, Rectifiers & Sockets $29.98

"CEBE" 1 Photoflash, w/case & battery $49.95

AC PACK for "CEBE" I $10.95

HOBBY I complete 120 watt sec. .. $69.95

WRITE FOR DETAILS & SPECIAL PRICES

TA8 "SUN-FLASH" LAMPS

"Tab" No.	Replaces	W-Sec. Max. Each	
U5W	SPRG/FA104	150	$5.98
No. 1	ANGLO 5804X	100	1.98
21SF	GE FT 210	200	9.98
53GT	GE FT 403	500	13.50
VA	SYLV. 4330	200	9.98
35MGTQ	FT 503	5000	49.98
V4X4	X400	200	10.98
DX	SPRGFA100	150	9.00

PHOTOFLASH CONDENSERS

10DMFD/500WVDC	$1.98
200MFD/450WVDC	2.89
400MFD/450WVDC	4.49
16MF0 600VAC/2800VDC Intermit't.	6.95
27MF0 /1.2KVDC 2KVOCint.54W.Sec.	8.95

MICA CONDENSERS

Fig.	MFD	WVDC	PRICE
A	.033	600	69c; 5 for $2.50
A	.03	600	69c; 5 for 2.39
A	.02	600	69c; 5 for 2.25
A	.015	2500	1.75; 2 for 3.00
B	.01	600	56c; 3 for 1.20
B	.01	1000	49c; 3 for 1.25
B	.01	1200	69c; 3 for 1.49
B	.008	600	39c; 3 for 1.00
A	.005	2500	1.19; 3 for 2.95
A	.004	600	49c; 3 for 1.10
B	.002	1200	58c; 3 for 1.25
A	.002	2500	98c; 3 for 2.25
A	.001	1200	55c; 3 for 1.20
C	.00075	5000	2.98; 2 for 5.00
C	.0007	3000	89c; 3 for 2.39
A	.0004	2500	39c; 6 for 1.95
A	.0001	600	25c; 5 for 1.00
C	.0001	3000	89c; 3 for 2.00
C	.0001	5000	1.49; 4 for 5.00
C	.00005	3000	39c; 4 for 1.00

METER SPECIALS

At Newly Reduced Low Prices

0-30VDC-AN" 1.49; 2 for 2.49

0-60 ADC "A" Long Shunt. $2.95; 2 for 5.00

0-15VAC GE 2 1/2 RND 800 cyc 1.29

0-150VAC WSTGH 2 1/2 RND 60 cyc 3.49

0-150VAC 25-125cy/3 1/2"Sq./RA35. 5.98

0-1 MADC WSTGH 3 1/4" Sq. 6.49

0-50 Microamps Weston301 3 1/2"Sq. 13.98

0-500 MADC 2 1/2" RND Triplett 221T 4.98

VU-20+3 Weston 301 3" Sq. 14.98

0-120 MA RF 3 1/2" RND Weston 301 12.98

Money Back Guarantee (Cost of Mdse. Only) $5 Min. Order F.O.B. N.Y.C. Add Shpg. Charges & 25% Dep. Tubes Gtd. via R-Exp. only. Prices subject to Change Without Notice. Rector 2-6245

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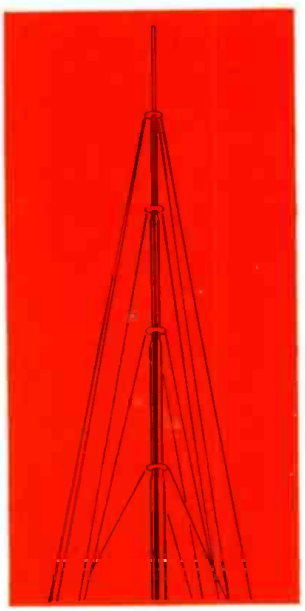
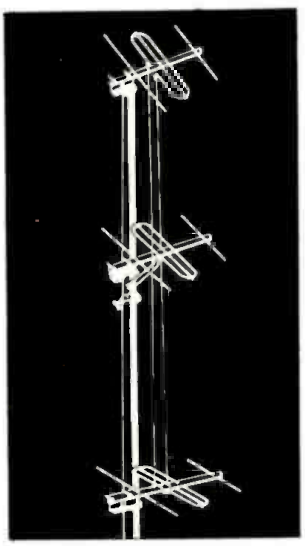
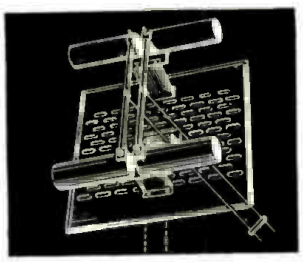
BOW TIE — Peak-A-Bow design with the only adjustable screen on the market . . . Available in single and stacked models.



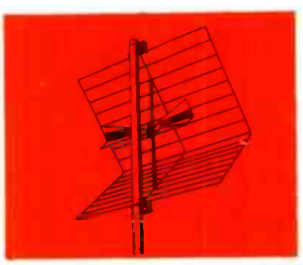
ZIP-HI MAST — Corrosion-proof 16 gouge permotube . . . easily assembled . . . in 2, 3, 4, 5 section models.



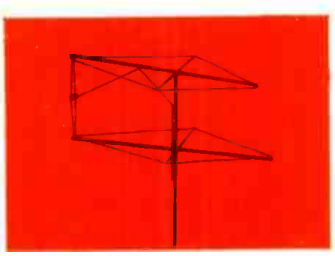
3 X 3 — Original development for UHF band composed of 3 stacked 3 element beams. Full wave spacing between boys . . . clean cut pattern with sharp forward lobe and no side lobes . . . cut to frequency . . . unsurpassed for near fringe and fringe areas.



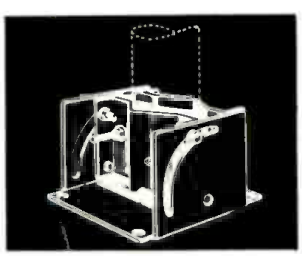
CAN-CAN — New lazy H design for entire UHF band . . . uni-directional pattern . . . sturdy compact unit . . . field tested and thoroughly proven.



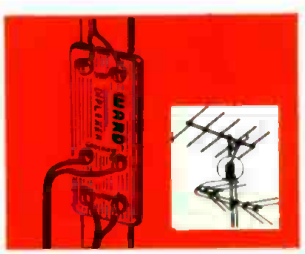
CORNER REFLECTOR — For semi-fringe areas . . . ruggedly designed to eliminate ghosts and vibration.



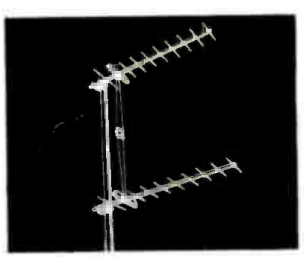
RHOMBIC — Highest gain of all UHF antennas . . . for fringe and super fringe areas.



HEAVY DUTY BASE — Ruggedly constructed to fit all masts from 1¼" to 2¼" O.D.



DIPLEXER — For separate UHF-VHF antennas . . . or for set and converters with separate UHF-VHF terminals . . . Foolproof . . . easily installed.



10 ELEMENT YAGI — Multi-channel series of 10 element UHF Yagis . . . Excellent for fringe areas . . . very directional . . . completely pre-assembled — single and stacked models.

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The MALLORY UHF Converter can mean EXTRA PROFITS when UHF television comes to your area

Where UHF television has already gone on the air, the Mallory Converter has proven to be one of the fastest moving items in the new UHF market. And for good reason too.

- **The Mallory Converter will equip any TV set to receive *all* channels—old and new.**
- **Picture definition is excellent . . . tuning is easy.**

Another outstanding feature of the Mallory Converter is that it tunes in *all* channels in *any* area. The customer who has one has nothing more to buy, no adjustments to make . . . even if he moves to another broadcast area.

YOUR MALLORY DISTRIBUTOR will be glad to show you the Mallory Converter . . . tell you how successful it has been for dealers in other areas. Get complete information today, so you can make the most of the new UHF market tomorrow.

Installation is FAST and EASY

. . . and it can be done right in your customers' homes in a matter of minutes. Simply connect the antenna leads and power lines from the Converter to the set. That's all there is to it.

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